EA Consulting Pvt Ltd

**FINAL REPORT**
**JULY 2015**

# ENVIRONMENTAL IMPACT ASSESSMENT
# GREEN LINE BUS RAPID TRANSIT SYSTEM

EMC Pakistan Private Limited

# Environmental Impact Assessment (EIA)
# Green Line
# Bus Rapid Transit System

Final Report
July 2015

**EMC PAKISTAN PRIVATE LIMITED**
503, Anum Estate, Opp. Duty Free Shop, Main Shahrae Faisal, Karachi.
Phones: 9221-34311466, 34311467, Fax: 9221-34311467.
E-mail: mail@emc.com.pk, info@emc.com.pk
Website: www.emc.com.pk

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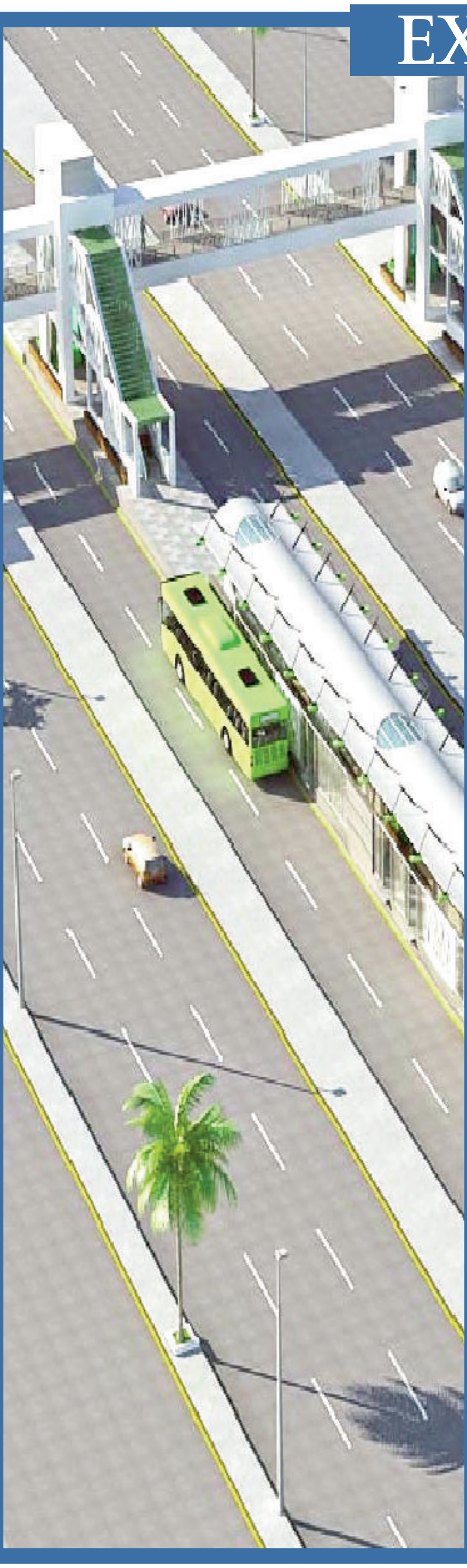


# EXECUTIVE SUMMARY

## Introduction

The Karachi Transport Improvement Project (KTIP) was thereafter started by the Japanese International Co-operation Agency (JICA) in 2009 and a comprehensive planned development for the Karachi Transport System was proposed. This Transport Master Plan outlines policy and projects with the development horizon up to 2030. The Public Transport development component of this plan had identified 9 major Mass Transit Corridors with a total length of 193 Kms and included Bus based and Rail based solutions. The Plan was followed with a feasibility Study for two Corridors; the Green Line and the Red Line to be launched for Immediate Action Program for development as Bus Rapid Transit System.

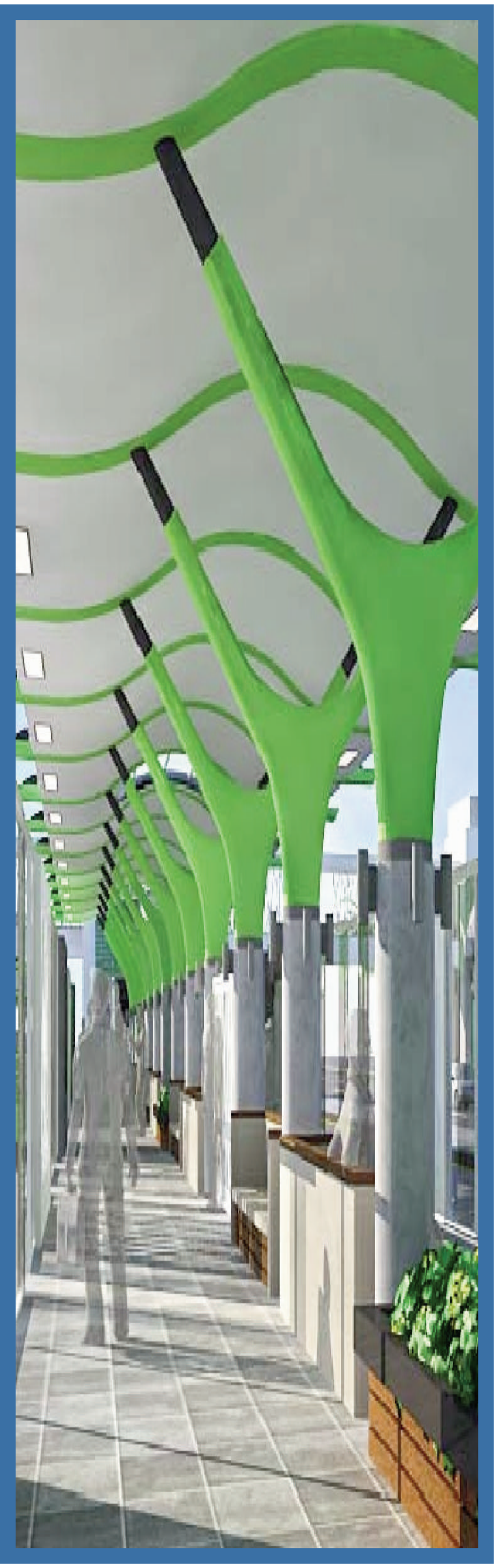
The Prime Minister of Pakistan announced the GOP financial assistance to be made available under Public Sector development Plan (PSDP) portfolio for the Green Line Project.

The Project start point is at KESC Power House to the traffic study in Surjani from where it runs southwards through Khwaja Shamsudin Azeemi Road toward Nagan Chowrangi along Shareh-e-Usman. From Nagan Chowrangi it runs along Sharah-e-Sher Shah Suri (South westerly) onto Nawab Siddiq Ali Khan Road through Nazimabad Petrol Pump intersection proceeding towards Lasbella Chowk. At Lasbella Chowk the route turns South eastwards onto Business Recorder Road and runs upto Guru Mandar. On crossing Guru Mandar the Green Line route turns south westward onto M. A. Jinnah Road. The route westwards crosses Numaish and reaches the Municipal Park (also Known as Aurangzeb Park).

The Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2000 define Schedules (I & II) of projects falling under the requirement of IEE or EIA. This EIA Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the SEPA (Review of EIA/IEE) Regulations 2014.

According to SPEA Regulation, 2014, a proponent of a project falling in any category listed in Schedule II shall file an EIA with the Sindh Environmental Protection Agency, since the listed projects are generally major projects and have the potential to affect a large number of people. The proposed Green Line BRTS project is categorized in the Schedule-II under sub-section E of Transport thus requiring an EIA.

Bus Rapid Transit (BRT) is a high quality bus system providing high speed, reliable, and comfortable services compared to traditional bus services. The concept of BRT is based on railway system, i.e. running along exclusive way, high speed, accurate travel time, and high capacity.



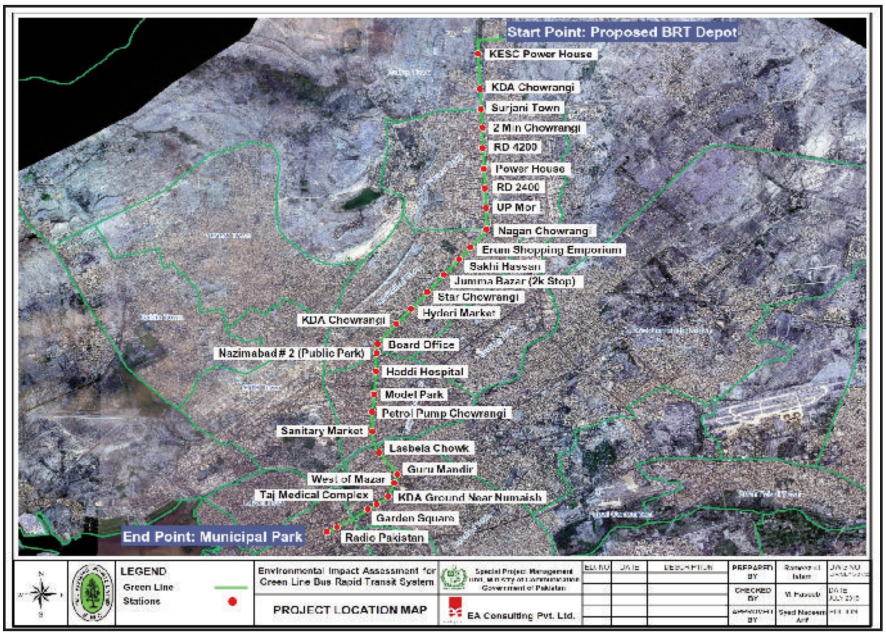



**Figure ES1: Project Location**

The construction and equipment costs of BRT are very low compared to other mass transit system. Capital costs of BRT system varies from US$ 1.4 million per kilometer (Transjakarta) to US$ 5.7 million per kilometer (Megabus, Pereira) while the capital costs of Transmillenio was US$12.5 million per kilometer2. Since Transmillenio is exceptional case, the capital costs of BRT is less than US$6 million per kilometer.

The cost of BRT system in Karachi was estimated as Rs. 270 million (US$ 3.2 million) per kilometer (KTIP), which is lower group of BRT costs in the world. On the other hand, railway network of the master plan (KTIP) was estimated as Rs. 5.0 billion per kilometer, which is 20 times higher than that of BRT system.

Based on the current traffic and forecast demand, a bus-based rapid transit system was found to be the appropriate public transportation system for the city of Karachi. KMC is proposing to improve its existing road network and also provide a public transportation system in the form of a BRT system along with its existing roads.

According to the studies carried out by JICA, the Green Line corridor stretches over a length of 24 km, starting from Aurangzaib Park which is cited in the report as Municipal Park, passing through Gurumander, Lasbela and Nagan Chowrangi, and finally ending at KESC Power House.

The alignment plan for Green Line BRTS is summarized as follows:

- From Gurumander – Nazimabad Petrol Pump Chowrangi, the segment will be elevated.
- The elevated portion of Green Line corridor will end after crossing Lasbella

Chowk, and from this point, the corridor will progress at grade on Lasbella Bridge until it crosses Liyari Expressway. Thereafter, the Green Line is again proposed to be elevated until it crosses Nazimabad 1st Chowrangi.

- From End of Nazimabad Ch – Nagan Chowrangi, the segment will be designed as at grade with Flyovers provided at Intersections.
- Grade separation is proposed between Nazimabad Chowrangi and Nagan Chowrangi as traffic volume is high and the existing level of service is also very low. Thus it will ensure uninterrupted operational service frequency of BRT.
- Thus from Board Office Chowrangi to Nagan Chowrangi, BRT is planned to run mostly along the median and the inner lane of the main carriageway is not required, but for this small segment, the Green Line may also consider acquiring inner lanes up till KDA Chowrangi.
- From End of Nagan Chowrangi – KESC Power House, BRT will be designed at grade with Under – Pass/Elevated Segments provided at Intersections
- From this point all the way to the end of alignment grade separations are proposed consisting mostly of depressed grade separations because of existing Pylon restrictions which necessitate grade separation below rather than overhead.

Air Quality Measurement has been conducted by EMC at 07 locations for 24 hours using the mobile Van services of SUPARCO.

The Air Quality Measurement results comply with NEQS except in NOx and CO at few locations. This is due to the huge traffic volume present along the BRT Corridor.

Noise and vibration level measurement is also conducted on the same 07 locations for 24 hours. Noise and vibration level has measured per 10 minutes and subtotal hourly.

The noise level of all locations except CNG green bus terminal surjani town (G-1) is high as compared to NEQS noise level for commercial area and less than for industrial area. These values, however, do not represent the actual scenario, since the peak noise emitted by rickshaws, motor cycles and heavy vehicles are higher than the recorded at the edge of the road or at a distance of 7.5 meters. The noise level recorded on the various mid-sections of

An EIA scoping meeting was organized by EA Consulting Private Limited (the lead consultant of the consortium comprising EMC Pakistan Private limited, Geo Technical Services Limited, National Management Consultants, and Data Communication and Control Private Limited as the associate consultants) on May 22, 2015.

The scoping meeting was attended by a good number of stakeholders including

representatives from government bodies, academia, and experts from various sectors, industrial units along the project road, utilities departments and other organizations. The participants highlighted some very important points during the discussion. Key Points highlighted by Stakeholders are:

1. The natural gas lines running below proposed alignment will need to be shifted particularly at places where elevated route is planned.
2. Unauthorized use of BRT route (use by motorbikes etc.) should be avoided.
3. Education of BRT Bus drivers is important and will be done for 3 months
4. Measures needed for sustainable implementation and operation of such mega projects.
5. To control the air pollution, buses that will be proposed to use in the system comply with EURO IV standards and are therefore environmentally sound.

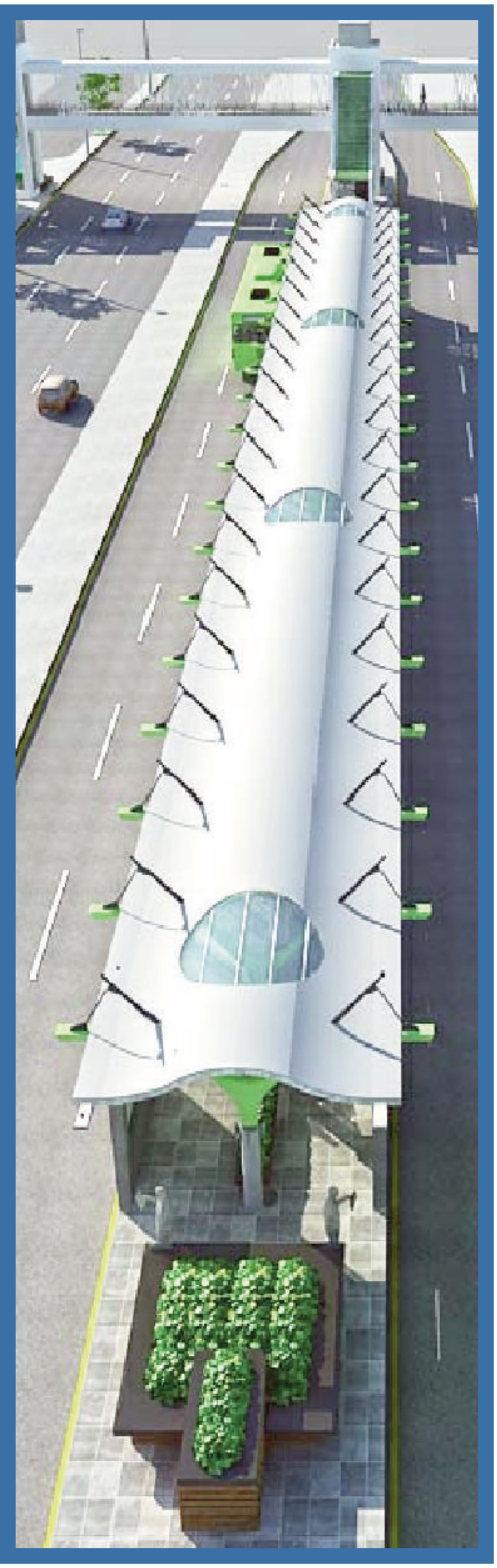
The main purpose of this EIA Study is to provide and analyze information on the nature and severity of environmental aspects of the above issues and propose mitigation measures in case of negative impacts arising from the construction and operation of the project and related activities that would take place concurrently or subsequently. The EIA study will in fact respond to the provision of Sindh Environmental Protection Act 2014 and its associated rules and regulations.

Potential impacts of the proposed project during preconstruction, construction and operation stages on the physical environment including air quality, water quality, noise and vibration; ecology including flora and fauna, and socio-economic environment of the macro environment of Green Line BRTS Project area have been assessed. The significant impacts with summarized mitigation measures are as follows.

From Nagan Chowrangi to the end of Route Alignment i.e. KESC Power House Chowrangi, huge Electricity pylons of 25 nos. run along the alignment covering the entire median.

1. Pedestrian bridges constructed to access the bridges will be elevated. Therefore it is a chance that they may contact with HTLs.
2. Grade separations needs to be provided due to existing U-turns and Chowrangi.
3. From 4K to Nagan Chowragi, Water transmission travelling under the median and needs to relocated.
4. Huge cost is involved for the relocation of these Pylons and HTLs

According to the earlier correspondence with K-Electric-Engg. & Construction department and EHT Department, safety distances are required for Electric pylons and HTLs.



- From this point all the way to the end of alignment grade separations are proposed consisting mostly of depressed grade separations because of existing Pylon restrictions which necessitate grade separation below rather than overhead.
- Another alternative is to shift the BRT line from center to left side of the road and being elevated as there is ample space available for elevated BRT development with negligible disturbance of social settings. For this development, Consultation and correspondence with KE is underway related to horizontal clearance for elevated bridge of BRT and No objection in this regard.

There are several locations where there are trees present in the median of the BRT corridor. As many as 72 species of plants were recorded during roadside trees measurement. The dominant plant species are obviously Conocarpus, Eucalyptus and Lignum species.

Where trees have to be felled, mitigation will be required in the form of reinstatement and compensatory planting. Soft landscaping should be installed in the median under the elevated sections to improve the appearance of the completed works. Other opportunity spaces should be sought by SPMU-MOC to plant trees as near the locations of the felled tree as possible. The contracts drawn up by SPMU-MOC for the BRT should require that wherever possible the trees are transplanted for use elsewhere in the project (e.g. amenity areas at intersections).

Recent international practice suggests that replacement at a minimum rate of 3:1 for trees would be appropriate given possible difficulties with establishing trees and low survival rate of young trees.

The essential components of the project include resizing/augmentation of the existing drains based on the hydrologic and hydraulic calculations, proposal of new drains in areas having no existing drainage facilities, and elimination of cross-connections.

Recommendations for Storm Drainage Improvement Authorities concerned include:

i. Provision of new drains

ii. Elimination of cross sewer connections with Drains

iii. Rehabilitation and de-silting of existing drains.

iv. Solid Waste Management.

The proposed BRT corridors will be constructed on existing traffic routes. Construction activities along these routes are likely to cause hindrance in traffic flow if not mitigated properly. A temporary traffic management plan will be developed and submitted by the contractor at least one month before commencement of construction. The main objectives of the plan shall be to maximize the safety of the workforce and the travelling public. The main secondary objective will be to keep

traffic flowing as freely as possible.

On the macro-environment the impact would be reduction in the air emissions due to expected switch over to a more environment friendly mode of transport which would curtail unnecessary delays in traffic that results in excessive vehicular emissions in the events of road jams particularly during peak hours.

The traffic noise will be from new generation passenger cars, and buses, which generate very little noise. Hence the impact during the operation phase is not expected to be felt outside the project boundaries. There would be smooth traffic flow hence no congestion and hence less noise at junctions and intersections.

During the operation phase the road will likely to be improved without any obstruction. As more commuters are diverted to BRT the traffic conditions will improve due to reduction in traffic flow which further suggests improved air quality and general environmental conditions associated with vehicular traffic along road side. Hence the project will bring the positive change.

The same applies while ensuring maximum operational safety it suggests that accidental hazards are minimized. As well as construction of separate BRT lane will greatly reduce the accidents associated with movements across the roads. Health risks due to vehicular/exhaust emissions experienced in congested traffic conditions is likely to be avoided by the commuters travelling on BRT thereby giving them a free or no exposure environment.

The proposed Project, when commissioned, would be integrated into the concerned microenvironment and will become a friendly component of its macroenvironment. The nature of Project, its siting; adoption of adequate measures to minimize waste and control pollution during construction as well as operation stages of the project will have residual impact of low significance on the microenvironment and macroenvironment as well as on precious ecology.

Construction of flyover and underpasses at the proposed corridor and operation of vehicular traffic is not expected to have unacceptable/significant impact on the aesthetics of the microenvironment and macroenvironment. The impact, if identified, will be mitigated through careful planning, suitable landscaping and adopting appropriate mitigation measures, besides providing a monitoring and contingency plan.

Mitigation will be assured by a program of environmental monitoring conducted to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the EPA Sindh.

There are two essential recommendations that need to be followed to ensure that the

environmental impacts of the project are successfully mitigated. The Implementing Agency (KMC) shall ensure that:

- All mitigation, compensation and enhancement measures proposed in this EIA report are implemented in full, as described in the document;
- The Environmental Management and Monitoring Plan is implemented in letter and spirit.

Screening of potential impact suggests that proposed "Green Line Bus Rapid Transit System" will, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition.

Furthermore the Project will achieve the prime objectives of sustainable development in facilitating dedicated, safe, secure and speedy travel along the Green Line Corridor, besides upgrading and modernizing the infrastructure facilities of the fast growing section by identifying the bottlenecks and removing the constraints to smooth flow of traffic.

# CONTENT

# 01 INTRODUCTION

## 1.1 General

The Greater Karachi Strategic Development Plan (KSDP-2020) was adopted by the City Council of the then City District Government Karachi. Which laid emphasis on the development of the Urban Transport sector.

The Karachi Transport Improvement Project (KTIP) was thereafter started by the Japanese International Co-operation Agency (JICA) in 2009 and a comprehensive planned development for the Karachi Transport System was proposed. This Transport Master Plan outlines policy and projects with the development horizon up to 2030. The Public Transport development component of this plan had identified 9 major Mass Transit Corridors with a total length of 193 Kms and included Bus based and Rail based solutions. The Plan was followed with a feasibility Study for two Corridors; the Green Line and the Red Line to be launched for Immediate Action Program for development as Bus Rapid Transit System.

The Prime Minister of Pakistan announced the GOP financial assistance to be made available under Public Sector development Plan (PSDP) portfolio for the Green Line Project.

The Contract Agreement for Consultancy services between SPMU and EA Consulting Pvt. Ltd. (Lead Consultant) was signed on 31-03-2015. The scope consists of detailed design, carry out construction supervision, conduct EIA and other Consultancy tasks for Green Line BRT System from KESC Power House Chowrangi, Surjani to Guru Mandar and the elevates Station cum-U-Turn at Municipal Park.

## 1.2. Project Location

The Project start point is at KESC Power House to the traffic study in Surjani from where it runs southwards through Khwaja Shamsudin Azeemi Road toward Nagan Chowrangi along Shareh-e-Usman. From Nagan Chowrangi it runs along Sharah-e-Sher Shah Suri (South westerly) onto Nawab Siddiq Ali Khan Road through Nazimabad Petrol Pump intersection proceeding towards Lasbella Chowk. At Lasbella Chowk the route turns South eastwards onto Business Recorder Road and runs upto Guru Mandar. On crossing Guru Mandar the Green Line route turns south westward onto M. A. Jinnah Road. The route westwards crosses Numaish and reaches the Municipal Park (also Known as Aurangzeb Park).

Figure 1.1 shows the project alignment with the major intersections and proposed bus stations.

## 1.3 Present Condition and Issues

### 1.3.1. Transportation network in Karachi City

The total road length in Karachi city is approximately 10,000 km. Local roads accounted for 93%, while the highways and arterial roads for less than 5%. There are three highways namely Super Highway (M-9), National Highway (N-5), and RCD highway (N-25), and six arterial roads:

i) Korangi Road extending southeastward, ii) Shahrah-e-Faisal Road extending eastward and connecting with the National Highway, iii) University Road extending northeastward, iv) Shahrah-e-Pakistan Road extending northeastward and connecting with the Super

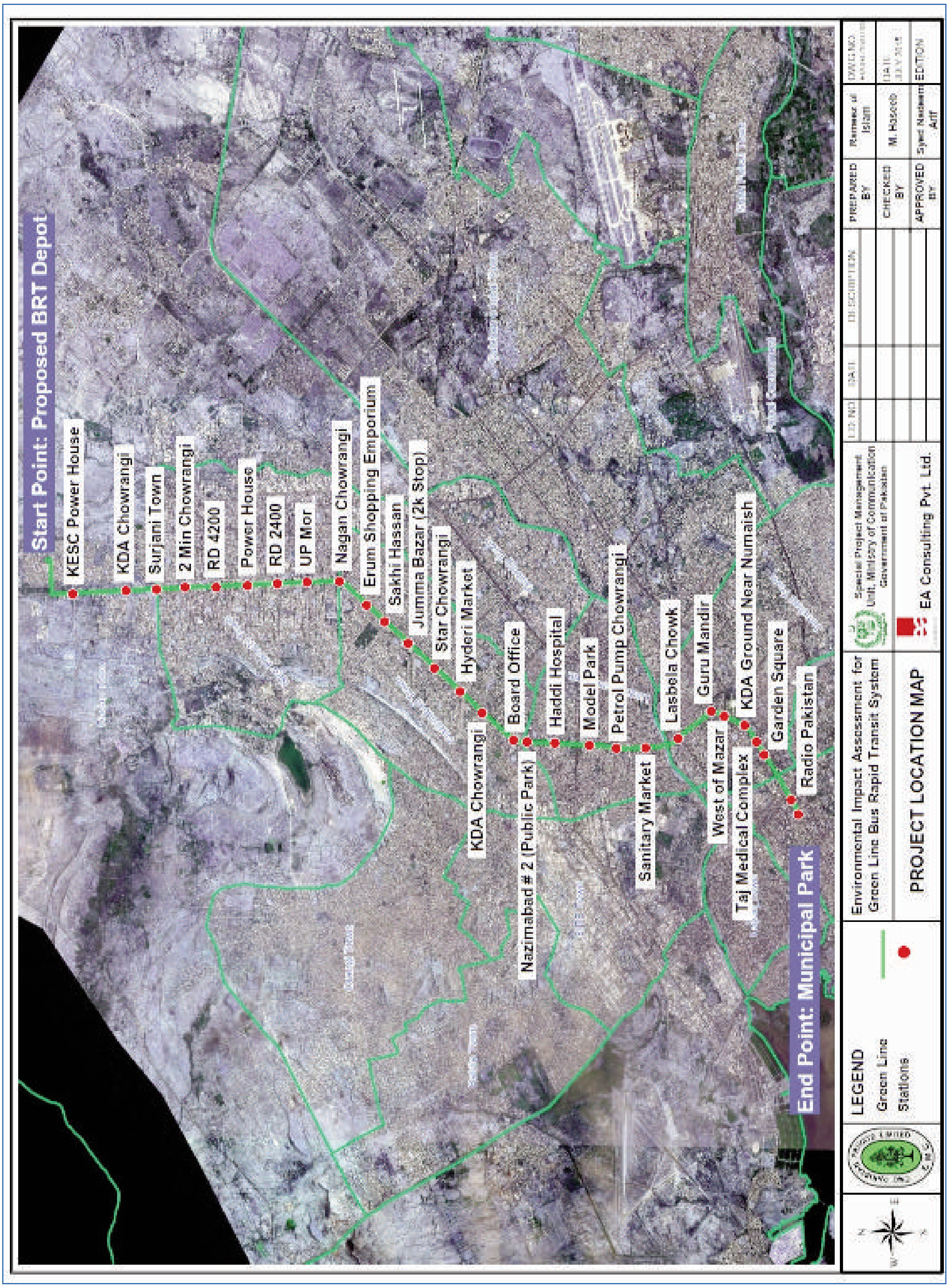



**Fig 1.1:** Location Map of Green Line BRTS

Highway, v) Chaudry Fazal Ellahi Road extending northward, and vi) RCD Highway extending northwestward.

Pakistan Railway plays an important role for inter-city transport, carrying 17,000 passengers per day with 15 trains (one round trip for each train), although most of these trains are usually not operated as scheduled. KCR was in service during 1969-1999, but currently it is not in operation. The revitalization project of KCR was approved by GOP on 3rd September 2009. Bus (Minibus, Coach, and Large Bus) is the primary mode of public transport in Karachi, although the number of buses has been decreasing.

Rickshaw and Suzuki pickup are also popular transport modes in Karachi, which complement bus networks. Qingqi Rickshaws are mostly operated in local streets as a feeder service of the bus network and operation along main roads are restrained.

## 1.3.2. Serious Traffic Jams on Arterial Roads

Roads play an important role in the social and economic development of Pakistan and Karachi City. Although the road network in the city is relatively well developed, the rapid increase in the number of passenger vehicles and motorcycles in recent years has caused the heavy traffic congestion in various places in the city, which has no mass-transit system such as an urban railway system. There are approx. 20 trunk roads with a daily traffic volume of 100,000 vehicles or more in the city. The travel speed on these roads during the rush hour is around 15km/hour. The heavy congestion seriously affects people's lives and economic activities. Improvement of the urban traffic condition in the city is urgently required not only in view of the above-mentioned background but also to attract foreign investment to the city where industrial agglomeration is in progress.

## 1.3.3. Relevant Development Plan

### 1.3.3.1. Karachi Strategic Development Plan (KSDP)

In 2007, the CDGK has formulated the Karachi Strategic Development Plan 2020 (KSDP-2020) under

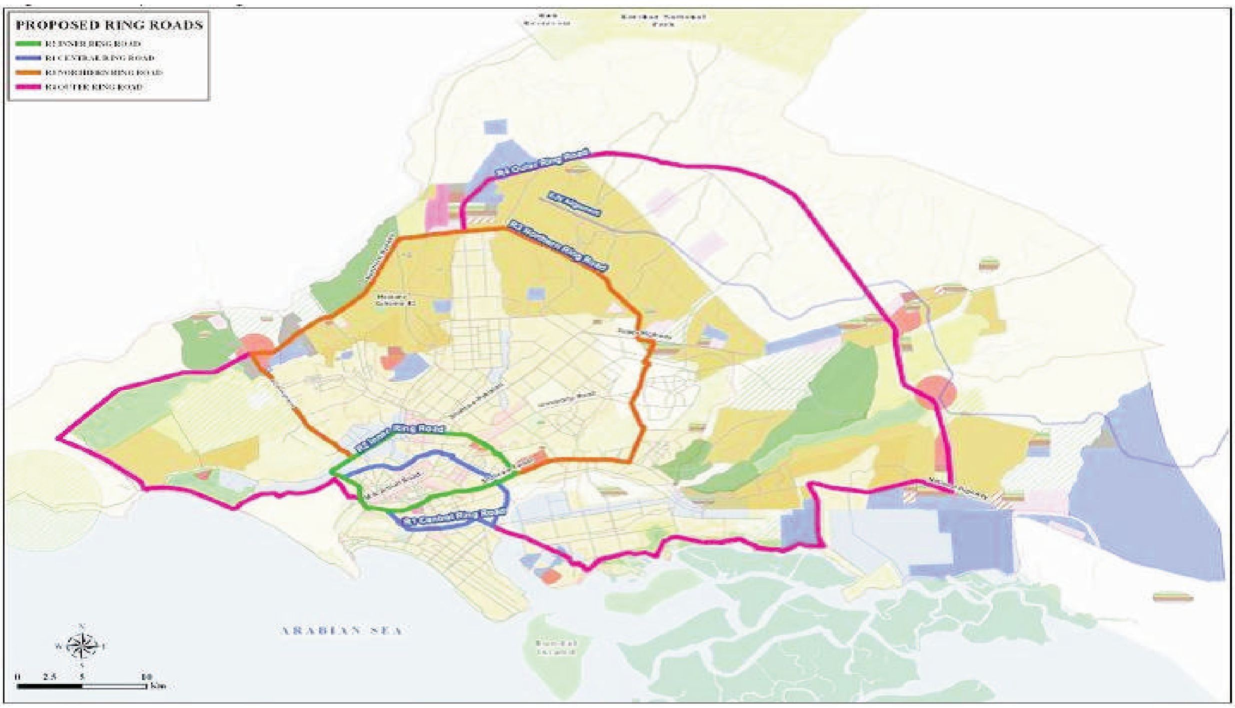



**Fig 1.2:** Ring Road Proposed in KSDP

*Source: KSDP*

Tameer-e-Karachi Program to set out a strategic framework and overall development direction and future pattern of the city over the next 13 years. KSDP consists of land use, housing, transport, other public infrastructures (water supply, sewage, waste management, drainage, and electric power), etc. As the strategy of transport sector, four ring roads were proposed in KSDP-2020 to divert traffic from congested radial roads, as shown in Figure 1-1-1. Central Ring Road (R1), Inner Ring Road (R2), and Northern Ring Road (R3) already exist although improvement of the said roads is necessary. Outer Ring Road (R4) was recommended to be developed towards 2020.

#### 1.3.3.2. Karachi Transport Improvement Project (KTIP)

JICA has conducted and completed the study on the Karachi Transportation Improvement Project (KTIP) in June 2012. In this study, Karachi Urban Transport Master Plan (KUTMP) for 2030 has been created and the feasibility study of a high priority project on mass rapid transit system has been conducted.

Figure 1-1-2 shows the future road network in 2030 and Figure 1-1-3 shows the public transport network proposed in KTIP. Future public transport network consists of four MRT routes including Karachi Circular Railway (KCR) and five BRT routes. Future road network has been proposed taking into consideration the accessibility to new cities and port, and improvement of missing links and bottlenecks as well as the coordination with public transport stations.

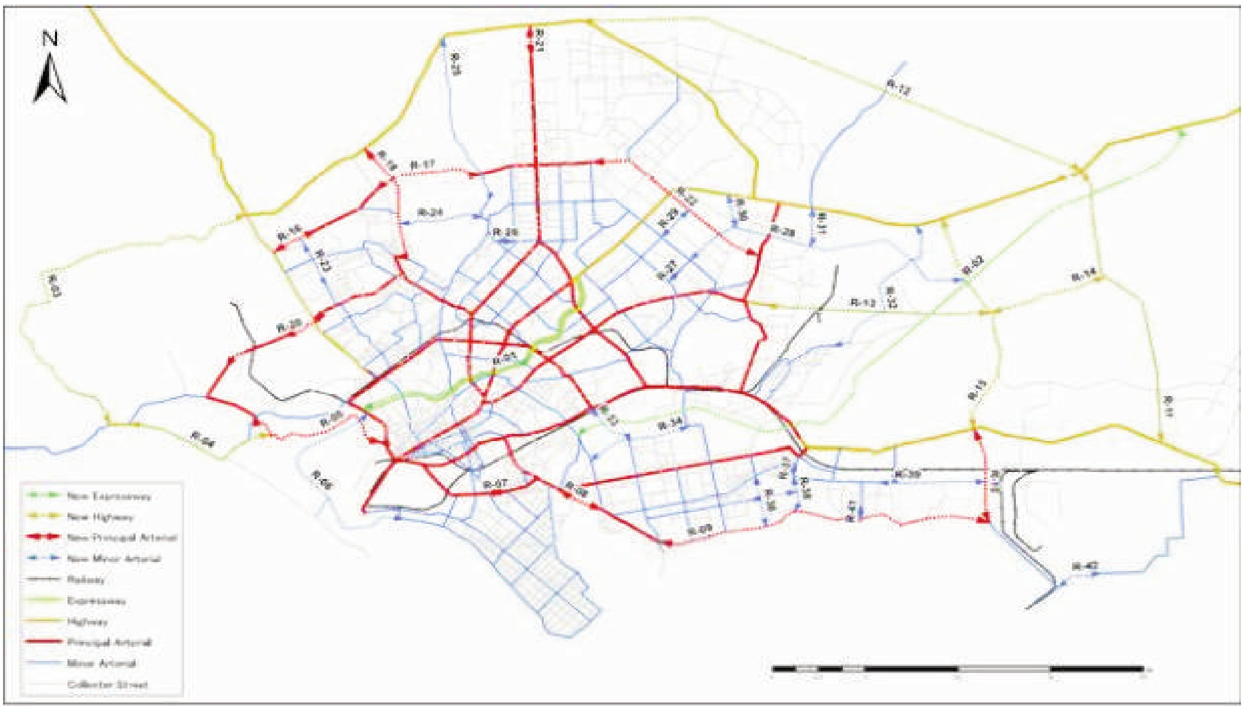


**Fig 1.3:** Future Road Network in 2030 Proposed in KTIP
*Source: KSDP*

## 1.4. Brief Description of Project

### 1.4.1. Objectives of the Project

The main objectives of the project as specified in the TOR are as follows:

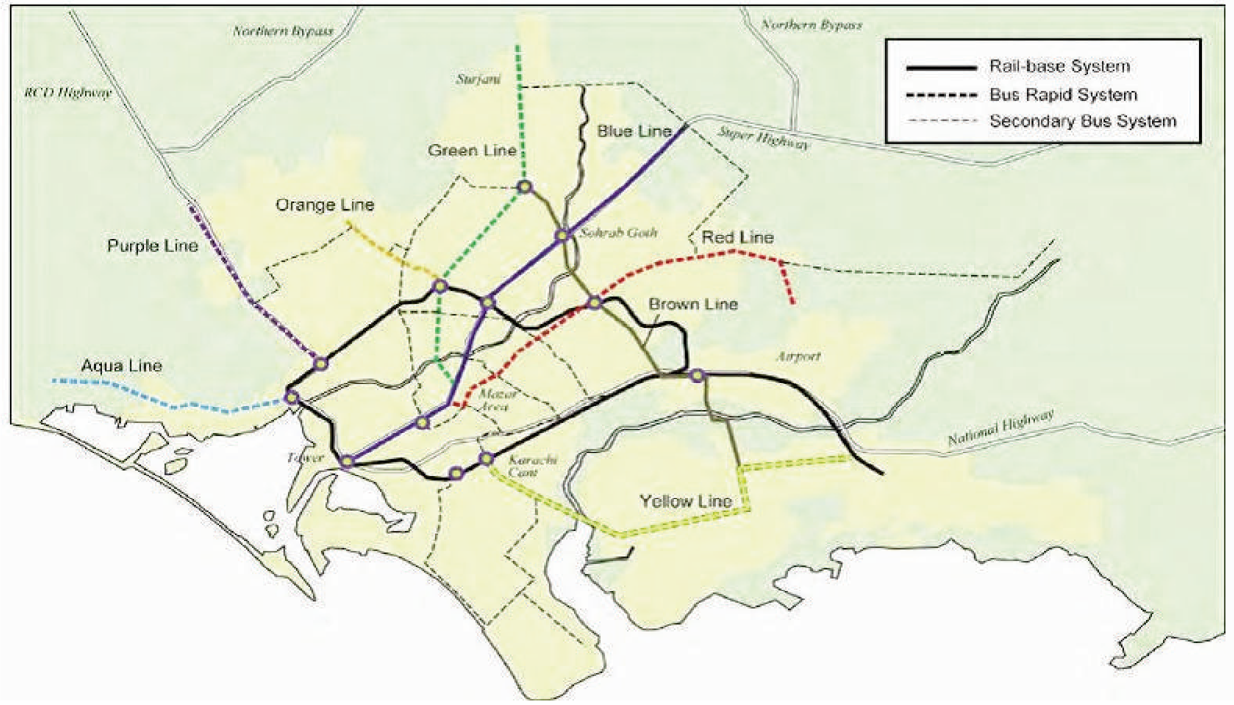



**Fig 1.4:** Public Transport Network Proposed in KTIP
*Source: KSDP*

a) To provide reliable, safe, affordable, high quality and fast BRT Bus Service,

b) To Improve the quality of life of commuters in Karachi,

c) To improve the quality of public transport system in Karachi,

d) To provide infrastructure that allows buses to ply in an efficient manner with exclusive right-of-way for a significant portion of their route length, and

e) Reduce passengers' travel time, and

f) Encourage mode shift from private use of vehicles to Public transport mode.

However, in the consultant view the Project objectives may also include additional features such as efficient service than an ordinary bus line to the general public alleviating congestion on surrounding roads and providing substantial travel time savings along the corridor with limited disturbance to the existing transport network. The goal is to approach the service quality matching the rail transit while still enjoying the cost savings and flexibility of bus transit.

The Proposed BRT System will be a high-quality bus based transit system that will deliver fast, comfortable and cost effective urban mobility through:

- The provision of right-of-way infrastructure.
- Rapid and frequent operations.
- Excellence in marketing and customer service.

## 1.4.2. Justification of Project

### 1.4.2.1. World Trend

Bus Rapid Transit (BRT) is a high quality bus system providing high speed, reliable, and comfortable services compared to traditional bus services. The concept of BRT is based on railway system, i.e. running along exclusive way, high speed, accurate travel time, and high capacity.

Curitiba (Brazil) introduced a high quality bus service system in 1974, which is now recognized as the first successful case of BRT in the world although some advanced bus transit services such as busway and bus exclusive lanes had been introduced in some cities. In 2000, Bogota (Columbia) opened innovative BRT system (TransMillenio) which made great impact on transit planners and decision makers in the world, showing that the BRT can achieve high capacity transport service similar to railway system.

Curitiba

In the 2000s, a number of capital cities in the world introduced BRT such as Taipei (2001), Seoul (2004), Jakarta (2004), Beijing (2005), New Delhi (2008), Istanbul (2008), Lima (2010), and Bangkok (2010).

BRT has been recognized as a cost-efficient mass transit system which can solve urban transport problem in not only developing country but also developed country.

### 1.4.2.2. BRT Type

There are a number of variations for BRT, and the boundary between BRT and conventional bus services is not clear as far as the physical appearance concerned. A typical BRT is the bus transit service on exclusive lanes in road spaces.

As defined in "Private /Public Partnership based Environmentally- friendly Public Transport System For Karachi, 2006", there are three levels of BRT system commonly used for the classification of BRT.

- Level 1 Bus Lane
- Level 2 Busway
- Level 3 BRT

Level-1 system usually provides a bus lane along kerb side. The bus lane is sometimes a priority lane which gives priority of using the lanes to buses but other

Bogota

vehicles can use the lanes when the bus traffic is not heavy, and other times an exclusive lane. In case that this system is introduced in the urban street system where access demand along the road side exist and there are intersections with crossing streets, the bus lanes are easily interrupted by other vehicles.

To avoid interweave of buses and other traffic, bus lanes are located in the center of roads in Level-2 systems. The Busway system is usually a part of the network of general bus services.

The improvement of bus services by introduction of this system would be insufficient in case that there are a number of operators (like Karachi) and it is allowed to use the busway by many operators. The BRT systems in Seoul and Taipei are the examples of this system.

Level-3 system is similar to railway system. In most cases, buses are only operated on the dedicated lanes controlled by a single operator along the lanes. Since the BRT buses need not run in general traffic roads, advanced vehicle technologies can be used to increase the capacity and speed. In addition, pre-board fare

Seoul (Level 2)

collection reduces dwell time at bus stations.

Metrobus (Istanbul) is the example of BRT of Level-3. Note that Level-3 does not necessarily mean high capacity system. For example, TransJakarta (Jakarta) is categorized to Level-3 system but the capacity is very small.

TransMillenio (Bogota) is quite different from other BRTs in terms of the capacity, speed, and quality. It is


Jakarta (Level 3)

classified as "Full BRT".

### 1.4.2.3. BRT Capacity

The Bogota BRT (TransMillenio) shows that BRT system can provide transport capacity as high as railway system, by achieving the capacity of 43,000 passengers per hour per direction. From this, BRT has

Lima (Level 2)

been proposed in many cities as an alternative of rail-base mass transit system.

The maximum capacity of a standard BRT is approximately 13,000 passengers per hour per direction.

Figure below shows examples of passenger volume per hour per direction in the world. Only Bogota's BRT

Istanbul (Level 3)

achieves the capacity of 43,000, followed by Sao Paulo and Santiago at the capacity of approximately 20,000.

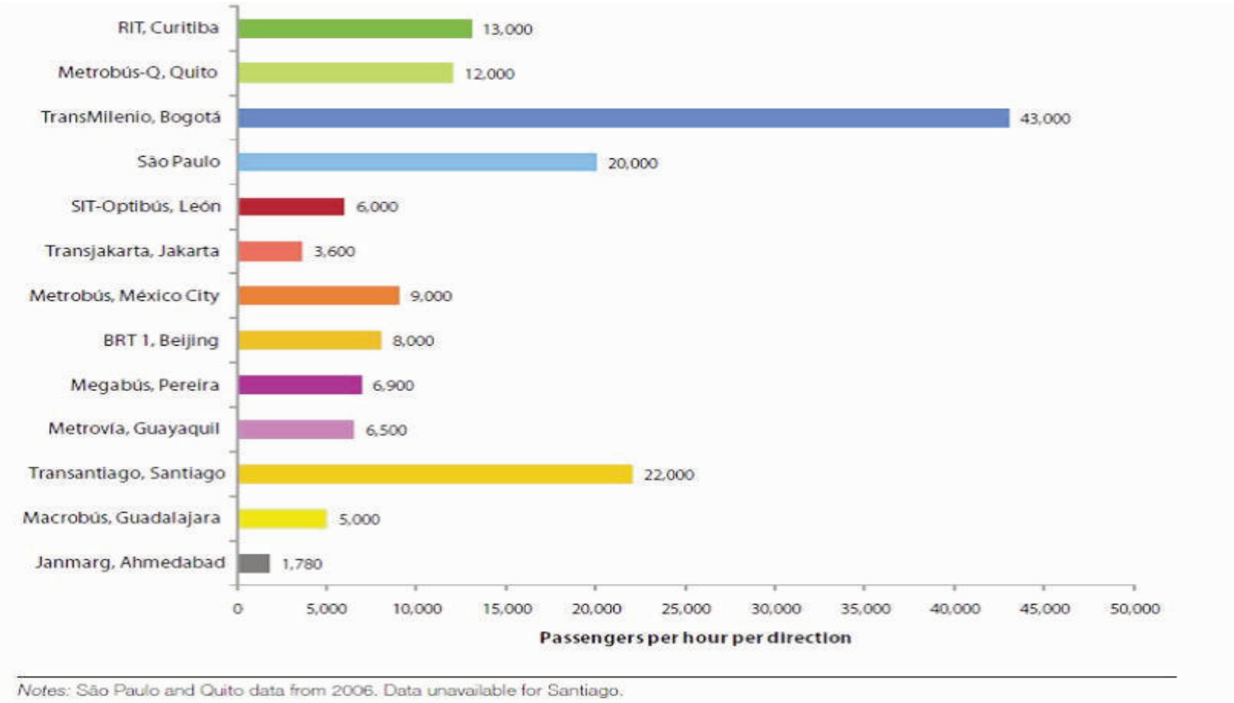



**Fig 1.5:** Comparison of Hourly Passenger Volume per Direction
*Source: EMBARQ*

The throughput of Curitiba and Quito is approximately 12,000 – 13,000. Other cities show the passenger volume of 3,600 – 9,000.

The capacity of BRT is similar to Light Rail Transit (LRT) of at-grade type.

As far as the capacity concerned, the present bus operation in mixed traffic lanes shows relatively high passenger volume. For example, M.A. Jinnha Road carries 21,000 bus passengers per hour per direction in a peak hour and Shahra-e-Faisal carries 14,000 bus passengers. Bus passenger volume reaches 22,000 per hour per direction along University Road near Jail Chowrangi.

### 1.4.2.4. Speed

The world experiences show that BRT is not necessarily high speed system. The average commercial speed of a standard BRT is approximately 20km/h ranging from 15 to 25km/h, while Transmillenio achieves approximately 30km/h. It is expected that a standard BRT can achieve a commercial speed of 25-30km/h. The commercial speed depends on the distance between stations, the density of intersections to be crossed, and necessary time at stations. Due to the delay at intersections, the maximum speed of a BRT without stopping at stations would be approximately 30-40km/h depending on the signal pashing given to BRT lanes. With the stopping at stations, the speed would reduce to 20-30km/h.

Since the average speed of existing minibuses in Karachi is approximately 17km/h, the speed of 20km/h will produce very small benefit from travel time saving. Therefore, it is necessary to achieve higher commercial speed.

### 1.4.2.5. Cost Performance

The construction and equipment costs of BRT are very low compared to other mass transit system. Capital costs of BRT system varies from US$ 1.4 million per kilometer (Transjakarta) to US$ 5.7 million per kilometer (Megabus, Pereira) while the capital costs of Transmillenio was US$12.5 million per kilometer2. Since Transmillenio is exceptional case, the capital costs of BRT is less than US$6 million per kilometer.

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## 1.5. Project Proponent

The Prime Minister of Pakistan announced the GOP financial assistance to be made available under Public Sector development Plan (PSDP) portfolio for the Green Line Project. A Special Project Management Unit under the Ministry of Communications has been developed for the implementation of this project.

The Government of Pakistan as per approval of the PC-I for Green Line project by ECNEC, issued notification to constitute the Project Steering Committee to provide strategic and policy guidance for the project.

Subsequently, the ministry of Communications also issued a notification for the project Coordination Committee (PCC) for the Green Line BRTS Project. This is a technical committee to enable coordination of operational and design issues. This committee will also coordinate the security and traffic management during the implementation phase.

## 1.6. Environmental Impact Assessment

According to the United Nations Environment Programme's Division of Technology, Industry and Economics, an EIA is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, finding ways and means to reduce the adverse impacts, shaping projects to suit the local environment, and presenting options to decision-makers.

An EIA can bring about both environmental and economic benefits, such as reduction in costs and time taken for implementation and design of a project and lesser intervention of legalities and regulations. A properly conducted EIA lessens conflicts by promoting community participation, informs decision-makers, and helps lay the base for environmentally sound projects

### 1.6.1. Purpose of EIA Study

The main purpose of this EIA Study is to provide and analyze information on the nature and severity of environmental aspects of the above issues and propose mitigation measures in case of negative impacts arising from the construction and operation of the project and related activities that would take place concurrently or subsequently. The EIA study will in fact respond to the provision of Sindh Environmental Protection Act 2014 and its associated rules and regulations. The Study will:

- Identify all major and minor impacts, negative as well as positive, on the environment
- Propose mitigation measures for negative impacts through specified design and management procedures
- Identify Socioeconomic aspects, and
- Devise Environmental Management Plan (EMP) for sustainable operation of the Project

### 1.6.2. Categorization of the Project

The Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2000 define Schedules (I & II) of projects falling under the requirement of IEE or EIA. This EIA Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2014 which define Schedules (I & II) as follows:

Schedule I: A project falls in Schedule I if it is likely to have adverse environmental impacts, but of lesser degree or significance than those for category 'A' and all the mitigation measures to handle the impact is manageable. Such types of projects need IEE report including EMP.

Schedule II: Projects are categorized in Schedule II if they generate significant adverse environmental impacts that require a comprehensive management plan, or if the project is located within or passes through: a) Areas declared by the Government of Pakistan as environmentally sensitive (National Parks/Sanctuaries/Game Reserve), b) Areas of international significance (e.g. protected wetland as designated by the RAMSAR Convention), or c) Areas designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as cultural heritage sites.

According to Sindh Environmental Protection Agency Regulation, 2014, a proponent of a project falling in any category listed in Schedule II shall file an EIA with the Sindh Environmental Protection Agency, since the listed projects are generally major projects and have the potential to affect a large number of people.
The proposed Green Line BRTS project is categorized in the Schedule-II under sub-section E of Transport thus requiring an EIA. (See Annexure B for details)

## 1.7. Procedure of EIA

EMC adopted the following procedures for making assessment of impact of different activities during the design, construction and operational phases on microenvironment and macroenvironment of the project activity areas:

### 1.7.1. Review of Legislation and Guidelines

Provincial/National legislations, international environmental guidelines, and best industry practices were reviewed to set environmental standards that SPMU (MoC-GoP) will be required to follow during different stages of the project. Sindh Environmental Protection Act 2014 and IEE/EIA Regulations, 2014 are used during the study.

Review of legislations included but not limited to the following:

- Policies and Legislation relevant to the project.
- Complementary legislation applicable to project for sustainable management of the environment covering land, water resources and water quality, solid waste management, atmospheric emissions.
- Administration: identification of relevant organization with its role and responsibility and make clear the approval process with its average time schedule though visit to relevant organization and reviewing documents.

### 1.7.2. Baseline Data Collection

Detailed environmental baseline surveys were conducted to collect primary data on the Project Area to help identify sensitive receptors. The primary data were examined and compared with secondary data available from earlier environmental studies in the region. The scope of survey included collection of information on following key aspects:

(1) To confirm baseline data including Biophysical of the Project Area including the following items with their seasonal variability:

- Climate and Rainfall
- Air Quality
- Noise Quality
- Topography

- Soil
- Geology
- Hydrology
- Vegetation
- Fauna
- Geomorphology

(2) To confirm baseline data including Socio Economic Environment of the Project Area including the following items with their seasonal variability

- Administrative Division
- Demography and Settlement
- Socio-Economic Activities
- Land use in the Project area
- Existing Infrastructure and Social Services
- Current Resettlement Issues

(3) Detailed Groundwork Investigations: For having an over view of the project area and to assess the existing infrastructure and socio-economic activities, a detailed groundwork investigation was carried out along the proposed route of Green Line.

- Small businesses
- Historical / Archeological site
- Schools
- Road side Trees

### 1.7.3. Consultation with Stakeholders

Stakeholder consultation: A stakeholder consultation was undertaken to document the concerns of the local community and other stakeholders, and to identify issues that may require additional assessment in order to address these concerns. Stakeholder consultation was conducted during the survey with following objectives:

- To inform the Stakeholders, Communities and Project Affected Persons about the project
- To gather feedback from primary and secondary stakeholders of project
- To identify relevant potential issues, including the socioeconomic impact of the project, and corresponding mitigation measures.

During the stakeholder consultation process for the project, following key considerations were focused:

- Identification of sensitive receptors in the area
- Concerns of the industries/shop owners along the project alignment

### 1.7.4. Identification of Aspects

Identification of environmental aspects and their significance is fundamentally important for determination of severity of incidence of impacts at different stages of the project. This step is aimed at obtaining an inventory of the aspects. The aspects identified during this step cover all activities in order to determine those which have or can have significant impact on the environment.

### 1.7.5. Impact Assessment & EMP

Environmental experts at EMC analyzed and assessed the anticipated impacts that are likely to arise due to the identified aspects. Each of the potential impacts identified during the consultation session was evaluated using the environmental, socioeconomic, and project information collected. Air quality monitoring was undertaken to oversee the impact of gaseous emissions. In general, the impact assessment discussion covers the following aspects:

- Present baseline conditions
- Potential change in environmental parameters due to project
- Prediction of potential impacts

- Evaluation of the potential impacts
- Defining of mitigation measures to reduce impacts to as low as practicable
- Monitoring of residual impacts.

An environmental management plan (EMP) was developed to oversee the environmental performance of the project and adoption of proposed mitigation measures. A monitoring plan has also been incorporated in the EMP to monitor impact of all activities and performance of mitigation measures and to identify the residual impact if any, and also the positive/negative changes in the physical, and socioeconomic environment.

### 1.7.6. Documentation & Review

This is the final step of the EIA study. The data generated during and for the study are compiled and examined by experts of the respective field. Sections of this report were prepared as the study progressed, by EMC office staff in consultation with experts. 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, examined the alternatives in the light of observations on the field as well as meetings with the stakeholders, before organizing the Report in the present form.

## 1.8. Structure of EIA Report

The EIA report has been structured on the standard format, prescribed by the Federal EPA. The Report has been presented in the following sections:

Chapter 1: Provides an introduction and overview of the Project and EIA process,

Chapter 2: Gives an overview of national policy and legislation along with guidelines relevant to the project,

Chapter 3: Comparison of Alternative options

Chapter 4: Provides description of the microenvironment and macro environment of the Project area; explaining its physical environment, socio-economic conditions as well as the built environment of the area,

Chapter 5: Provides description of the microenvironment and macro environment of the Project area; explaining its physical environment, socio-economic conditions as well as the built environment of the area,

Chapter 6: Presents the objectives and outcomes of the stakeholder consultation conducted during the EIA process,

Chapter 7: It includes screening of potential Environmental and Social Impacts arising from the Construction and rehabilitation of Green Line BRTS Project and incorporates the mitigation measures been devised. General and Project specific guidelines were used to assess the potential environmental impacts at various phases of the Project,

Chapter 8: Presents the Environmental Management Plan and Monitoring Program for the project,

Chapter 9: Summarizes the report and presents its conclusions and gives necessary recommendations.

The main text of the report is supported by a series of Annexure which provide supplementary information including respective sections of prominent national laws and guidelines.

## 1.9. EIA Study Team

EMC composed the following team of experts and all experts were assigned specific tasks relevant to their expertise.

**Table 1.1: EIA Study Team**

| S. No. | Name of Experts | Position in IEE Study Team |
|---|---|---|
| 1. | Mr. Syed Nadeem Arif | Project Manager |
| 2. | Muhammad Haseeb | Environmental Specialist/Project Coordinator |
| 3. | Mr. Saquib Ejaz Hussain | Environmental Specialist |
| 4. | Dr. Syed Ali Ghalib | Expert on Fauna |
| 5. | Dr. M. Asad Ghufran | Expert on Flora |
| 6. | Dr. Muhammad Mansha | Air & Noise Quality Expert |
| 7. | Mr. Ahmed Zohair | Environmental Engineer |
| 8. | Mr. Khurram Shams | Socioeconomic Expert |
| 9. | Ms. Farhat Shaheen | Environmental Scientist |
| 10. | Ms. Nida Kanwal | Sociologist |
| 11. | Mr. Sultan Mehmood Zaman | Field Supervisor / Soil Scientist |
| 12. | Mr. Jalal Abbas | Environmental Scientist |

# 02 POLICY, STATUTORY & INSTITUTIONAL FRAMEWORK

This section describes the current legal responsibilities of the proponent in the context of the environment and sustainable development, and the institutions that exist in the country that may influence the environmental management of the proposed Project.

SPMU (MoC-GoP) will comprehensively follow the relevant requirements of the policy documents and legislative framework as well as recommendations as described in the national and international guidelines in relevance to the proposed project. Provisions of many of these guidelines have been incorporated in the mitigation measures and the Environmental Management & Monitoring Plan (EMMP) which have been formulated for the better management of environmental and social impacts.

## 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.

The Mid-Term Development Framework: 2005-2010 (MTDF 2005-10) of the Planning Commission has been developed in line with the National Environment Action Plan (NEAP) objectives, and focuses on four core areas i.e., clean air, clean water; solid waste management, and Ecosystem management. The Plan has been prepared keeping in mind Pakistan's experience with such initiatives in the last decade; the current capacity to undertake planning, implementation and oversight and the identified needs for improvement in such capacity. The MTDF clearly specifies issues in environment which need to be addressed.

### 2.1.1. National Environmental Policy, 2005

The National Environmental Policy, 2005 aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life for the citizens through sustainable development. It provides an overarching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives direction for addressing the cross sectorial issues as well as the underlying causes of environmental degradation and meeting international obligations.

The National Environmental Policy, 2005 while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provide broad guidelines to the Federal Government, Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources.

The National Environmental Policy, 2005 is agreed for compliance by the proposed project.

### 2.1.2. National Resettlement Policy

National Resettlement Policy (draft) has been formulated to not only cover the affected persons (APs) in existing systems but also to ensure an equitable and uniform treatment of resettlement issues all over Pakistan. This policy applies to all development projects involving adverse social impacts, including land acquisition, loss of assets, income, business etc. It has addressed those areas, which are not looked after at Land Acquisition Act (LAA) and is applicable wherever the people, families or communities are affected by any public sector or private development project, even when there is no displacement. The policy also aims to compensate for the loss of income to those who suffer due to loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pasture, water rights, public infrastructure like mosques, shrines, schools, graveyards etc.

The policy is supplemented with Guidelines for planning and implementation of resettlement, which form an integral part of Policy. Also, the

Government has tabled an enabling law entitled "Project Implementation and Resettlement of Affected Persons Ordinance" (henceforth to be called "Resettlement Ordinance"), for enactment by the provincial and local governments, after incorporating the local requirements.

The Ordinance although being a new law, shall not supercede other laws of Pakistan in regard to the land acquisition and resettlement issues, and shall be supplementary to the LAA as well as the other laws.

### 2.1.3. The Biodiversity Action Plan

The Biodiversity Action Plan, 2000 has been the most significant direct step towards addressing the issue of loss of biodiversity. It details the current status, trends, direct & indirect causes of loss of biodiversity; its principles, goals and aims; proposals for an action plan including planning & policies, legislation, identification and monitoring, in situ & ex situ conservation, sustainable use, research and training, public education and awareness, Environmental Impact Assessment, information extraction and financial resources etc.

The Wild Birds and Animals Protection Act 1912 , the West Pakistan Wildlife Protection Ordinance 1959, the Wildlife Protection Rules 1972, provide for the protection of flora and fauna in the territory, including vegetation and protected forests. This EIA study has addressed all aspects of conservation, including wildlife, and forest.

By the perusal of above captioned legislation, it is evident that the Wild Bird and Animal life will not be disturbed due to the activity of K-2/K-3. PAEC has operated KANUPP for last 40 years and nothing has been reported as an adverse act against the Wild Bird and Wild life existing in the area.

## 2.2. 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 Government of Sindh (GOS) has designated its Ministry of Environment and Alternative Energy, to administer matters related to the environment in Sindh. The Sindh EPA is directly under the Ministry of Environment and Alternative Energy.

### 2.2.1. Institutional Setup for Environmental Management

The highest 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 roles, responsibilities and authorities of PEPC and the EPA's are defined in the PEPA 1997.

The PEPC has been formed by the Federal Government. Its members include the President of Pakistan, or someone appointed by the President, as the Chairperson; the Minister of the Ministry of Environment, Local Government and Rural Development as the vice-Chairperson; Governors of the Provinces; Ministers in charge of the subject of environment in the Provinces; Secretary to the Federal Government in charge of the Ministry of Environment, Local Government and Rural Development; Director General Federal EPA; heads of other federal and provincial departments; environmentalists and community representatives including scientists. The functions and powers of the Council include formulation of national environmental policy, enforcement of PEPA 1997, approval of the NEQS, incorporation of environmental considerations into national development plans and policies and provide guidelines for the protection and conservation of biodiversity in general and for the conservation of renewable and nonrenewable resources.

The Federal government has also formed the Federal EPA, which is headed by a Director General and has wide-ranging functions given in PEPA 1997. These include the preparation and coordination of national environmental policy for approval by the PEPC, administering and implementing the PEPA 1997 and preparation, revision or establishment of NEQS.

The Provincial Environmental Protection Agencies are formed by the respective Provincial Governments. A Director General who exercises powers delegated to him by the Provincial Government heads each Provincial EPA. IEEs and EIAs are submitted to provincial EPAs for approval.

The proposed project would be located in Sindh Province. Hence this EIA Report will be sent to the EPA Sindh for review and issue of No Objection Certificate (NOC). Coordination of the environmental monitoring activity continues as a provincial subject and is assigned to Provincial EPAs; in this case EPA Sindh has been duly authorized to enforce environmental compliance.

## 2.3. Statutory Framework

The constitution of Pakistan contains provision for environmental protection and resource conservation. The constitution mentions environmental pollution and the ecology as a subject in the concurrent legislative list, meaning that both the provincial and federal government may initiate and make legislation for the purpose. Article 9 of the Constitution defines the right to life as a “fundamental right” in these words “No person shall be deprived of life or liberty save in accordance with law”. The Supreme Court of Pakistan in its judgment in the case Shehla Zia and others vs WAPDA (1994) declared that the right to a clean environment is part of the fundamental constitutional right to life.

Several laws exist for the protection of the environment. Some of these laws are Federal and the rest Provincial in character. The promulgation of the Environmental Protection Ordinance 1983 was the first codifying legislation on the issue of environmental protection. This was indeed a consolidated enactment to plug the gaps and remove defects/deficiencies in the legislation. 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.

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two ‘lists’ attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the ‘Concurrent List’ contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject.

However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The main consequences of this change are as follows: i) The Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management haves been transferred to the provinces. The international obligations in the context of environment will be managed by various ministries and departments of the federal government, ii) The Pakistan Environmental Protection Act 1997 (PEPA 1997) is technically no longer applicable to the provinces. The provinces are required to enact their own legislation for environmental protection.

### 2.3.1. Sindh Environmental Protection Act, 2014

Legislative assembly of Sindh province of Pakistan passed the bill on 24th February 2014 to enact Sindh Environmental Protection Act 2014. The Act envisages protection, improvement, conservation and rehabilitation of environment of Sindh with the help of legal action against polluters and green awakening of communities.

It equally lays emphasis for the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its eco-system by avoiding all types of environmental hazards.

Environmental Protection Council (EPC): It has been formed consisting of Chief Minister as Chairman with Minister in charge of Environment Protection Department, Addl. Chief Secretary, Planning & Development Department, Government of Sindh and Secretaries of Environment, Finance, Public Health Engineering, Irrigation, Health, Agriculture, Local Government, Industries, Livestock & Fisheries Forest & Wildlife, Energy, Education Departments Government of Sindh and Divisional Commissioners of Sindh. Non-official members are also included (i.e. representatives of Chamber of Commerce & Industry and from medical or legal professions etc.) along with DG, EPA & two Members of Provincial Assembly also form part of EPC.

The functions and powers of EPC include coordination & supervision of provisions of Act, approving provincial environmental & sustainable development policies & SEQS, provide guidance for protection & conservation, consider annual Sindh Environmental Report, deal with interprovincial and federal provincial issues, provide guidance for bio safety and assist Federal Government in implementation of various provisions of UN Convention on laws on Seas (UNCLOS).

Sindh Environmental Protection Agency (SEPA): SEPA would be headed by Director General (DG) with the aim to exercise the powers and perform the functions assigned to it under the provisions of this Act and the rules and regulations made there under. The Agency shall have technical and legal staff and may form advisory committees.

The Agency shall administer and implement the provisions of this Act and rules and regulations. It shall also prepare environmental policies, take measures for implementation of environmental policies, prepare Sindh Environment Report and prepare or revise Sindh Environmental Quality Standards. SEPA shall also 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 and sustainable development. SEPA would also take measures for protection of environment such as to promote research; issues licenses for dealing with hazardous substances, certify laboratories, identify need for or initiate legislation, specify safeguards etc. SEPA would also encourage public awareness and education regarding environmental issues.

SEPA would have powers to enter or inspect under a search warrant issued by Environmental Protection Tribunal or a Court search at any time, any land or building etc. where there are reasonable grounds to believe that an offence under this Act has been or is being or likely to be committed. SEPA may also take samples, arrange for testing or confiscate any article in discharge of their duties.

This act has also provided for Sindh Sustainable Fund derived from various sources such as voluntary contributions or fees generated etc. This fund is utilized for protection, conservation or improvement of environment. It is appendices in this EIA report.

Salient Features

**Section-11:** No person shall discharge or emit or allow the discharge or emission of any effluent waste, pollutant, noise or adverse environmental effects in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards.

**Section-12 & 13:** No person shall import hazardous waste into Sindh province and handle hazardous substances except under licenses etc.

**Section 14:** No person shall undertake any action which adversely affects environment or which lead to pollute or impairment of or damage to biodiversity, ecosystem, aesthetics or any damage to environment etc.

**Section 15:** This section deals with regulation of motor vehicles banning emission of air or noise pollutants being emitted from them in excess of allowable standards.

**Section 17:** This section states that no proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment and has obtained from Agency approval in respect thereof. SEPA shall review the IEE & EIA and accord approval subject to such terms and conditions as it may prescribe or require. The agency shall communicate within four (04) months its approval or otherwise from the date EIA is filed failing which the EIA shall deemed to have been approved.

**Section 21:** Where agency is satisfied that the discharge or emission has occurred in violation of any provision of this act or rules etc. then it may, after giving an opportunity to person responsible, by order direct such person to take such measures within specified period. The agency under this section has been empowered to immediately stop, prevent or minimize emission, disposal etc. for remedying adverse environmental effects.

**Section 22:** The person who fails to comply with section 11, 17, 18 and 21 shall be punishable with a fine which may extend to five million rupees, to the damage caused to environment 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. And, where a person convicted under sub-sections 1&2 had been previously convicted for any contravention of this Act, the Environmental Protection Tribunal (EPT) may, in addition to punishment, award imprisonment for a term that may extend up to three years, or order confiscation or closure of facility etc.

**Section 23:** Where any violation of this Act has been committed by any of employee of any corporate body, then, that employee shall be considered to be guilty of environmental pollution.

**Section 25:** This section allows for establishment of Environmental Protection Tribunals.

### 2.3.2. Sindh EPA (Review of IEE/EIA) Regulations 2014

The Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2000 define Schedules (I & II) of projects falling under the requirement of IEE or EIA. This EIA Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2014 which define Schedules (I & II) as follows:

Schedule I: A project falls in Schedule I if it is likely to have adverse environmental impacts, but of lesser degree or significance than those for category 'A' and all the mitigation measures to handle the impact is manageable. Such types of projects need IEE report including EMP.

Schedule II: Projects are categorized in Schedule II if they generate significant adverse environmental impacts that require a comprehensive management plan, or if the project is located within or passes through: a) Areas declared by the Government of Pakistan as environmentally sensitive (National Parks/Sanctuaries/Game Reserve), b) Areas of international significance (e.g. protected wetland as designated by the RAMSAR Convention), or c) Areas designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as cultural heritage sites.

According to Sindh Environmental Protection Agency Regulation, 2014, a proponent of a project falling in any category listed in Schedule II shall file an EIA with the Sindh Environmental Protection Agency, since the listed projects are generally major projects and have the potential to affect a large number of people. The proposed Green Line BRTS project is categorized in the Schedule-II under sub-section E of Transport thus requiring an EIA.

(See Annexure B for details)

**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 100MW
3. Coal power projects above 50 MW
4. Transmission lines (11 KV and above) and distribution projects.
5. Nuclear power plants
6. Wind energy projects if falls under any sensitive, protected area.

**B. Oil and Gas projects**

1. Petroleum refineries.
2. LPG and LNG Projects(including LNG Terminals, re-gasification units) except LPG filling stations
3. Oil and gas transmission systems

4. Oil and gas gathering system, separation and storage.

**C. Manufacturing and processing**

1. Cement plants
2. Chemical manufacturing industries
3. Fertilizer plants
4. Steel Mills
5. Sugar Mills and Distilleries
6. Food processing industries including beverages, dairy milk and products, slaughter houses and related activities with total cost more than Rs. 200 Million
7. Industrial estates (including export processing zones)
8. Man-made fibers and resin projects with total cost of Rs 200M and above
9. Pesticides (manufacture or formulation)
10. Petrochemicals complex
11. 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
12. Tanning and leather finishing projects
13. Battery manufacturing plant

**D. 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. 100 million and above

**E. Transport**

1. Airports
2. **Federal or Provincial highways or major roads (including rehabilitation or rebuilding or reconstruction of existing roads)**
3. Ports and harbor development
4. Railway works
5. **Flyovers, underpasses and bridges having total length of more than 500m**

**F. Water management, dams, irrigation and flood protection**

1. Dams and reservoirs with storage volume of 25 million cubic meters and above having surface area of 4 square kilometers and above
2. Irrigation and drainage projects serving 15,000 hectares and above
3. Flood Protection

**G. Water supply and filtration**

Large Water supply schemes and **filtration** plants.

**H. Waste Disposal and treatment**

1. Handling, storage or disposal of hazardous or toxic wastes or radioactive waste (including landfill sites,

incineration of hospital toxic waste )

2. Waste disposal facilities for municipal or industrial wastes, with total annual capacity of 10,000 tons and above.

3. Waste water treatment facility for industrial or municipal effluents.

**I. Urban development and tourism**

1. Housing schemes above 10 acres
2. Residential/commercial high rise buildings/apartments from15 stories and above.
3. Land use studies and urban plans (large cities)
4. Large scale public facilities.
5. Large-scale tourism development projects

**J. Environmentally Sensitive Areas**

All projects situated in environmentally sensitive areas

**K. Other projects**

1. Any other project for which filing of an EIA is required by the Agency under sub-regulation (2) of Regulation 5.
2. Any other project likely to cause an adverse environmental effect

### 2.3.3. National Environmental Quality Standards (NEQS)

One of the functions of the Pak EPA under the provision of PEPO of 1983 was to issue NEQS for municipal and liquid industrial effluent, industrial gaseous emissions and motor vehicle exhaust and noise. The Pak EPA issued a statutory regulatory order (S.R.O) in 1994. It required all units coming into production after 1st July 1994 to comply immediately with the new standards. Those already in production at the time of S.R.O were required to comply starting 1st July 1996. The Pak EPA was not able to implement the NEQS effectively for many reasons, including lack of implementation capacity and resistance from industry.

With the PEPA, 1997 the Pak EPA revised the NEQS with full consultation of the private sector, industrialist, trade and business associations and NGOs. The municipal and liquid industrial effluent standards cover 32 parameters. The standards for industrial gaseous emissions specify limits for 16 parameters, and the standards for motor vehicles prescribe maximum permissible limits for smoke, carbon monoxide and noise. Revised standards cover discharges limits of effluents into inland water, sewage treatment plant and the sea. The NEQS are primarily concentration based. Unfortunately, the limits on industrial effluents are neither industry specific nor do they have any relationship with the quantum of production. The NEQS prohibit dilution, but this can be easily circumvented.

SPMU (MoC-GoP) is committed to comply with the applicable NEQS in letter and spirit.

The chronological list of NEQS is shown in Table 2.1.

Table 2.2 shows national environmental quality standard for ambient air.

Table 2.3 shows the standards for motor vehicle noise.

Table 2.4 shows the proposed national environmental quality standard for noise.

The NEQS for effluents are shown in Table 2.5.

**Table 2.1: National Environmental Quality Standards**

| Date | Number | Scope |
|---|---|---|
| 1993 | 742(I)/1993 | Liquid Industrial Effluent |
| | | Industrial Gaseous Emission |
| | | Vehicle Exhaust and Noise |
| 1995 | 1023(I)/1995 | Industrial Gaseous Emission from Power Plants operating on coal and oil (added) |
| 2000 | 549(I)/2000 | Liquid Industrial Effluent (amended) |
| | | Industrial Gaseous Emission (amended) |
| 2010 | 1062(I)/2010 | Ambient Air |
| 2010 | 1063(I)/2010 | Drinking Water Quality |
| 2010 | 1062(I)/2010 | Noise |

**Table 2.2: National Environmental Quality Standard for Ambient Air**

| Pollutant | Time-weighted average | Concentration in Ambient Air Effective from 1st Jan 2009 | Effective from 1st Jan 2012 | Method of measurement |
|---|---|---|---|---|
| Sulfur Dioxide (SO2) | Annual Average* | 80µg/m3 | 80µgm3 | Ultraviolet Fluorescence Method |
| | 24 hours** | 120µg/m3 | 120µgm3 | |
| Oxides of Nitrogen as (NO) | Annual Average* | 40µg/m3 | 40µgm3 | Gas Phase Chemiluminescence |
| | 24 hours** | 40µgm3 | 40µgm3 | |
| Oxides of Nitrogen as (NO2) | Annual Average* | 40µgm3 | 40µgm3 | Gas Phase Chemiluminescence |
| | 24 hours** | 80µgm3 | 80µgm3 | |
| O3 | 1 hour | 180µgm3 | 130µgm3 | Non dispersive UV absorption method |
| Suspended Particulate Matter (SPM) than 1.1m3/minute) | Annual Average* | 400µgm3 | 360µgm3 | High volume Sampling, (Average flow rate not less |
| | 24 hours** | 550µgm3 | 500µgm3 | |
| Respirable | | | | |
| Particulate Matter (PM10) | Annual Average* | 200µgm3 | 120µgm3 | B Ray absorption method |
| | 24 hours** | 250µgm3 | 150µgm3 | |
| Respirable Particulate Matter (PM2.5) | Annual Average* | 25µgm3 | 15µgm3 | B Ray absorption method |
| | 24 hours** | 40µgm3 | 35µgm3 | |
| | 1 hour | 25µgm3 | 15µgm3 | |
| Lead (Pb) | Annual Average* | 1.5µgm3 | 1µgm3 | ASS Method after sampling using EPM 2000 or |
| | 24 hours** | 2µgm3 | 1.5µgm3 | equivalent Filter paper |
| Carbon Monoxide (CO) | 8hours** | 5mg/m3 | 5mg/m3 | Non Dispersive Infra Red (NDIR) method |
| | 1hours | 10mg/m3 | 10mg/m3 | |

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

**24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

**Table 2.3: The Motor Vehicle Ordinance (1965) and Roles (1969)**

| Parameter | Standards (maximum permissible limit) | Measuring method |
|---|---|---|
| Noise | 85dB(A) | Sound-meter at 7.5meter from the source |

**Table 2.4: Proposed National Environmental Quality Standard for Noise**

| S. No. | Category of Area / Zone | Effective from 1st January, 2009 | | Effective from 1st January, 2010 | |
|---|---|---|---|---|---|
| | | Limit it in dB(A) Leq* | | | |
| | | Day Time | Night Time | Day Time | Night Time |
| 1 | Residential area (A) | 65 | 50 | 55 | 45 |

## Table 2.4: Proposed National Environmental Quality Standard for Noise

| S. No. | Category of Area / Zone | Effective from 1st January, 2009 | | Effective from 1st January, 2010 | |
|---|---|---|---|---|---|
| | | Limit it in dB(A) Leq* | | | |
| | | Day Time | Night Time | Day Time | Night Time |
| 1 | Residential area (A) | 65 | 50 | 55 | 45 |
| 2 | Commercial area (B) | 70 | 60 | 65 | 55 |
| 3 | Industrial area (C) | 80 | 75 | 75 | 65 |
| 4 | Silence Zone (D) | 55 | 45 | 50 | 45 |
| Note: 1 | Day time hours: 6.00 a. m to 10.00 p. m | | | | |
| 2 | Night time hours: 10.00 p. m to 6.00p. m | | | | |
| 3 | Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts. | | | | |
| 4 | Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority. | | | | |
| *dB(A)Leq | Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. | | | | |

## Table 2.5: National Environmental Quality Standard for Municipal & Liquid Industrial Effluents

| S. # | Parameter | Into Inland Waters | Into Sewage Treatment | Into Sea | Unit |
|---|---|---|---|---|---|
| 1 | Temperature or Temp. increase | <3 | <3 | <3 | oC |
| 2 | pH value (H+) | 6-9 | 6-9 | 6-9 | |
| 3 | Biological Oxygen Demand (BOD)5 at 20oC | 80 | 250 | 80 | mg/l |
| 4 | Chemical Oxygen Demand (COD) | 150 | 400 | 400 | mg/l |
| 5 | Total Suspended Solids (TSS) | 200 | 400 | 200 | mg/l |
| 6 | Total Dissolved Solids (TDS) | 3500 | 3500 | 3500 | mg/l |
| 7 | Oil and Grease | 10 | 10 | 10 | mg/l |
| 8 | Phenolic Compounds (as Phenol) | 0.1 | 0.3 | 0.3 | mg/l |
| 9 | Chloride (as Cl-) | 1000 | 1000 | SC | mg/l |
| 10 | Fluoride (as F-) | 10 | 10 | 10 | mg/l |
| 11 | Cyanide (as CN-)total | 1.0 | 1.0 | 1.0 | mg/l |
| 12 | An-ionic detergents (as MBAS) | 20 | 20 | 20 | mg/l |
| 13 | Sulphate(SO42-) | 600 | 1000 | SC | mg/l |
| 14 | Sulphide (S2-) | 1.0 | 1.0 | 1.0 | mg/l |
| 15 | Ammonia (NH3) | 40 | 40 | 40 | mg/l |
| 16 | Pesticides | 0.15 | 0.15 | 0.15 | mg/l |
| 17 | Cadmium | 0.1 | 0.1 | 0.1 | mg/l |
| 18 | Chromium (trivalent and hexavalent) | 1.0 | 1.0 | 1.0 | mg/l |
| 19 | Copper | 1.0 | 1.0 | 1.0 | mg/l |
| 20 | Lead | 0.5 | 0.5 | 0.5 | mg/l |
| 21 | Mercury | 0.01 | 0.01 | 0.01 | mg/l |
| 22 | Selenium | 0.5 | 0.5 | 0.5 | mg/l |
| 23 | Nickel | 1.0 | 1.0 | 1.0 | mg/l |
| 24 | Silver | 1.0 | 1.0 | 1.0 | mg/l |
| 25 | Total toxic metals | 2.0 | 2.0 | 2.0 | mg/l |
| 26 | Zinc | 5.0 | 5.0 | 5.0 | mg/l |
| 27 | Arsenic | 1.0 | 1.0 | 1.0 | mg/l |
| 28 | Barium | 1.5 | 1.5 | 1.5 | mg/l |
| 29 | Iron | 8.0 | 8.0 | 8.0 | mg/l |
| 30 | Manganese | 1.5 | 1.5 | 1.5 | mg/l |
| 31 | Boron | 6.0 | 6.0 | 6.0 | mg/l |
| 32 | Chlorine | 1.0 | 1.0 | 1.0 | mg/l |

## 2.3.4. Antiquities Act 1975

The Antiquities Act, 1975 ensures the protection of Pakistan's cultural resources. 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 EIA 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 Green Line BRTS under consideration.

## 2.3.5. Sindh Cultural Heritage (Preservation) Act, 1994

The Sindh Cultural Heritage (Preservation) Act, 1994 is the provincial law for the protection of cultural assets. Its objectives are similar to those of the Antiquity Act.

Karachi alone has over 200 buildings declared as "Protected Heritage" by the Government of Sindh. Up to date copies of this protected area list will be sought by the proponent to avoid confusion at any later stage in development; as it is an on-going process to bring new sites within official notification.

None of the sites protected under this law has been identified on the proposed BRT corridors.

## 2.3.6. Forest Act 1927

The Forest Act deals with the matters related with protection and conservation of natural vegetation/habitats. In that regard it empowers the concerned agency to declare protected and reserved forest areas and maintaining the same. In spite of the fact that it recognizes the right of people for access to the natural resources for their household use, it prohibits unlawful cutting of trees and other vegetation. The permission is required prior to undertaking any tree cutting from the area under the charge of Forest Department of Sindh.

The Project alignment does not encompass any reserve/protected forest area.

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

### 2.3.7. 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.

### 2.3.8. Land Acquisition Act, 1894

The land acquisition in Pakistan is regulated by the Land Acquisition Act, 1894 (LAA) with its successive amendments is the main law regulating land acquisition for public purpose. The LAA has been variously interpreted by local governments, and some province has augmented the LAA by issuing provincial legislations. The LAA and its Implementation Rules require that following an impacts assessment/valuation effort, land and crops are compensated in cash at market rate to titled landowners and registered land tenants/users, respectively. The LAA mandates that land valuation is to be based on the latest three years average registered land sale rates, though, in several recent cases the median rate over the past year, or even the current rates, have been applied. Due to widespread land under-valuation by the Revenue Department, current market rates are now frequently used with an added 15% Compulsory Acquisition Surcharge as provided in the LAA.

Based on the LAA, only legal owners and tenants registered with the Land Revenue Department or possessing formal lease agreements, are eligible for compensation or livelihood support. The rights of the non-titled are however addressed under the 1986 Punjab Jinnah Abadis for Non-proprietors in

Rural Areas Act which recognize to squatters the right to receive rehabilitation in form of a replacement plot. It is to be noted that this right has been sometimes extended in practice to include some form of rehabilitation in cash or in forms different from land.

It is also noted that the LAA does not automatically mandate for specific rehabilitation/assistance provisions benefiting the poor, vulnerable groups, or severely affected AHs, nor it automatically provides for rehabilitation of income/livelihood losses or resettlement.

The proposed project does not involve any land acquisition therefore no provision of this law would be applicable.

## 2.3.9. Labor Laws

There are three categories of laws, firstly, the law that regulates the relations between employer and employee; secondly those laws that provide for compulsory levies and thirdly those that provide for minimum standards for employees; the same are as follows:

- Labor Laws regulating the Relation of Employer and Employee
- Labor Laws Assigning Levies;
- Labor Laws Assigning Standards for Wages;
- Labor Laws Setting Standards for Work Place;

### 2.3.9.1. Labor Laws regulating the relationship between Employer & Employee

There is only one labor law that regulates the relationship between employer and employee; the same is:

Industrial Relations Ordinance (IRO), 2002

The law operates in following three areas:

- Regulation of formation of trade unions;
- Regulation and improvement of relations between employer and workmen;
- Avoidance and settlement of any differences or disputes arising between the employer and workmen
- Applicability: The law is applicable to all persons employed in an establishment or group of establishments or industry except those employed:
- In the police or any of the defense services of Pakistan;
- By the Pakistan Security Printing Corporation of the Security Papers Limited or Pakistan Min;
- In the administration of the state other than those employed as workmen by the Railway, Post, Telegraph and the Telephone Departments
- By the institutions working for the rehabilitation of the disables except those institutions running on commercial basis;
- By an institution established for employees old age pension or for workers welfare;
- As a member of the Watch and Wards, Security or Fire Service Staff of an Oil Refiner or of any establishment engaged in the production, transaction or distribution or natural gas or liquefied petroleum or gas products or of sea port or airport; and
- By the Pakistan Army directly or indirectly;

Important definitions under the Ordinance

For the purposes of this document following definitions are important:

- "Employer" Section 2 (x):- in relation to an establishment any person or body of persons, whether incorporated or not, who or which employs workmen in an establishment under a contract of employment and includes "any person responsible for the direction, administration, management and control of the authority including every director, manager, secretary, agent or office bearer, a contractor who procures labor for use by another person or establishment".
- "Establishment" Section 2 (xi):- means any office, firm, factory, society, undertaking company, shop, premises or enterprise which employs workmen directly or through a contractor for the purposes of carrying on any business or industry including all its departments and branches.
- "Industry" Sec. 2 (xvii) means any business, trade manufacture, calling, service, occupation or employment engaged in an organized economic activity of producing goods or services for sale excluding those set up for charitable purposes.
- "Industrial dispute" Sec. 2 (xvi) means any dispute or difference between employers and workmen which is concerned with the employment or non-employment or the terms of employment or the conditions of work; and is not in respect of enforcement of any right guaranteed or accrued to workers by or under any law, other than this Ordinance, or any award or settlement for the time being in force.

Responsibilities of Employer under IRO 2002

- Not to transfer, dismiss, discharge or punish any office bearer of a trade union during pendency of application for registration of trade union. (section 10)
- To provide list of employees working for more than three months to the registrar within 15 days of the requirements. (Section 20 (4a))
- To provide for all the facilities as may be required by registrar for the conduct of poll for determination of the Collective bargaining agent and not to interfere in the polling for such determination. (section 20 (7))
- After an application for determination of collective bargaining agent is made to the Registrar, no employer shall transfer, remove, retrench or terminate any worker who is office bearer of any contestant trade union save with the permission of the Registrar. (section 20 (15))
- To deduct amount of subscription to the funds of trade union on request of collective bargaining agent and deposit the same to the account of trade union. (section 21)
- To provide for all the facilities as may be required for the holding of ballot for the election of shop steward (applicable only to establishment employing fifty or more workmen are employed. (Sec. 23)
- To set up a Joint Works Council consisting of not more than ten members in which workers participation shall be to the extent of forty percent and the Convener of the Council from the management. (applicable where fifty or more workers are employed. (section 24)
- To try to settle the dispute by bilateral negotiations in case of complaint as to settlement of an industrial dispute from the employees. (section 25)
- Not to declare a lock out while any conciliation

proceedings or proceedings before an arbitrator or a Labor court is pending in respect of an industrial dispute. (section 36)

- Not to discharge, dismiss or otherwise punish any workman or change his conditions of service during pendency of proceedings before an arbitrator, conciliator or the labor Court or a Court of Competent Jurisdiction regarding an industrial dispute. (section 40)
- Not to remove any fixed assets of the establishment during the currency of an illegal lock-out or a strike which is not illegal. (section 41)
- To communicate his decision in writing within fifteen days of a complaint being brought to his notice by a workman either himself, through his shop steward or through collective bargaining agent. (section 46 (2))
- Not to indulge in unfair labor practices such as restraining a workman from joining a trade union or to dismiss, discharge or punish a workman by reason of his taking part in the activities of a trade union etc. (Section 63)

### 2.3.9.2. Labor Laws Assigning Levies

Following are the labor laws assigning levies on the employers for the benefit of their employees or workers:

**Employees' Old Age Benefit Act, 1976 (EOBI)**

EOBI applies to industry or establishment employing ten or more persons directly or indirectly. The law continues to apply even if the number of persons employed is subsequently reduced to less than ten. The law provides benefit to employees in the following areas:

- Pension for old-age
- Old Age grant
- Invalidity Pension
- Widow's Pension

Provincial Employees Social Security Ordinance, 1965 (ESSO)

This law applies to all classes of person, industries or establishments having five or more employees. The purpose of the Ordinance is to provide benefit to certain employees under the following circumstances:

- In the event of sickness
- Maternity benefits
- Employment injury or death
- All maters ancillary to the above. The law is applicable on employees including permanent, daily wages, contract employees and contractor's employees whose wages is up to PKR 5000/.

**Workers Welfare Fund Ordinance, 1971 (WWF)**

WWF is applicable to all industrial establishments whose total income is not less than Rs. 100,000/- annually. Money in the fund shall be used to:

- Establish housing estates
- For the welfare measures, including education, training, teaching new skills etc for the workers.

**West Pakistan Maternity Benefits Ordinance, 1972**

The law is applicable to female workers across the board within all establishments. To require establishment to grant mandatory benefits to women workers.

**Workers Children (Education) Ordinance, 1972**

This law is applicable to establishments employing ten or more workers. The definition of "worker" for applicability of this law is limited to a worker whose monthly wages do not exceed PKR 3,000 per month or less. The purpose of the Ordinance is to raise funds for the education of the children of the workers. The fund is required to provide educational facilities to the workers' children and assist with the improvement of schools located in or attached to the industrial undertakings.

**Workers Compensation Act, 1923**

The law is applicable to persons employed for whose average wages do not exceed Rs. 3000/ in a manufacturing process. This Act provides compensation to be paid by employer to the workers or their legal heirs who contract an injury, disease or death during working in an establishment.

### 2.3.9.3. Labor Laws Assigning Standards for Wages

There are three main laws dealing with payment and fixation of minimum wages:

**The payment of wages Act, 1936**

This law regulates the payment of wages to persons employed in the industry. It provides the time of payment of wages, mode of payment of wages and the deductions that can be made while paying wages. The law is applicable to all employees employed by an industry or establishment including the executives.

**The minimum wages Ordinance, 1961**

This law provides machinery for the regulation of minimum rates of wages that an establishment must follow. Under the Ordinance a Minimum Wages Board has been constituted which recommends to the Provincial Government to fix the minimum rates of wages for the workers in respect of any particular industry. Upon recommendations from the Board, the Provincial Government by notification in the official gazette declares the minimum rates of wages for such workers.

- In the Budget 2005-06 the minimum wages of an employee has been fixed as Rs. 3000/
- Pakistan minimum wages for unskilled workers Ordinance, 1969. The law prescribes minimum rate of wages which must be paid by an establishment to worker and not less than that. The minimum wages fixed by the Government at present is Rs. 3000/-. This law is applicable to establishments wherein fifty or more persons are employed.

**Penalty**

In case of violation of the provisions of the Ordinance, imprisonment up to 6 months or fine up to Rs. 500 or both

### 2.3.9.4. Labor Laws Setting Standards for Work Place.

There are mainly eight labor laws setting minimum standards to be maintained at the work place by the employer:

**The Shops and Establishments Ordinance, 1965**

The purpose of this Ordinance is to provide basic standards relating to payment of wages, working hours, overtime, weekly holidays, sick leave, festival holidays, termination of employment and other ancillary matters. The law applies to all the establishments. However, the government may grant exemption to any establishment from the operation of the provision of this Ordinance.

West Pakistan Industrial and Commercial Employment (Standing Order) Ordinance 1968

The purpose of the Ordinance is to provide minimum service conditions for certain establishments as specified by the Ordinance. This law also provides specification of terms and conditions of service by employer like issuance of tickets to a permanent workman, publication of working time, holidays, pay days, rate of wages, provision of terms and conditions of service in writing etc. This law applies to every industrial or commercial establishment wherein twenty or more workers are employed.

**The Factories Act, 1934**

The purpose of the Act is to regulate and standardize the condition in factories falling under the Act. The categories regulated are, (a) basic standards for health and safety (b) disposal of waste (c) ventilation and temperature (d) dust and fume (e) overcrowding (f) lighting (g) availability of drinking water (h) toilet facilities (I) compulsory vaccination (j) provision of canteens (k) precaution in case of fire (l) fencing of machinery (m) working hours. This law is very comprehensive and covers almost all the aspect of a healthy working environment. The law applies to all factories employing 10 or more workers.

**The Employment (Record of Services) Act 1951**

The Act requires employers to maintain records of personnel employed in different classes of employment. It applies to all employers and employees in areas specified by provincial Government. Employers are required to maintain a service book on each employee. However, on termination of the employment, the service book is to be handed over to the employee. Details of employment record covered in the service book are:

- Scale of pay or rate of wages
- Any increment in wages
- Record keeping for transfer of employment
- Grant of leave other than casual leave
- Discharge, dismissed or has resigned or retired from employment
- Any fine or punishment

**The Employment of Children Act, 1991**

This Act imposes ban on employment of children in certain occupations and regulates working conditions of children (aged 14 years) where they are allowed to work. The law applies to all the establishments throughout Pakistan.

**The Apprenticeship Ordinance, 1962**

To promote and regulate systematic apprenticeship programs in Pakistan and for securing certain minimum standards of skill. The law is applicable to industrial establishments having fifty or more employees. It requires that an industrial establishment having more than fifty workers must train apprentices in a proportion not less than 20% of persons employed. The incentive is given in the form of income tax relief.

## 2.4. Environmental and Social Guidelines

### 2.4.1. 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 followed by comments on their relevance to proposed project:

- **Policy and Procedures for Filing, Review and Approval of Environmental Assessments, Pakistan Environmental Protection Agency, September 1997:** These guidelines define the policy context and the administrative procedures that govern the environmental assessment process from the project pre-feasibility stage to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.

The overall flow of obtaining the approval of IEE and EIA is shown in figure 2.2 and 2.3.

- **Guidelines for the Preparation and Review of**

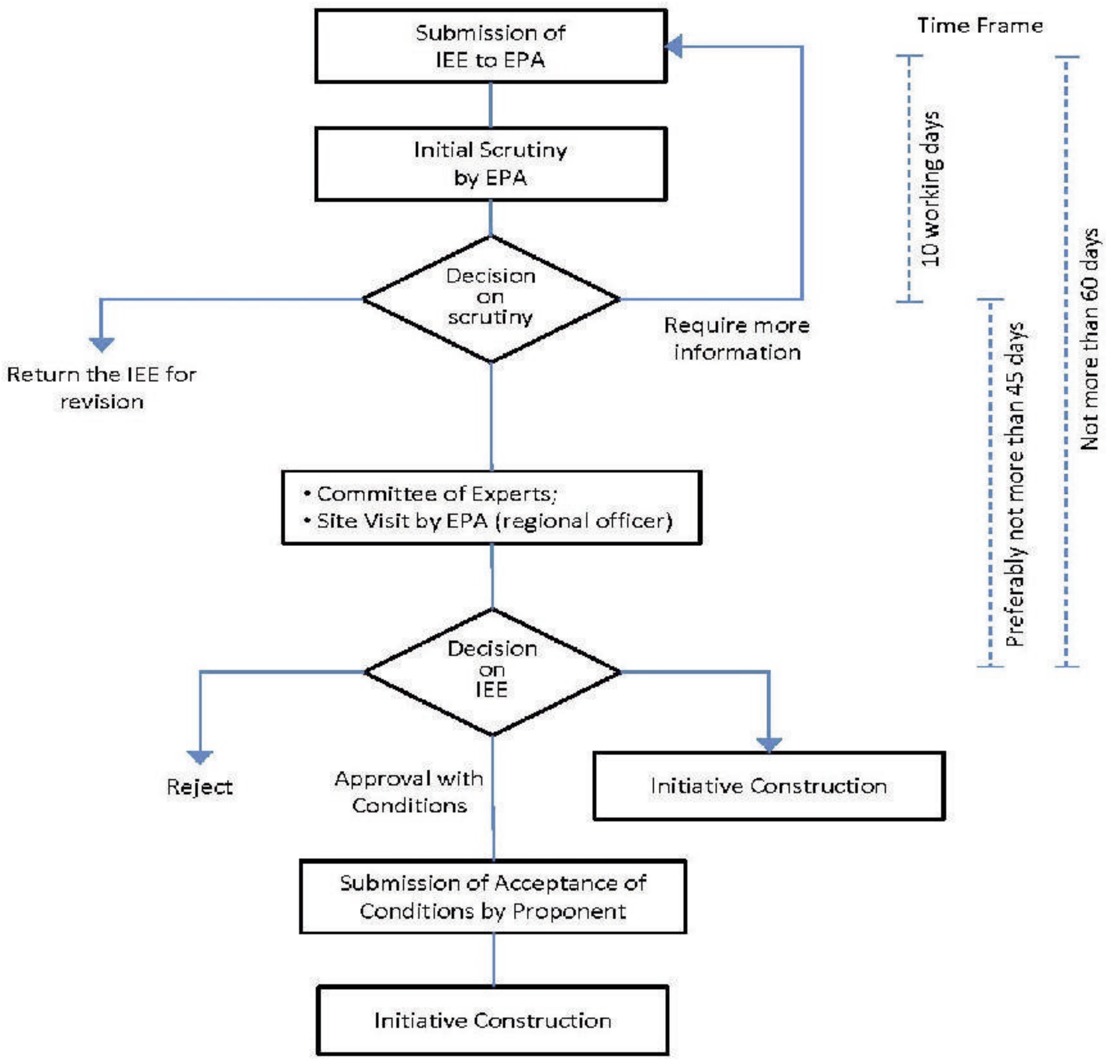



**Fig 2.1:** IEE Review and Approval Procedure

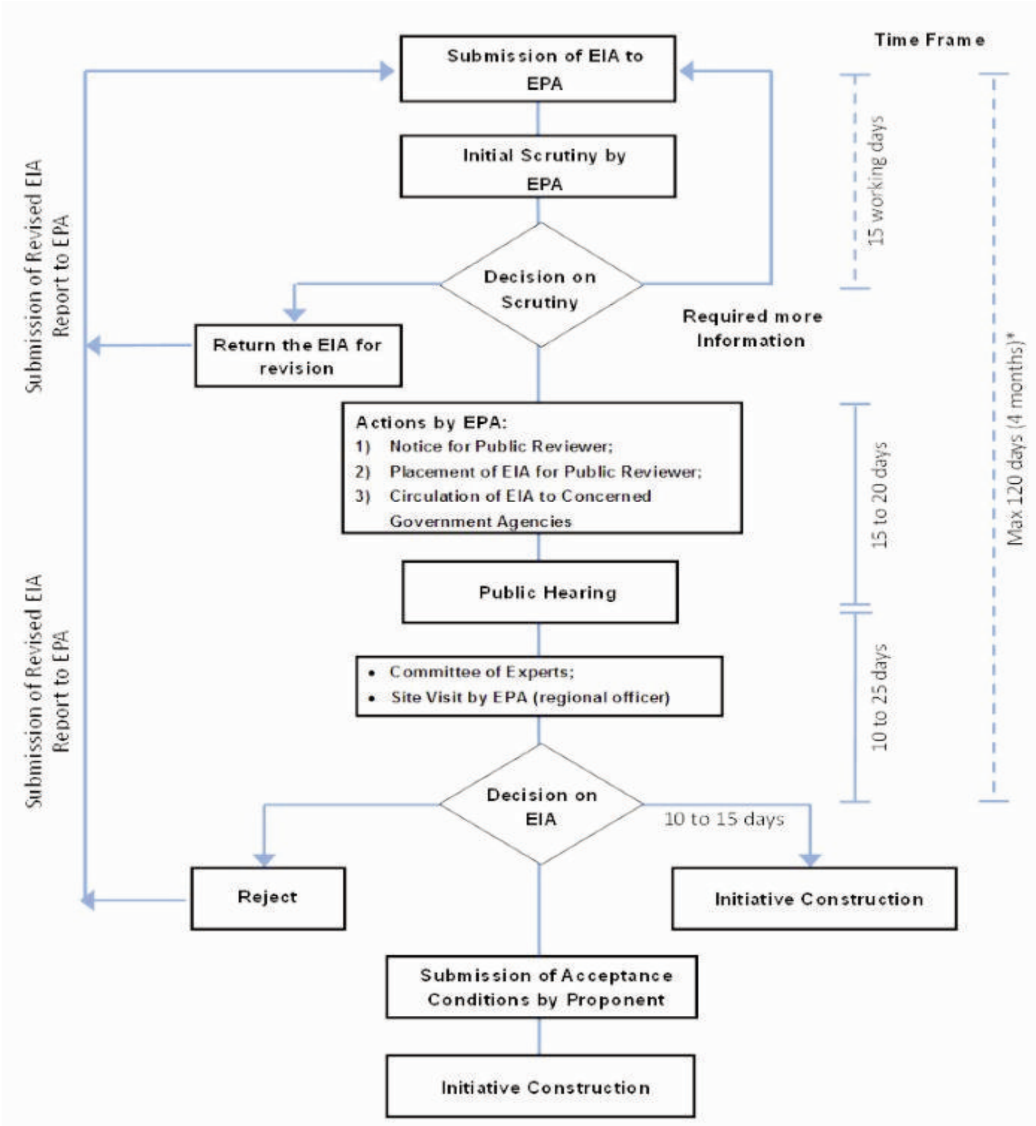



**Fig 2.2:** EIA Review and Approval Procedure

**Environmental Reports, Pakistan Environmental Protection Agency, 1997:** The guidelines on the preparation and review of environmental reports target project proponents and specify:

- The nature of the information to be included in environmental reports
- The minimum qualifications of the EIA conductors appointed
- The need to incorporate suitable mitigation measures at every stage of project implementation
- The need to specify monitoring procedures.
- The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the Study Area, detailed assessment thereof, and mitigation measures.

- **Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May, 1997:** These guidelines support the two guidelines mentioned above. They deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.
- **Sectoral Guidelines for Environmental Reports (Major Roads):** The Sectoral Guidelines are part of package of regulations and Guidelines that also include the National Environmental Quality Standards. The Guidelines are concerned with construction of major roads and highways as well as rehabilitation of major routes. Minor works such as maintenance, repair and improvement of existing roads and the construction of small lengths of new roads of limited capacity are not included within the scope of this Guideline.

### 2.4.2. World Bank Guidelines on Environment

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

- Environmental Assessment-Operational Policy 4.01.Washington, DC, USA. World Bank 1999.
- **Environmental Assessment Sourcebook, Volume I:** Policies, Procedures, and Cross Sectoral Issues. World Bank Technical. Paper Number 139, Environment Department, the World Bank, 1991.
- 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.
- **Pollution Prevention and Abatement handbook:** Towards Cleaner Production, Environment Department, 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 EIA, and address the 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.

### 2.4.3. Equator Principles

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:

### 2.4.3.1. 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 C (minimal or no impacts).

### 2.4.3.2. 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.

### 2.4.3.3. 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.

#### 2.4.3.4. 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'.

#### 2.4.3.5. 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.

#### 2.4.3.6. Principle 6: Grievance Mechanism

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

#### 2.4.3.7. Principle 7: Independent Review

Assessment, preparation of Assessment Plan and consultation process.

#### 2.4.3.8. 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.

#### 2.4.3.9. 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.

#### 2.4.3.10. Principle 10: EPFI Reporting

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

This EIA 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 Green Line BRTS Project in Schedule A (Significant Impacts), requiring Environmental Assessment.

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 Management and Monitoring Plan.

e. Principle 5 (Consultation and Disclosure): Being a project of Schedule-A, the consultation with stakeholders (NGOs and project affected groups) has carried out through scoping sessions and social surveys. The consultation meetings have established that no resettlement or acquisition of land is involved.

f. Principle 6 (Grievance Mechanism): This Principle will not apply since 'no' resettlement 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): The principle is applicable to the propose Green Line BRTS 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.

### 2.4.4. 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.

#### 2.4.4.1. Performance Standard-1: Social & Environmental Assessment and

### Management System

This Performance Standard seeks to:

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

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

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

4. 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 EIA 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.

### 2.4.4.2. 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.

### 2.4.4.3. 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 Green Line BRTS project. Various aspects of pollution prevention and abatement of the proposed project are discussed separately in this report.

### 2.4.4.4. 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 jetty on health, safety and security of the community in the microenvironment as well as the macro environment. The Environmental Management Plan also addresses community aspects.

### 2.4.4.5. 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 EIA has recommended measures for the conservation of flora, fauna and other natural resources.

### 2.4.4.6. 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 cultural heritage sites are identified at or in the immediate vicinity of the project location or on proposed BRT corridor. 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.

# 03 DESCRIPTION OF PROJECT

## 3.1 Introduction

This section of the report describes the project and presents the conceptual and technical details of the proposed BRT project for Karachi Transportation. Bus Rapid Transit (BRT) is a high quality bus system providing high speed, reliable, and comfortable services compared to traditional bus services. The concept of BRT is based on railway system, i.e. running along exclusive way, high speed, accurate travel time, and high capacity.

### 3.1.1. Historical Background

Curitiba (Brazil) introduced a high quality bus service system in 1974, which is now recognized as the first successful case of BRT in the world although some advanced bus transit services such as bus way and bus exclusive lanes had been introduced in some cities. In 2000, Bogota (Columbia) opened innovative BRT system (Trans Millenio) which made great impact on transit planners and decision makers in the world, showing that the BRT can achieve high capacity transport service similar to railway system.

In the 2000s, a number of capital cities in the world introduced BRT such as Taipei (2001), Seoul (2004), Jakarta (2004), Beijing (2005), New Delhi (2008), Istanbul (2008), Lima (2010), and Bangkok (2010).

BRT has been recognized as a cost-efficient mass transit system which can solve urban transport problem in not only developing country but also developed country.

### 3.1.2. Proposed BRT Corridors

Based on the current traffic and forecast demand, a bus-based rapid transit system was found to be the appropriate public transportation system for the city of Karachi. KMC is proposing to improve its existing road network and also provide a public transportation system in the form of a BRT system along with its existing roads. Green Line BRT corridor has been proposed as shown in Figure 3.1.

The proposed project involves Bus Based Rapid Transit System (BRTS) corridor, Green Line (Surjani to Aurangzaib Park).

### 3.1.3. Objectives of the Project

- The objective of the Project is to construct a mass transit corridor. There by it contributes mitigating the ever-congesting traffic.
- The project will be proposed on the existing road network to reduce travelling time and to provide equitable access throughout the city
- To increase economic productivity

## 3.2. Technical Details of Project

According to the studies carried out by JICA, the Green Line corridor stretches over a length of 24 km, starting from Aurangzaib Park which is cited in the report as Municipal Park, passing through Gurumander, Lasbela and Nagan Chowrangi, and finally ending at KESC Power House. From the start to the end point the Green Line will share seven stations with Blue Line as indicated below:

- Municipal Park Station

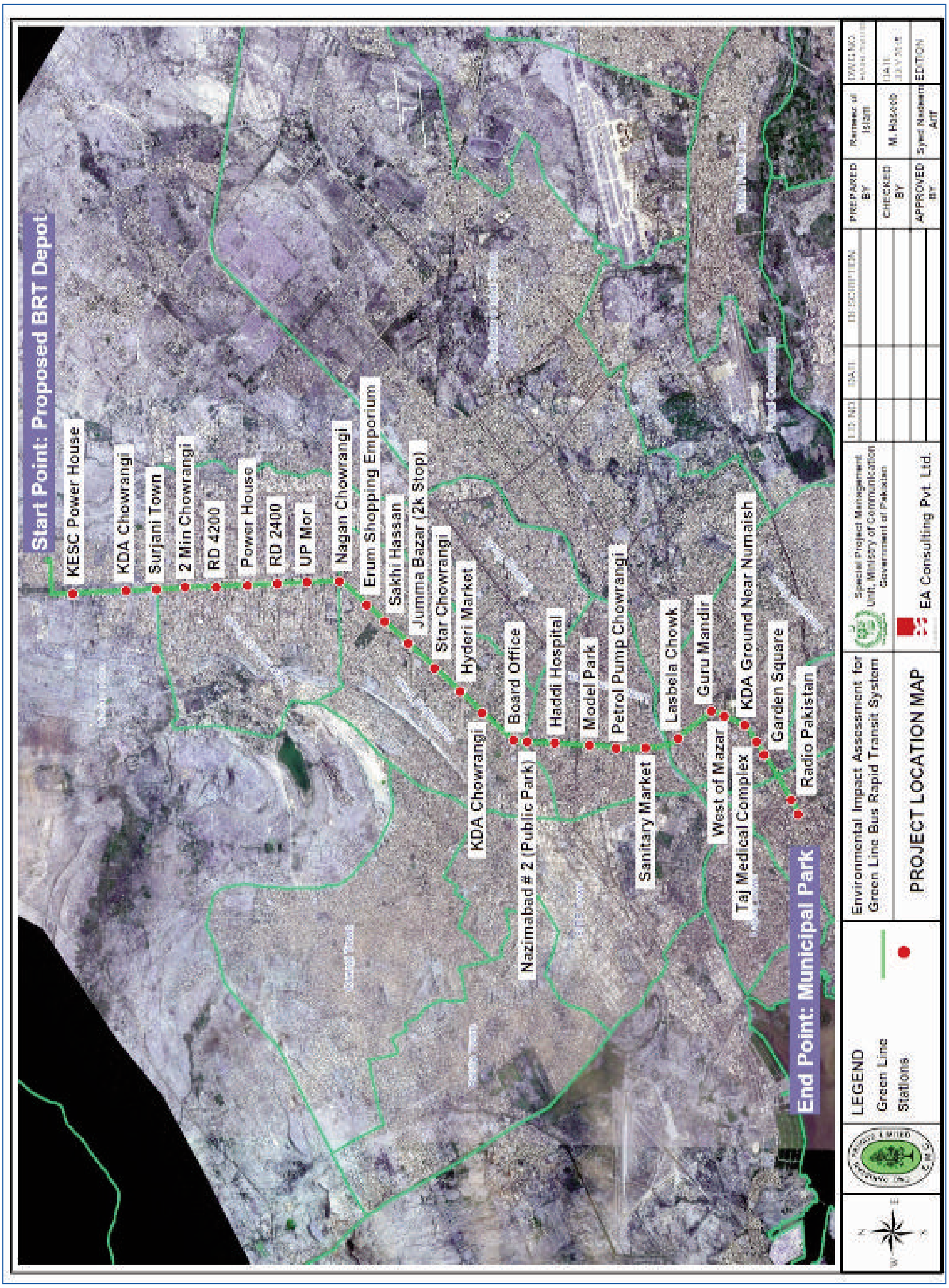



**Fig 3.1:** Green Line BRTS proposed Corridor

- Radio Pakistan Station
- Garden Square Station
- Taj Medical Complex Station
- KGA Ground Station
- West of Mazar-e-Quaid Station, and
- Gurumander Station

Gurumander Station is the main convergence and integration point for both Blue Line and Green Line BRT Corridors. As per the TOR for Green Line the first portion i.e. from Municipal Park Station to Gurumander Station has been withheld assuming it will be designed and constructed as a part of Blue Line; therefore, the design and confluence point geometry will remain an issue. However, at the Municipal Park a terminal station (an elevated U – Turn) is to be designed having parking and other allied facilities for Green Line bus operations by the Green Line design team.

Other than this portion of the corridor, design for which remains in pending due to Blue Line confluence, a detailed reconnaissance survey and a further basic traffic study has been carried out that will be further strengthened by micro simulation for post construction level of service analysis in the upcoming reports. On the basis of observations acquired through initial surveys, different kinds of treatments have been proposed for all the conflict areas, bottlenecks, major intersections and existing U – turns.

## 3.2.1. A General Overview of the Remaining Green Line Corridor

View of various experts working on the project are summarized below:

### 3.2.1.1. Elevated Segment (From Gurumander – Nazimabad Petrol Pump Chowrangi)

Keeping in view the inordinate long distance of 1.5 Km between Gurumander and Nazimabad Petrol Pump Chowrangi a new mid-way station at Patel Para is necessary. It will also be elevated for the Green Line Bus users of the vicinity.

The elevated portion of Green Line corridor will end after crossing Lasbella Chowk, and from this point, the corridor will progress at grade on Lasbella Bridge until it crosses Liyari Expressway. Thereafter, the Green Line is again proposed to be elevated until it crosses Nazimabad 1st Chowrangi.

In the elevated portion described, two stations have been proposed by JICA i.e. at Sanitary Market and at Nazimabad 1st Chowrangi just before the elevated portion begins to ramp down. Both of these stations will be elevated.

### 3.2.1.2. At Grade Segment with Flyovers provided at Intersections (From End of Nazimabad Ch – Nagan Chowrangi)

Grade separation is proposed between Nazimabad Chowrangi and Nagan Chowrangi as traffic volume is high and the existing level of service is also very low. Thus it will ensure uninterrupted operational service frequency of BRT.

After Nazimabad Petrol Pump Chowrangi, the next station is Model Park Station. Due to space restrictions, it has been perceived that possibly left side widening of a lane along the median on each side may be required to design and construct this station which is proposed to be a staggered station in mid-section of road way. After this station, Green Line will run on the existing flyover of Nazimabad with one inner lane along the median in each direction, dedicated for BRT. Next after the existing bridge is the station in front of AO Clinic (this station is labeled in JICA report as Haddi Hospital). The same kind of staggered treatment as at Model Park Station is proposed for this station as well.

The existing bridge over KCR will be demolished, as per decision of the Govt. and a new bridge at Dr. Adeeb Rizvi road would be built. The Board Office Station is proposed to be located as close as possible to

Dr. Adeeb Rizvi Road. From Board Office Chowrangi to Nagan Chowrangi wide median is available for Construction of BRT lanes therefore on the same section BRT will run on and along the median.

BRT grade separation is also proposed at KDA Chowrangi due to high traffic volume. The station at KDA would also is elevated.

Between Board Office Chowrangi and KDA Chowrangi BRT Corridor encounters its first U-turn. The median on this segment is very wide therefore two types of treatments are possible to be suggested, 1) Signalized Operation, 2) Grade Separation. However, since no counts were available of this turning traffic, therefore prior to deciding upon the proposed treatment for this conflicting movement peak hour survey was performed at this intersection. The results of the performed survey showed that this U – Turn cannot be handled by installing signals although large space for storage lanes is available therefore, this U – Turn is proposed to be closed and replaced with u – turn provided under proposed KDA Chowrangi Bridge.

About 300 to 400 meters just before KDA Chowrangi, a KWSB facility is located entirely utilizing the median. It therefore will be necessary to move BRT running away along the two sides of KWSB structure. This will necessitate the utilization of inner most existing lanes of main carriage way. This transition of BRT lanes with respect to adjustment on outermost lanes on both sides will have to be examined by the design engineer to ensure continuity of existing three lanes. The outer lanes may require utilization of easement space and narrowing the existing separator island.

Thus from Board Office Chowrangi to Nagan Chowrangi, BRT is planned to run mostly along the median and the inner lane of the main carriageway is not required, but for this small segment, the Green Line may also consider acquiring inner lanes up till KDA Chowrangi.

From KDA Chowrangi the next Intersection along BRT Corridor is known as Five Star Chowrangi. Since this intersection is also highly congested and at peak hours it is operated at very low service level therefore a flyover has been proposed at this intersection for BRT.

Between KDA Chowrangi to Five Star Chowrangi, two U-turns exist in both directions. First U-turn is located just before Hyderi Market Station (which is proposed to be an at grade station), whereas the other is just after Hyderi Market. These U-Turns are both proposed to be eliminated and relocated under the proposed overpasses at KDA Chowrangi & Five Star Chowrangis.

The Next Station after Hyderi Market Station i.e. Five Star Chowrangi Station is recommended to be elevated and proposed to be located in the center of Intersection at the flyover proposed for BRT to cross these intersections. In this way the water pumping station right in the middle of this Chowrangi can also be avoided, the BRT running way straddling the KWSB facility.

After Five Star Chowrangi next intersection is Sakhi Hassna Chowrangi, similar sort of treatment is proposed for BRT on this intersection i.e. an over pass for BRT is proposed at this intersection along with elevated station in the center of intersection. Between Five Star and Sakhi Hassan Chowrangi there are two U-turns, both for two directional traffic flow, which are located just before and after the Jumma Bazar Station. Both U-turns are proposed to be moved, the first to be shifted under the flyover proposed at Five Star, while the other under the Flyover proposed at Sakhi Hassan Chowrangi.

From Sakhi Hassan Chowrangi to Nagan Chowrangi again two U-turns exist both for two way traffic. First U-turn is located before Erum Shopping Mall Station and the other is just after the same. First one is proposed to be shifted under Sakhi Hassan Flyover, however the other U-turn has a long storage lane for both directions and hence, for this U-turn a signalized operation and depressed BRT both are being studied.

At Nagan Chowrangi one inner lane can be utilized on each side and staggered station is also proposed due to space constraints. From Nagan Chowrangi to the end of Route Alignment i.e. KESC Power House Chowrangi, huge Electricity pylons run along the alignment covering the entire median. Therefore, an inner lane in each direction will be acquired from the main carriageway to run as BRT Lane along both sides of Pylons. To maintain uniform cross-section of the main carriageway one outside lane will have to constructed.

#### 3.2.1.3. At Grade Segment with Under – Pass/Elevated Segments provided at Intersections (From End of Nagan Chowrangi – KESC Power House)

Before the next station of BRT i.e. UP More Station, there is a one way U-turn. Traffic count data was not available for this U-turn on which an analysis of various options could be based on. During reconnaissance survey, it was observed that a high volume of traffic utilizes this U-turn. Therefore, in order to make final and appropriate decision about the treatment of this conflict for BRT, peak hour counts on a typical weekday was performed and the data is being processed for analysis. However, in the light of the observed high-volume, depressed BRT running way is recommended to be considered.

From this point all the way to the end of alignment grade separations are proposed consisting mostly of depressed grade separations because of existing Pylon restrictions which necessitate grade separation below rather than overhead. Furthermore, since traffic volume data of the remaining U-turns is not available therefore peak hour counts on a typical weekday are being performed to enable definitive decisions regarding the treatments that are proposed at these locations.

Stations at UP More and RD 2400 are at grade. After RD 2400 Station, a flyover is proposed at Power House Chowrangi where another BRT station is to be constructed at the end of the same.

The U-turn after the Power House Chowrangi is proposed to be shifted under the flyover. This U-turn is just before the next station i.e. RD 4200. Between RD-4200 and 2 Minute Chowrangi Station there is another U-turn and decision regarding this station shall be finalized after the analysis of survey performed.

Between 2 Minute Chowrangi and Surjani Chowrangi there is a U-turn which is proposed to be shifted over the proposed underpass at Surjani. Station at Surjani is proposed to be located just at the end of the underpass.

Between Surjani Chowrangi and KDA Chowrangi Surjani, there is a U-turn which is proposed to be shifted over the proposed underpass at Surjani and over the proposed underpass at KDA Chowrangi. The Station at KDA Chowrangi is proposed to be located just at the end of underpass. After KDA the next station i.e. at KESC Power House is the termination point of Green Line.

## 3.3. Preliminary Alignment and Cross-Sections

The proposed route for BRT Green line runs from Municipal Park near Eidgah in Saddar to KESC Power House in Surjani. The start point of alignment is taken as KESC Power House proceeding south towards Grumandar Intersection. Therefore, for purpose of detailed design and based on the sequencing of topographic survey stations, it is more viable to consider KESC Power House as the start point for Green Line alignment. Further, the bus depot is also located north of the starting point and the buses will arrive from the storage for starting their scheduled time table. The integration of green line with blue line at present does not have definite common time frame and the location of station connectivity with orange line is also not fixed, it will be more convenient to incorporate the field stationing by the designer.

## 3.3.1. Geometric Design Considerations

Considering the existing corridor conditions the alignment has been proposed on the center of the existing corridor. The alignment consists of long straight tangents and most curves are of large radii with no superelevation required. But on certain locations e.g. Nagan Chowrangi and Board Office sharp radii curves could not be avoided due to existing constraints, however these curves could be countered by providing adequate superelevation as per design standards. Proposed Cross Sections are provided with adequate Cross Slopes to allow sufficient Drainage Runoff.

Most of the stretches follow the Existing Road Profile or if improvements are proposed to maintain minimum grade for drainage, wherever grade separated sections are proposed they are designed in accordance with design standards provided in JICA report, consistent with the specified in TOR and vehicle specifications.

The proposed alignment plan is attached as Annex IV.

The alignment and the proposed cross sections can be best described by dividing the alignment into number of segments:

## 3.3.2. SEGMENT 1

### 3.3.2.1. The Dead Run

The Green Line alignment consists of a 1.3 km dead run before it arrives at its first station to start its route run at KESC Power House Intersection. This dead run (non-revenue route) starts from the bus depot and runs through a local road for 650 m and then runs along Khwaja Shams Uddin Azeemi Road for another 700m to reach its START station.

## 3.3.3. BRT Bus Depot

Depot areas serves an array of purposes including bus

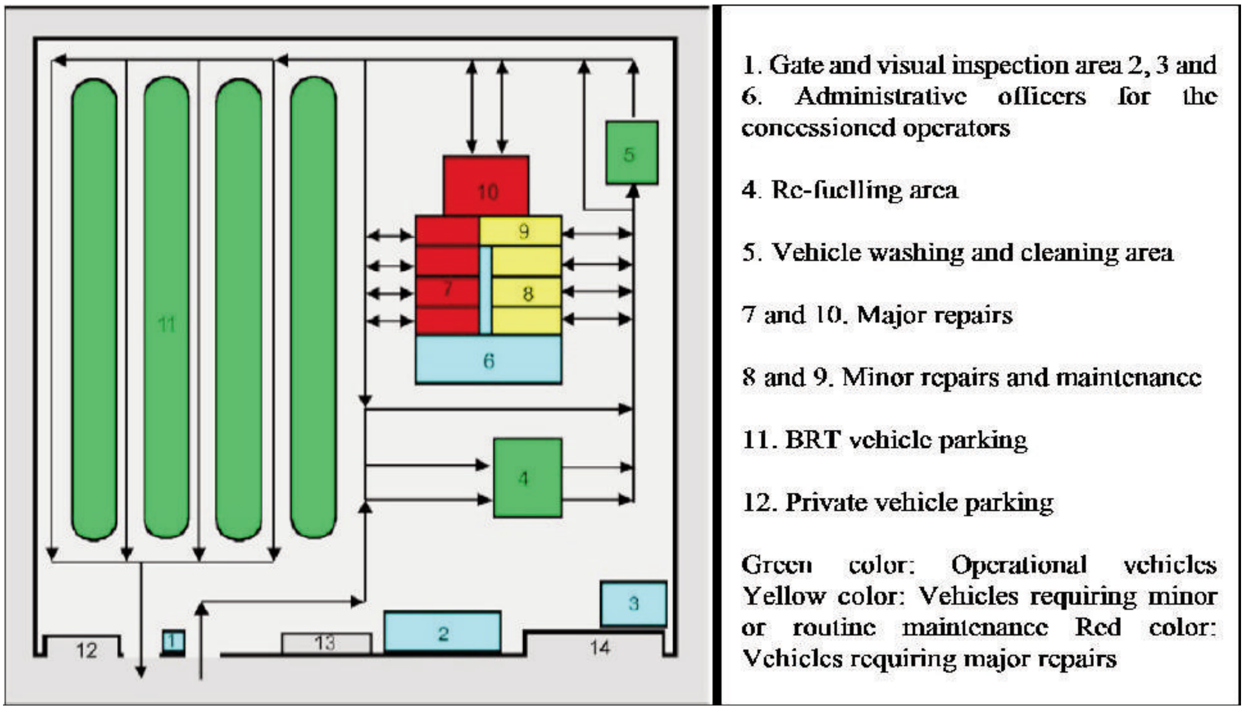



**Fig 1.3:** Standard Features for a depot area

*Source: Bus Rapid Transit – Planning Guide 2007, Institute for transportation and Development Policy (ITDP)* parking areas, refueling facilities , vehicle washing and cleaning, maintenance and repair areas, administrators offices for operators and employee facilities.

It is located to the north of New Karachi as shown in the Fig 3.2.


**Fig 1.3:** Proposed Location for BRT Bus Depot

The distance between the terminal station at KESC Power House Intersection and the proposed bus Depot is approximately 1.3 km.

- Total area of the Depot is 51,400 m2 (approximately 12.70 Acres).
- The depot was originally planned as a sport complex but was planned to be as one of the depots for the CNG bus project.
- Of the 51,400m2 area about 24,000m2 was being utilized for Bus Parking of 200 buses each 12m long. However, if the buses are articulated the total area required will increase accordingly. There is enough surplus capacity of the lot to accommodate 200 articulated buses.

## 3.3.4. SEGMENT 2

### 3.3.4.1. KESC Power House to Nagan Chowrangi

The major concern in this segment is the 132kV High Tension Power Line which runs in the median throughout the segment till Nagan Chowrangi.

### 3.3.4.2. Proposed Cross Sections for BRT Running Way

Refer to Figure 3.4 to 3.7 proposed cross section consists of:

- Eight meter central median which is allocated for the required lateral clearance from the electrical pylons. Four meters of median on each side of the pylon.
- 3.65m bus lanes including shy distance, along both sides of median.
- 0.5m space reserved on both sides for communication cables ducting.

- 0.6m mini barrier with fence on both sides to restrict the intruders from entering the BRT corridor.

Thus, the total ROW along the BRT running way sums up to 17.5m divided in two lanes of existing carriageway on both sides.

#### 3.3.4.3. Proposed Cross Section for Bus Stations

Due to availability of only 12m wide median, a staggered type bus stations are proposed considering the availability of space and to maintain uniformity in design and to also maintain uniform width of road carriageway.

#### 3.3.4.4. Intersections & U-Turns Treatments

It is proposed to convert Abdullah Chowk into a Roundabout which would serve for U-Turn maneuver for BRT buses. This Roundabout will also be open for mixed traffic. Remaining nine intersections consist of two major crossings namely Surjani/4k chowrangi and Power house chowrangi. The traffic study report warrants a grade separated facility for BRT on these two intersections. Refer to Annexure-C for typical BRT overpass and underpass cross sections on the remaining seven intersections the right turns are only provided at designated places i.e. closest to the intersections.

On the basis of traffic study report U-Turns have been shifted under the proposed grade separated facilities provided on the above mentioned intersections. Two exclusive U-turn have been proposed that can be grade separated or signalized.

### 3.3.5. SEGMENT 3

#### 3.3.5.1. Nagan Chowrangi to Nazimabad No. 1 Chowrangi

The existing bridge on Nagan Chowrangi makes the BRT corridor to shift on the left side. It transitions back on the central median near Erum Shopping Emporium. The 26 m wide median from Sakhi Hassan to Board Office intersection is enough to accommodate the BRT terminates on the Board office intersection also, its final location is pending. It is planned that the existing bridge over KCR will be demolished. The BRT shares existing Bridge on Nazimabad Petrol Pump Chowrangi.

#### 3.3.5.2. Proposed Cross Sections for BRT Running Way

Refer to Figure 3.8 to 3.11, proposed cross section consists of:

- 3.65m bus lanes including shy distance, along both sides of Centerline.
- 0.5m space reserved on both sides for communication cables ducting.
- 0.6m mini barrier with fence on both sides to restrict the intruders from entering the BRT corridor.

Thus, the total width R.O.W for BRT sums up to 9.5 m.

#### 3.3.5.3. Proposed Cross Section for Bus Stations

Refer to Annexure-C Non-staggered at-grade bus stations have been proposed throughout this segment.

- 6 m wide platform serving both the sides.
- 3.5 m wide bus bay on both the sides.
- 3.5 m wide passing lane including shy distance on both the sides.
- 0.5m space reserved on both sides for communication cables duct.
- 0.6m mini barrier with fence on both sides to restrict the intruders from entering the BRT corridor.

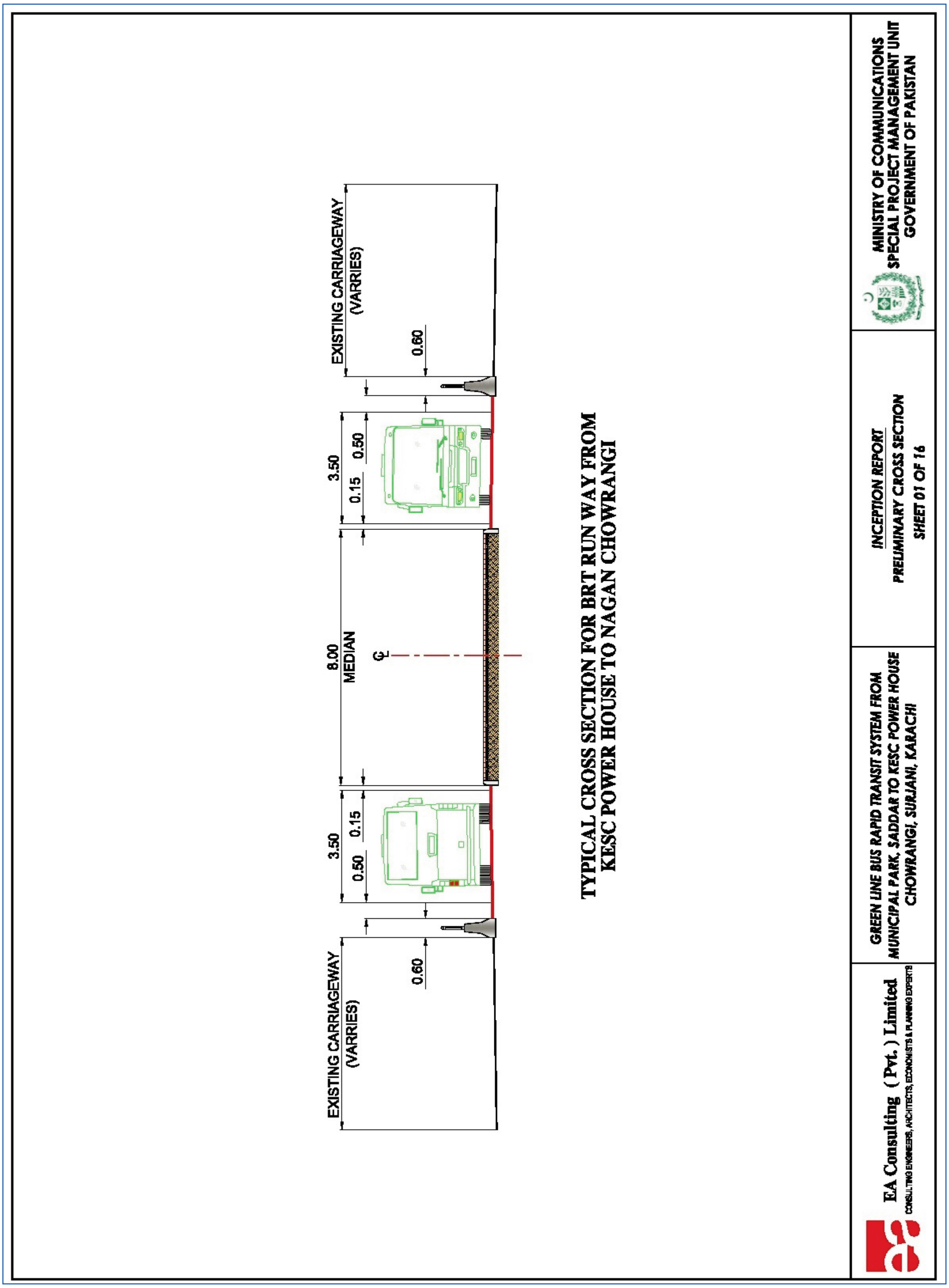



**Fig 3.4:** Segment 2: X-section of BRT Runway

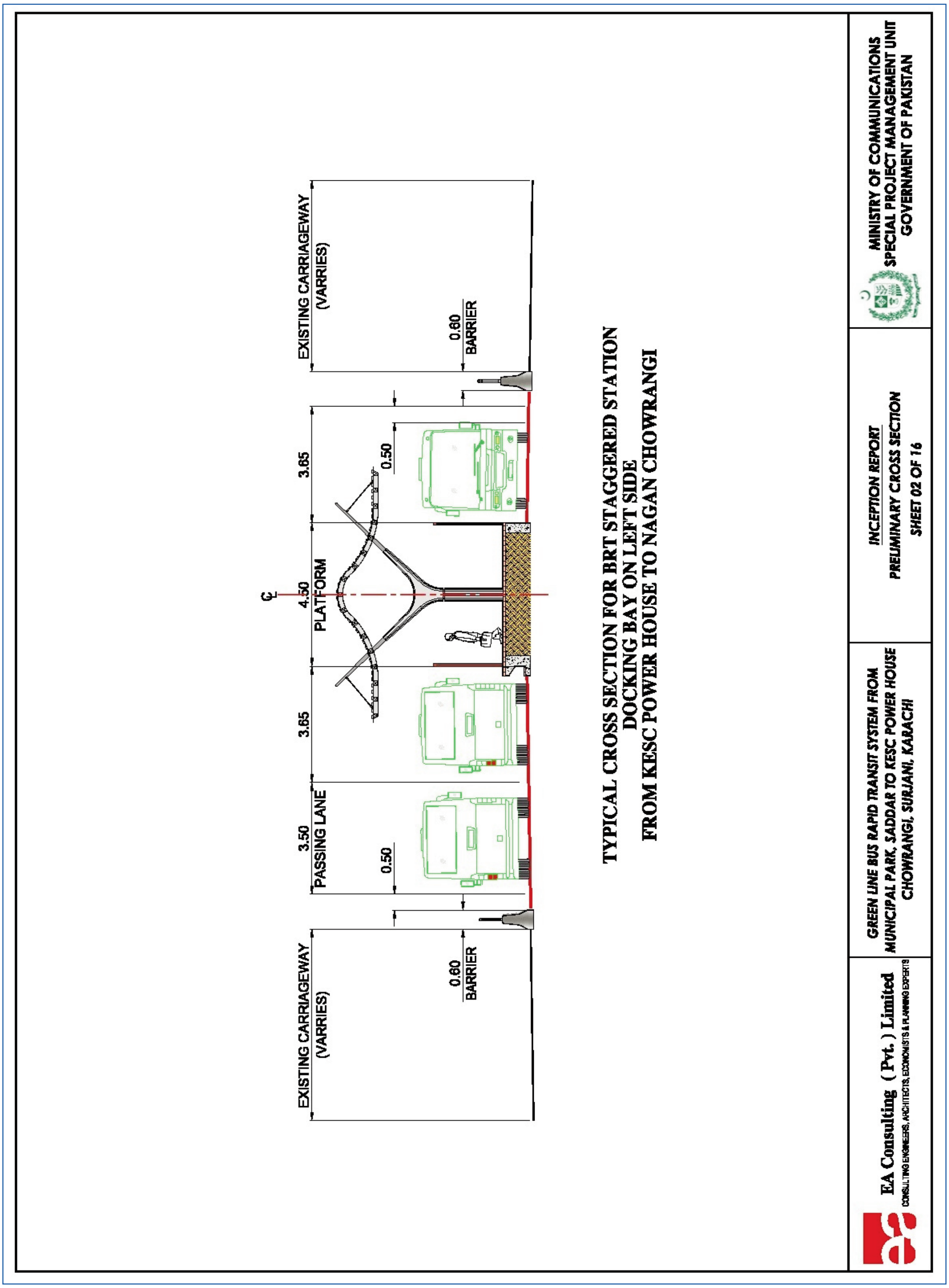



**Fig 3.5:** Segment 2: X-section of BRT Staggered Station

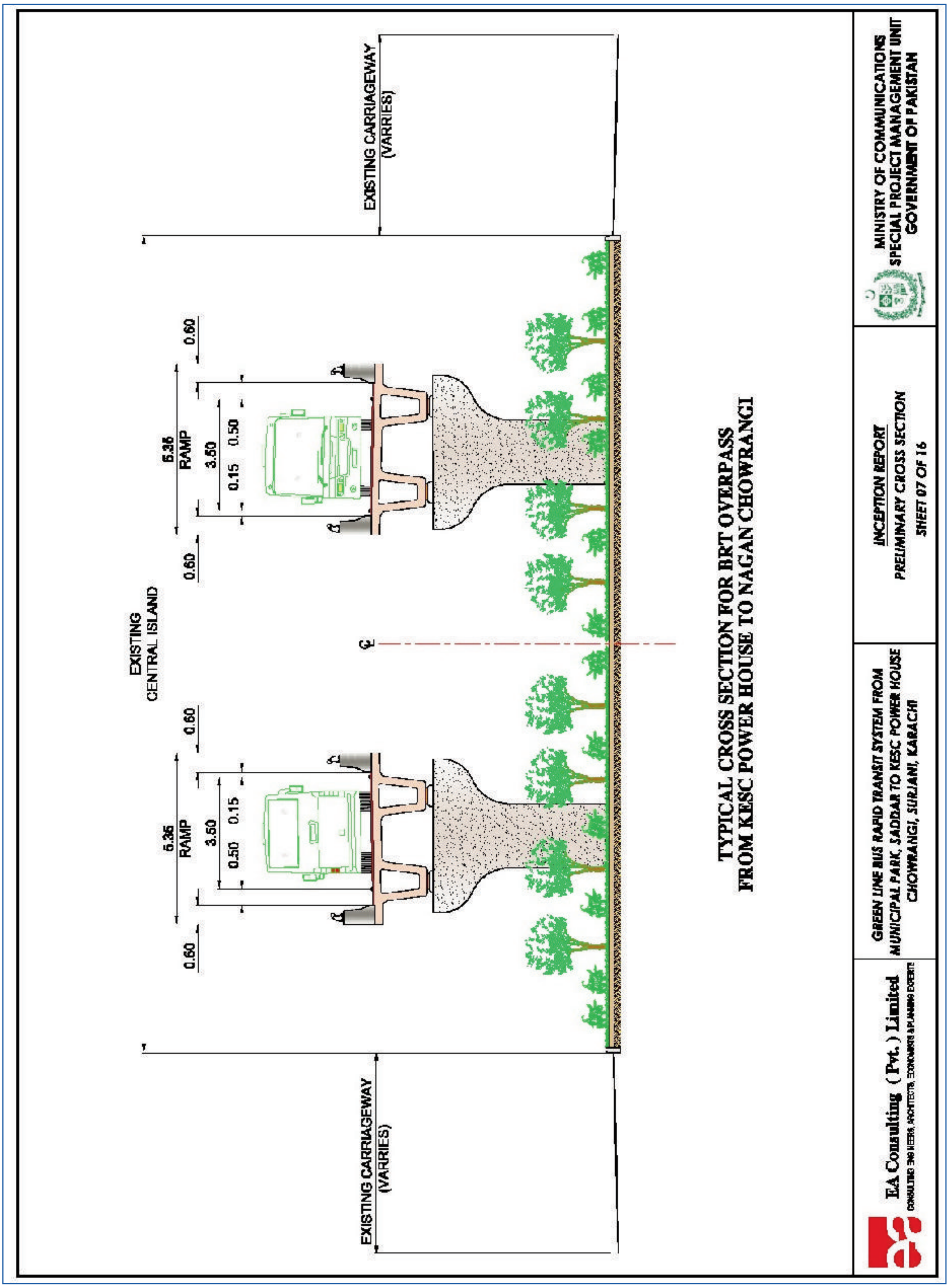



**Fig 3.6:** Segment 2: X-section of BRT Staggered Station

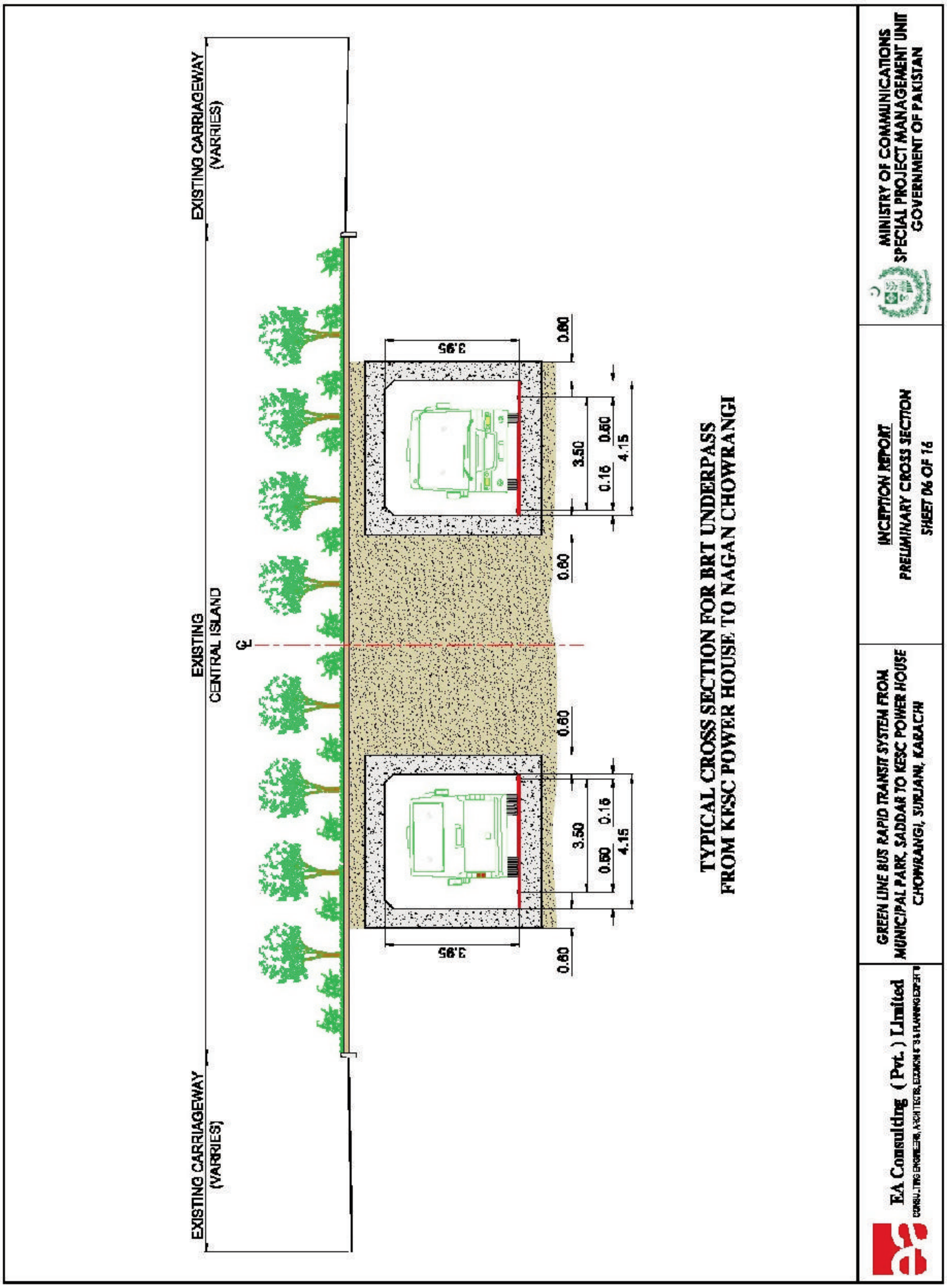



**Fig 3.7:** Segment 2: X-section of BRT Underpass

Thus, the total width R.O.W sums up to 22.2 m.

#### 3.3.5.4. Intersections & U-Turns Treatments

This segment contains four major intersections namely Sakhi Hassan Chowrangi, Five Star Intersection, KDA Chowrangi and Board Office Intersection. The traffic study report warrants suggest a grade separated facility for BRT on these intersections. Refer to Annexure-C for typical BRT overpass and underpass cross sections. On Board Office intersection a flyover has been proposed for both BRT and Mixed Traffic separated by mini Barriers for BRT lanes. On Petrol Pump Chowrangi the BRT shares the existing flyover and separation of BRT lanes is being considered. On the basis of traffic study report U-Turns have been shifted under/over the proposed grade separated facilities provided on the above mentioned intersections. The existing UTurn of Sakhi Hassan to Nagan Chowrangi is being proposed to be signalized due to adequate availability of storage lanes along the BRT running way, however signal control for U-Turns has been proposed to retain priority for BRT movement.

### 3.3.6. SEGMENT 4

#### 3.3.6.1. Nazimabad No.1 Chowrangi to Gurumandar Intersection

This segment is mostly elevated as was planned originally in the JICA proposal. The segment begins to ramp up after the Model park in Nazimabad. It becomes fully elevated at Nazimabad No.1 Intersection and runs elevated until it ramps down again and crosses under Lyari Expressway. The BRT again elevates before Lasbela intersection and continues elevated up to Gurumandar intersection. This arrangement requires further consideration with respect to the existing Bridge over Lyari River at level 1

#### 3.3.6.2. Proposed Cross Section for BRT Running Way

Refer to Figure 3.12 to 3.13. The proposed elevated cross section consists of:

- 3.65m bus lanes including shy distance, both sides of Centerline.
- 0.5m space reserved on both sides for communication cables duct.
- 0.6m mini barrier with fence on both sides to restrict the intruders from entering the
- BRT corridor.

Thus, the total R.O.W for BRT sums up to 9.5 m.

#### 3.3.6.3. Proposed Cross Section for Bus Stations

Refer to Annexure-C. A non-staggered elevated bus stations have been proposed throughout this segment.

- 6 m wide platform serving both the sides.
- 3.5 m wide bus bay on both the sides.
- 3.5 m wide passing lane including shy distance on both the sides.
- 0.5m space reserved on both sides for communication cables duct.
- 0.6m mini barrier with fence on both sides to restrict the intruders from entering the BRT corridor.

Thus, the total width of the elevated section sums up to 22.2 m.

The elevated structure has been proposed in such a manner that no existing lanes below used by mixed traffic are affected due to construction of the flyover.

#### 3.3.6.4. Intersections & U-Turns Treatments

Since the BRT is elevated throughout this segment, the

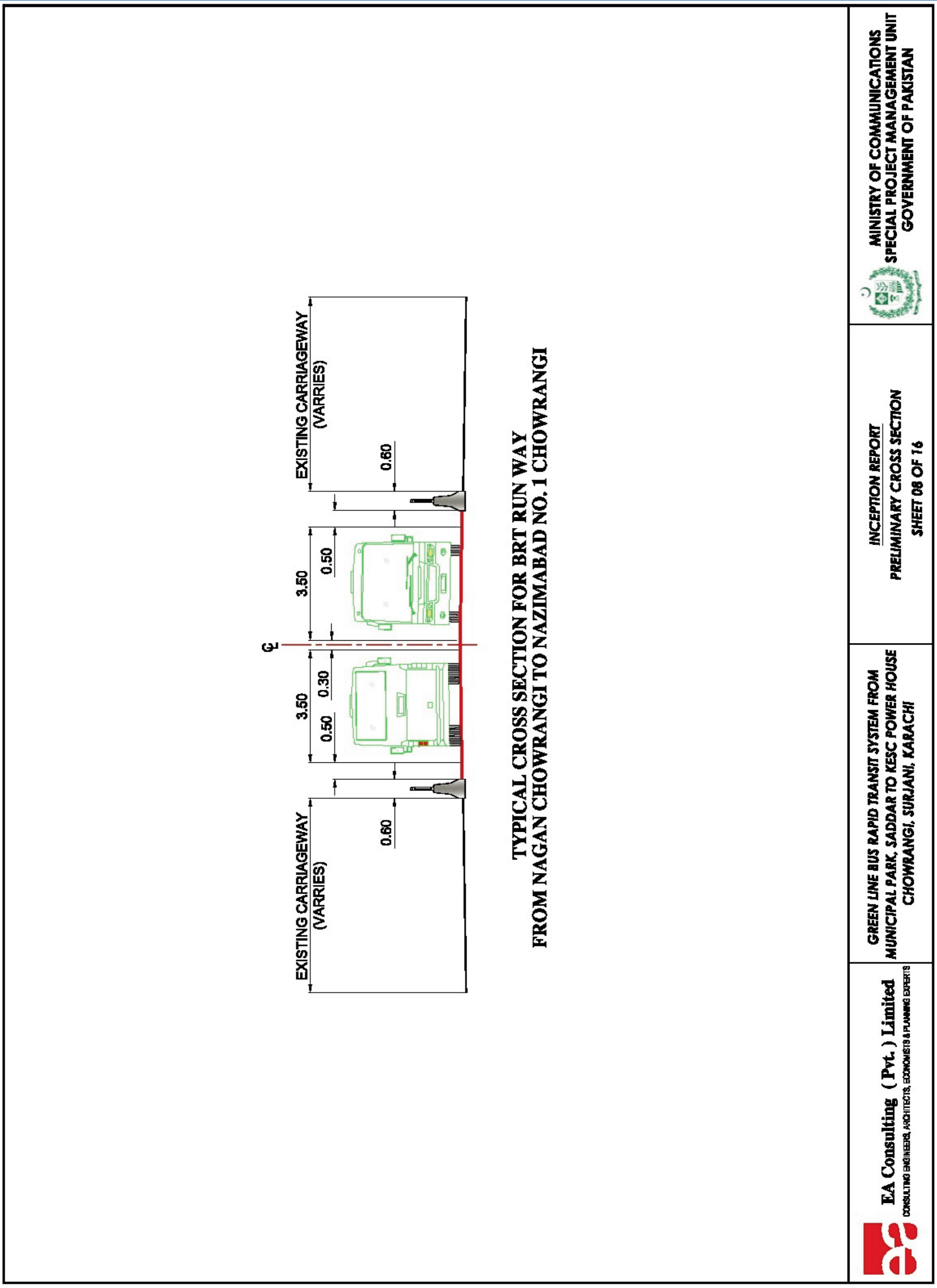



**Fig 3.8:** Segment 3: X-section of BRT Runway

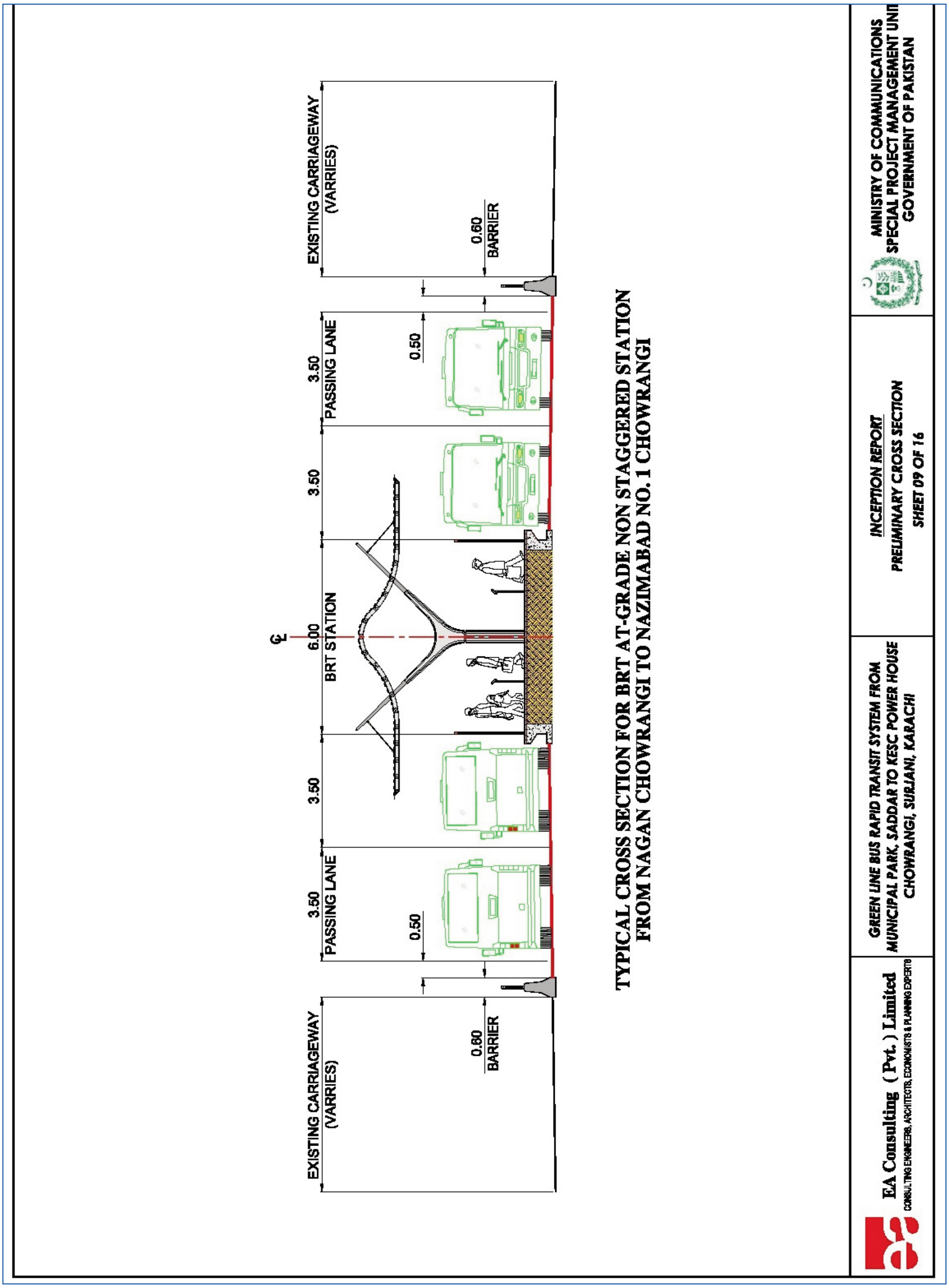



**Fig 3.9:** Segment 3: X-section of BRT Non-Staggered Station

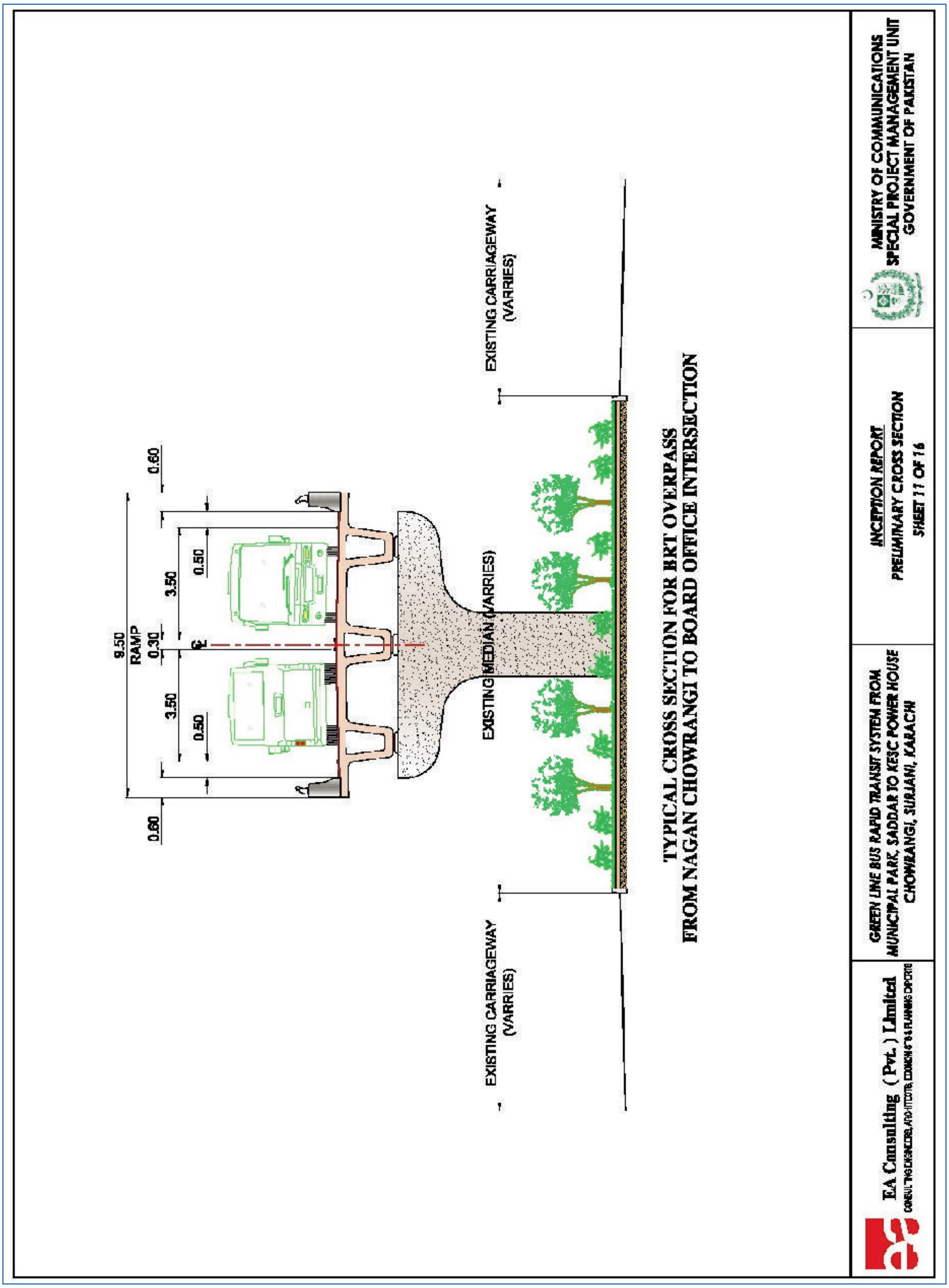



**Fig 3.10:** Segment 3: X-section of BRT Overpass

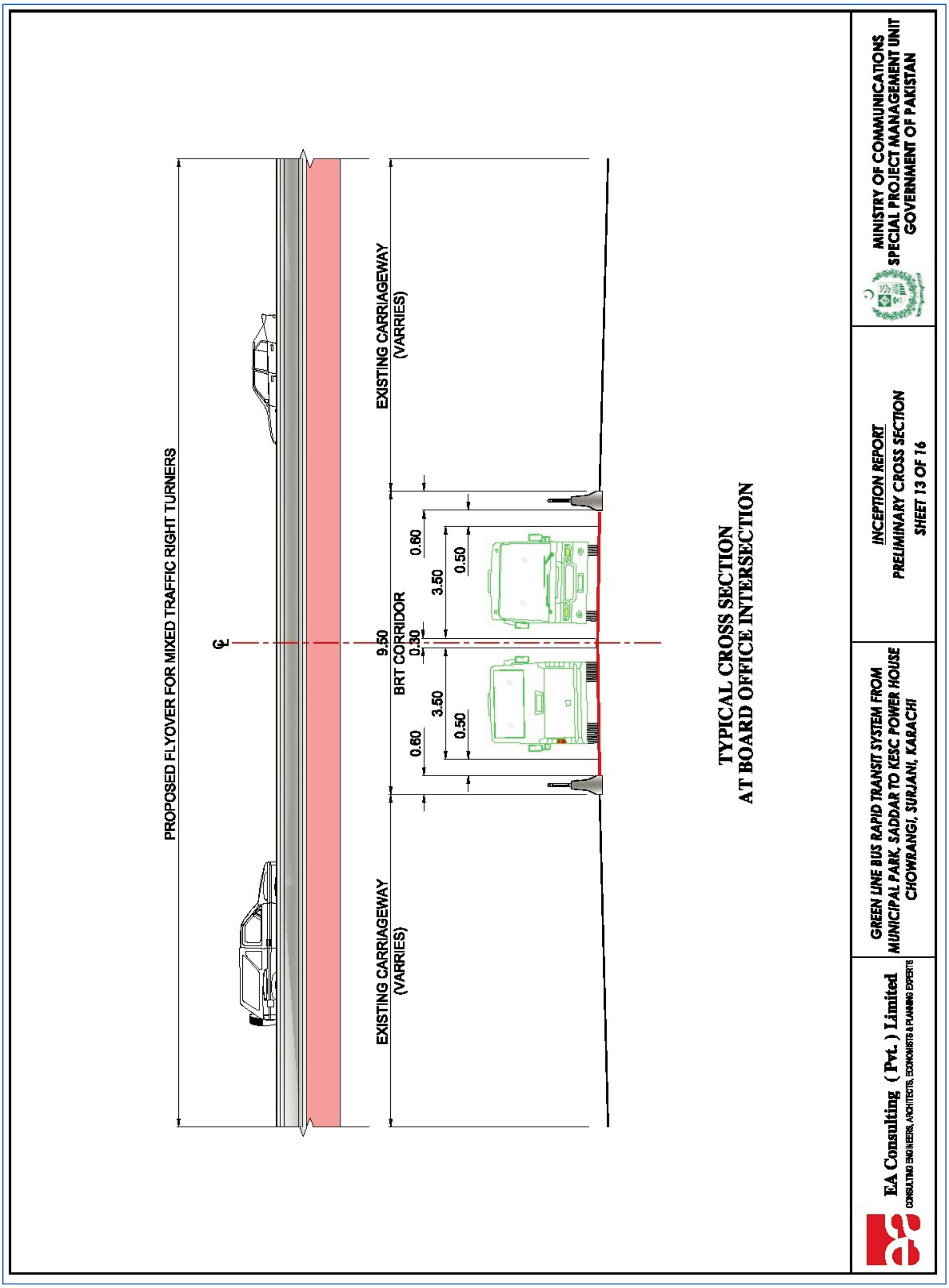



**Fig 3.11:** Segment 3: X-section of Bridge at Board Office Intersection

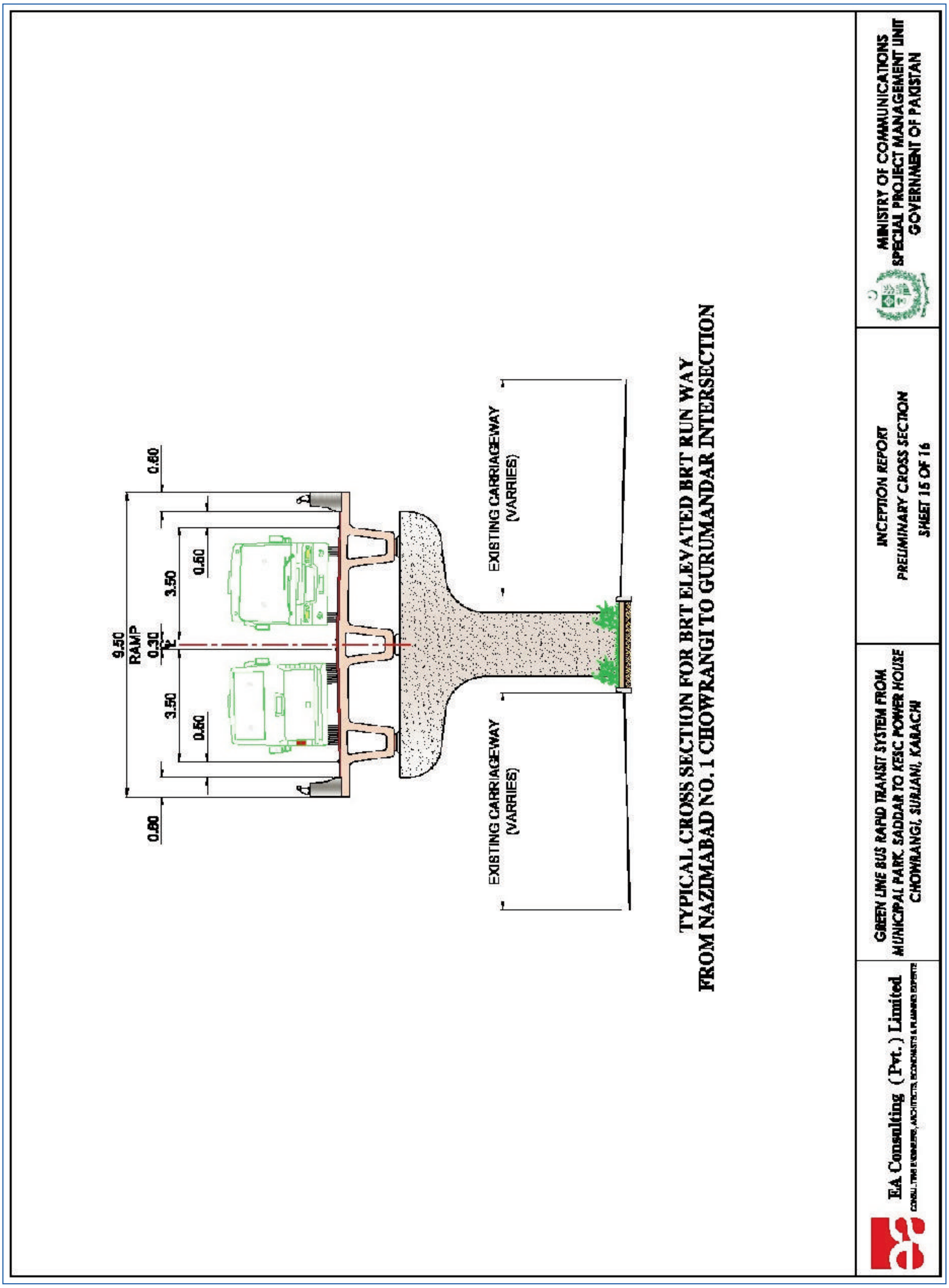



**Fig 3.12:** Segment 4: X-section of BRT Elevated Runway

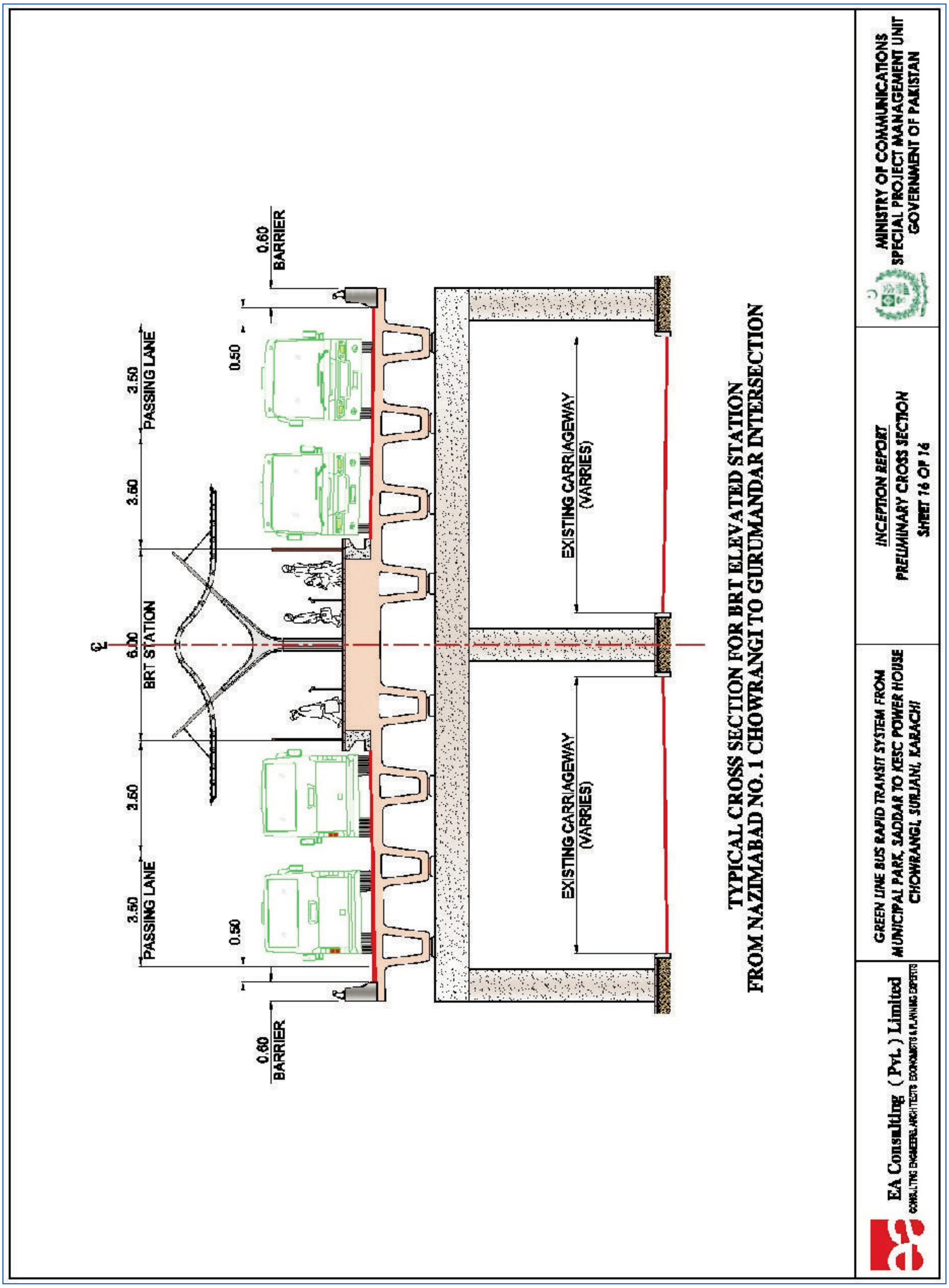



**Fig 3.13:** Segment 4: X-section of BRT Elevated Station

existing intersections and U-Turns will continue to work in the same manner as now.

## 3.3.7. Green Line Stations

Bus stops, stations and terminals form the interface between the passengers with the Bus Rapid Transit System. Hence it is essential that the location, size and other features of BRT Stations are finalized after a thorough study so that it can provide easy access and pleasant and less saturated environment for passengers boarding and alighting from the Bus Station. This translates to convenience, comfort, safe and easy access for all age groups of people. The Stations should support a strong identify of the Green Line and mesh into the surrounding Urban fabric. This sub section of the report will discuss following BRT Green Line Station features in detail:

- Station Type
- Access to the Station
- Bus Stop Locations and Details
- Boarding and Alighting Demand
- Provision of Bus Bays

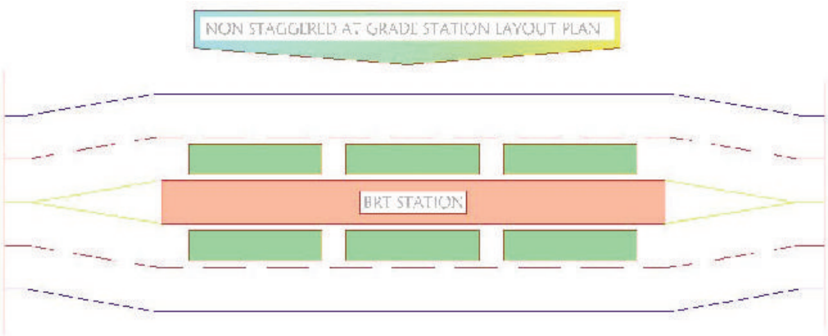
### 3.3.7.1. Type of Stations

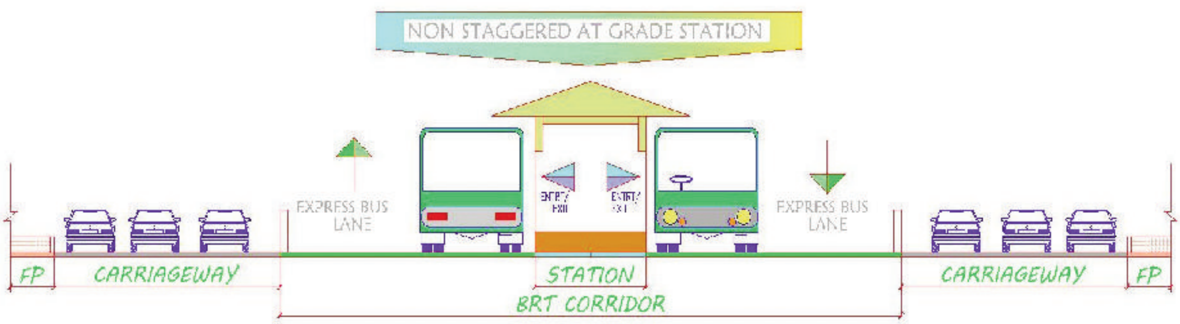
The area and width of the station is a critical point in terms of BRT Corridor Design. However physical dimensions of the station can be manipulated to reduce spatial width requirement. In one case a single station for BRT can serve for both directions. Alternatively a station can be split in two parts to serve each direction separately. This type of station is known as staggered station.

According to the TOR, 2 lanes in each direction are to be provided at stations to accommodate express busses therefore the requirement of width along the station is highly increased. Therefore, for BRT, three types of stations are proposed along the corridors as mentioned below considering the spatial requirements of each station and availability of Space:

- Non Staggered At- Grade Stations

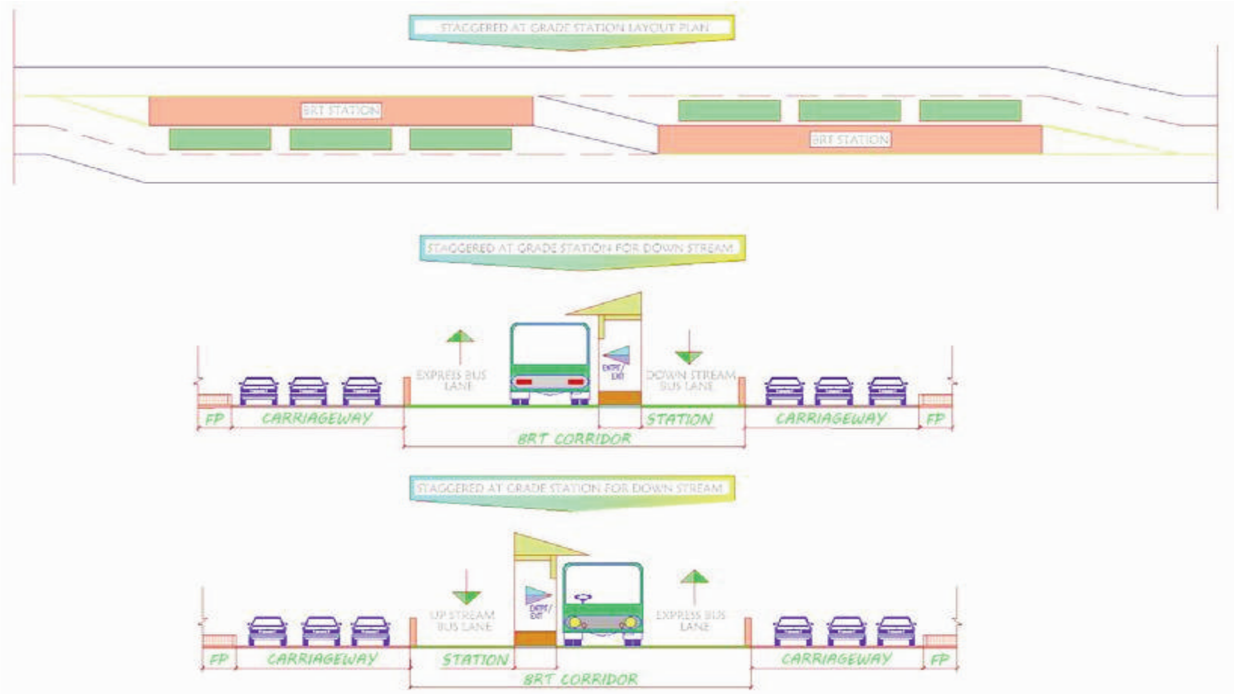
These types of stations are situated in the middle of



two BRT lanes and the station doors are on both sides i.e. both north bound and south bound vehicles can board and alight passengers from the same station. These types of stations are provided at locations where enough ground space along the right of way is available and space for lane acquisition if available can be made. Attached image 2A shows this type of Station.

two elevated BRT lanes and the station doors are on both sides i.e. both north bound and south bound vehicles can board and alight passengers from the same station. These types of stations are provided at locations where enough pavement width is not available on elevated section even for the design and construction of staggered BRT Stations. The Image 2C shows this type of Station.




**Staggered At- Grade Stations**

These are provided at those locations where the width of Carriageway does not allow construction of non-staggered at – grade stations, so in order to overcome this constraint the length of the station is increased by breaking the station width in two parts, both of the platforms serves either sides movement of roads respectively. In this manner the width of the station is reduced but the length of stations is increased. These types of stations are suitable in congested narrow roads. The Image 2B shows this type of Station.

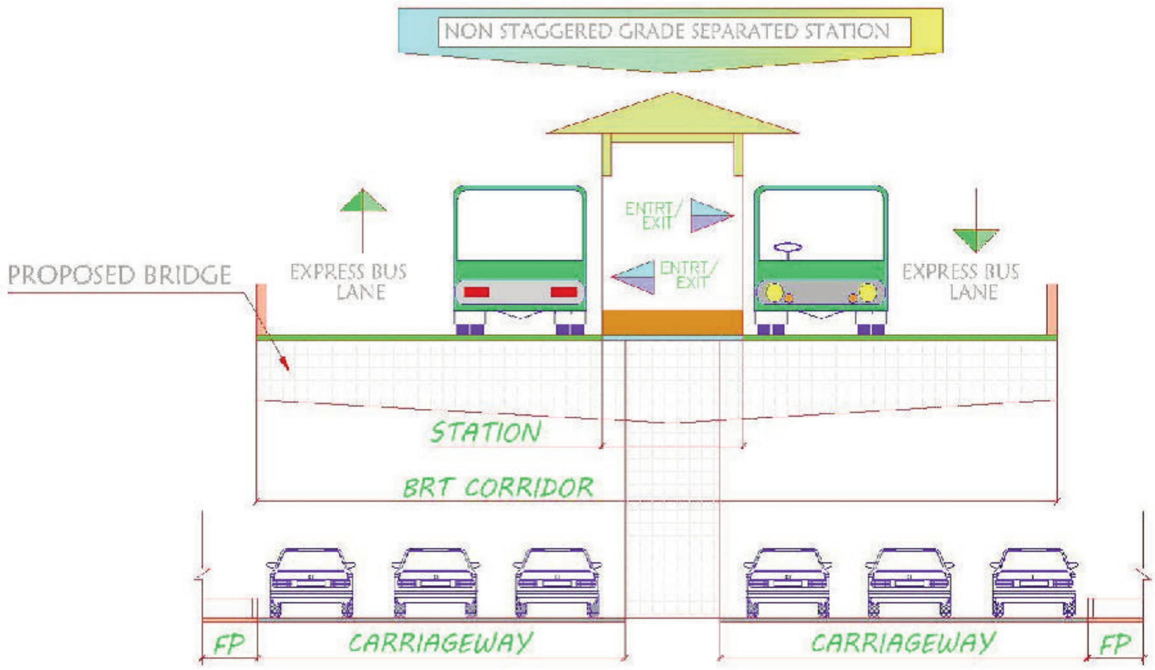
**Non Staggered Elevated Stations**

These types of stations are situated in the middle of

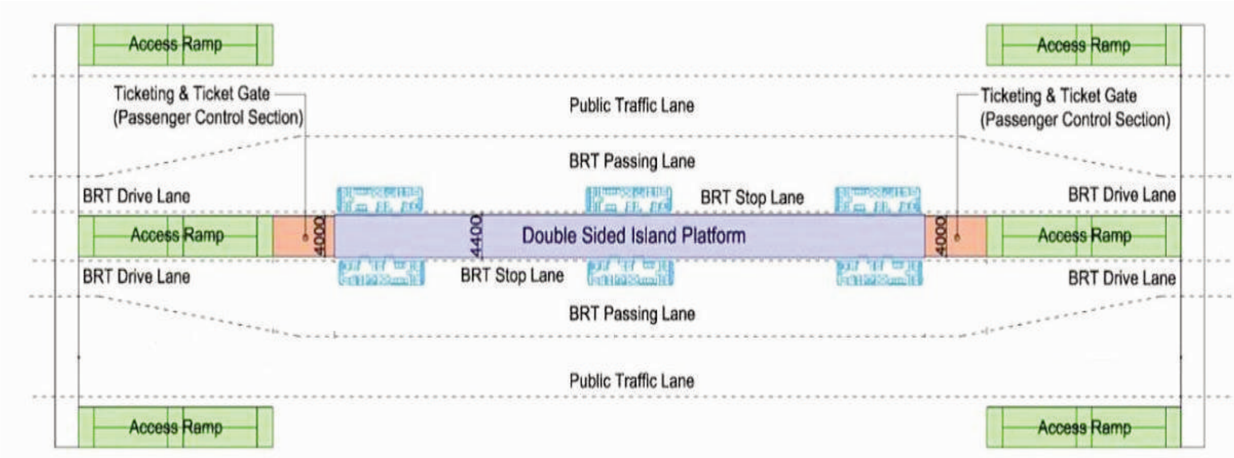
### 3.3.7.2. Access to the Station

Pedestrian access to bus stops depends upon the location. It can be controlled with the provision of at grade (zebra crossings) or grade separated crossings (under pass/foot over bridges). Bus stops located at intersections can be accessed through both, at grade zebra crossing and grade separated structures. Grade separated crossings are necessary along roads with RoW varying in between 40 M & 60 M and having high traffic volume. Grade Separated structures also provide safety for the passengers.

Since Green line BRT Corridor is a high traffic volume corridor and at most locations the RoW is varing




Between 40 m and above therefore access to the station is proposed via pedestrian bridges. This bridge will serve both purposes i.e. it will serve the pedestrians crossing the road and it will also serve the bus users who want to board in the bus or to leave the BRT Station. Following image shows the access to the



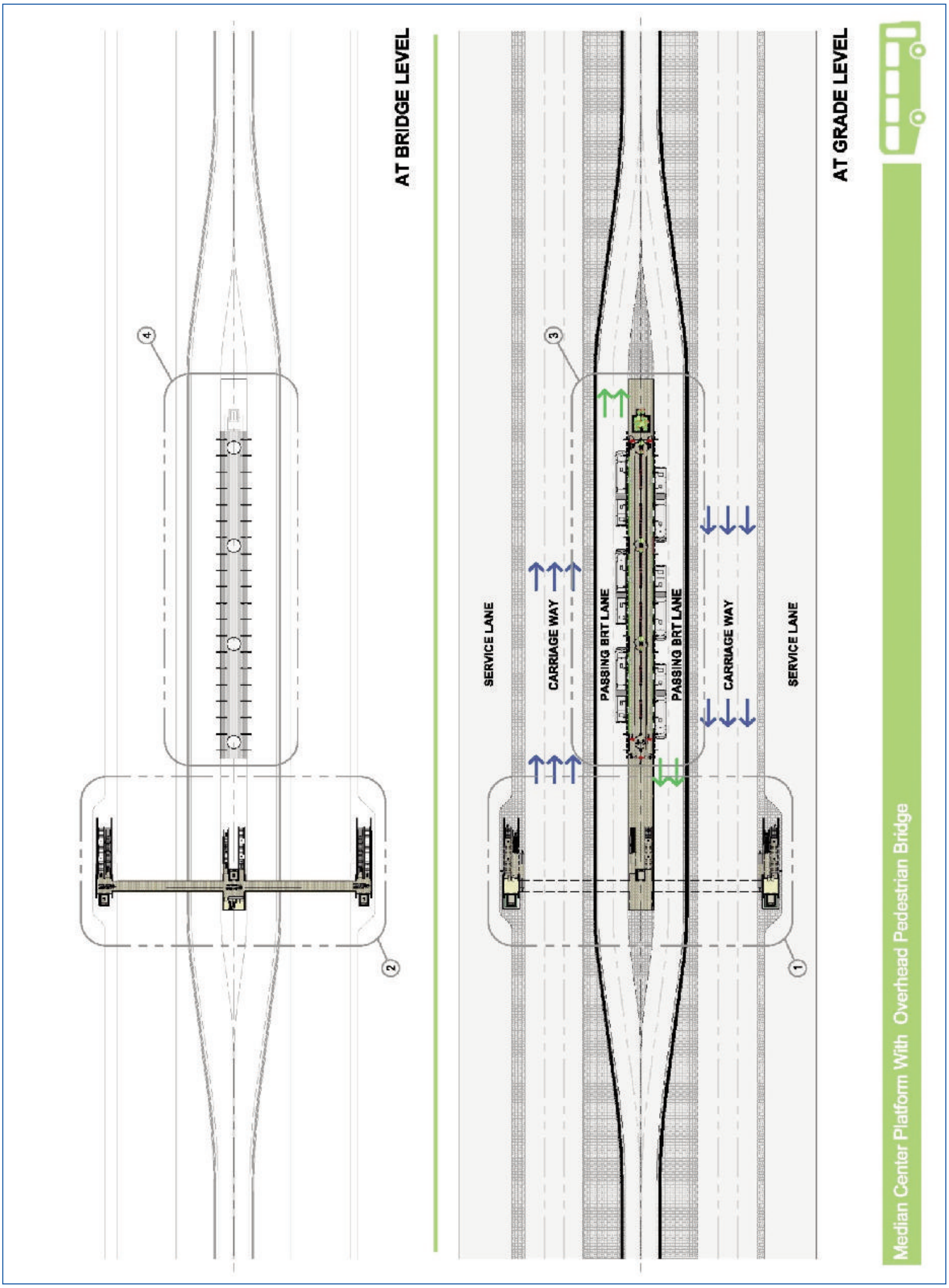

stations proposed by JICA in the KTIP Final Report Volume 2.

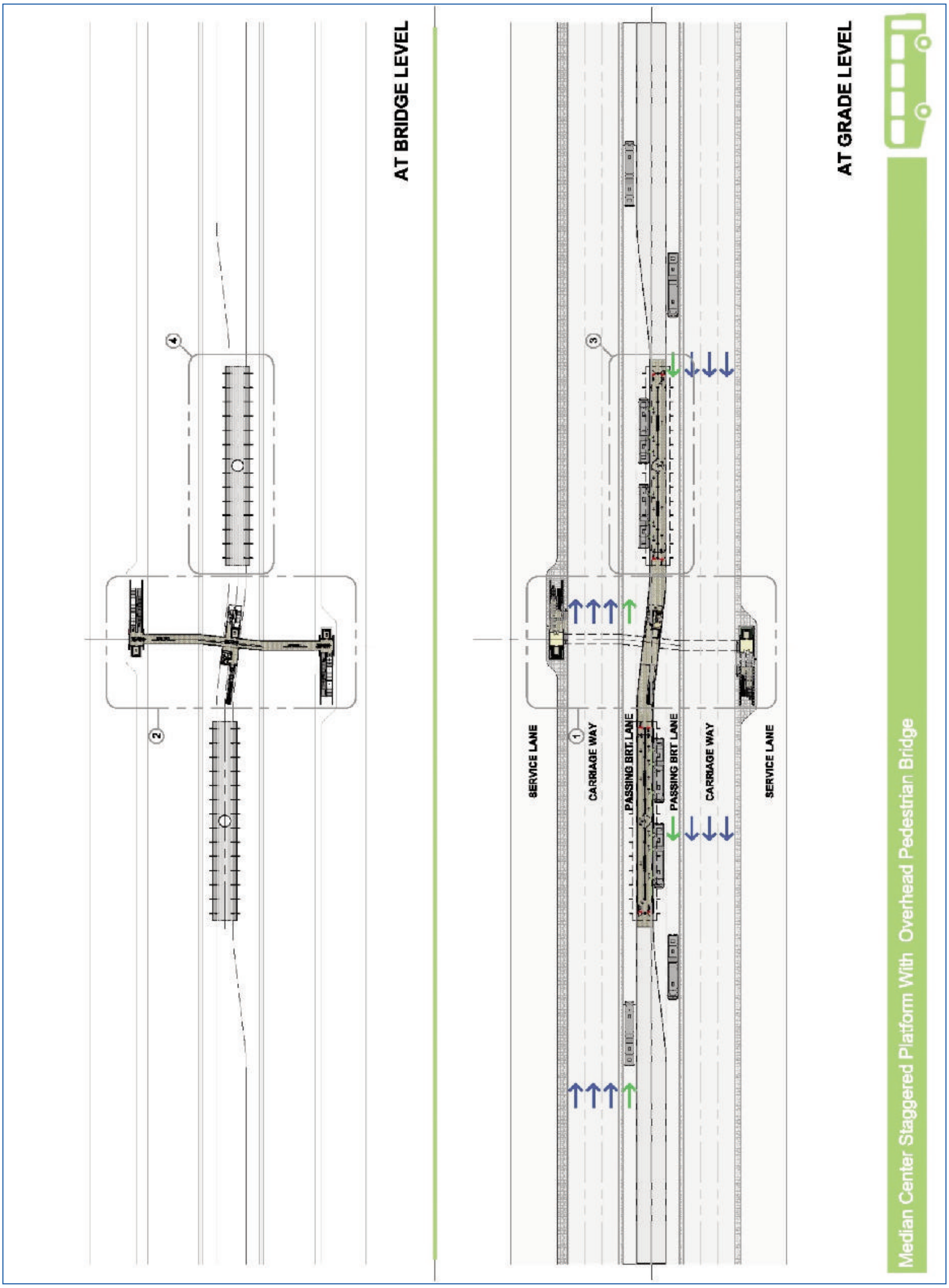
### 3.3.7.3. Green Line Station Locations and Details

Proposed stations are listed in sheet below in a tabular form, it describes station ID's, proposed treatment, for station types of stations as per the space availability and the stations that may be shared with blue line BRT.

Starting from Municipal Park to Gurumandir seven stations are proposed that are shared by both Blue Line and Green Line BRT, therefore the design and geometric decisions of these stations will be made after the availability of profile details of Blue Line BRT. The

Median Center Platform With Overhead Pedestrian Bridge - Aerial View


AT BRIDGE LEVEL
AT GRADE LEVEL
SERVICE LANE
CARRIAGE WAY
PASSING BRT LANE
PASSING BRT LANE
CARRIAGE WAY
SERVICE LANE
1
2
3
4
Median Center Platform With Overhead Pedestrian Bridge


AT BRIDGE LEVEL
AT GRADE LEVEL
SERVICE LANE
CARRIAGE WAY
PASSING BRT LANE
PASSING BRT LANE
CARRIAGE WAY
SERVICE LANE
Median Center Staggered Platform With Overhead Pedestrian Bridge

patel para is a proposed station between Guru Mander and Lasbella Chowk. This will be the first elevated station.

- Lasbela Chowk the station ID (St-03) is the first station to be treated separately after divergence from blue line, on Green Line and this station is proposed to be elevated since the BRT corridor from Gurumander to Nazimabad 1st Chowrangi is proposed to be elevated.
- Sanitary Market (St-04) is proposed to be elevated & Nazaibabad 1st Chowrangi station
- ID (St-05) is proposed to be at-grade.
- Model Park, station ID (St-06) and Nagan Chowrangi (St-15) are proposed to be at grade staggered station.
- Haddi hospital, public park (St-7B) and Board office stations ID (St-07) and (St-08) respectively shall be treated as at grade non staggered station.
- KDA Chowrangi station ID (st-09) five Star Chowrangi station ID (St-11) and Sakhi Hassan Chowrangi (St-13) are proposed to be at-grade non staggered stations. These stations are proposed to be located at the middle of intersection and access to the station from all four legs of intersection is proposed to be provided at the station for the convenience of passengers via pedestrian bridges.
- Hyderi Market (St-10), Jumma Bazar (St-12), Erum Shopping Mall (St-14), U.P More (St-16), RD 2400(St-17) and 2 minutes Chowrangi (St-20) are all proposed to be at grade non staggered stations.
- Power house Chowrangi (St-18),RD4200(St-19), Sujani Chowrangi(St-21), KDA Chowrangi (St-22) and KESC Power house(st-23) are all proposed to be at grade non staggered stations. The stations are proposed to be located just after the depressed/elevated section of BRT. This section is proposed to eliminate the conflicting movements of intersection.

### 3.3.8. Boarding and Alighting Demand

For the Purpose of estimation of Travel Demand and Boarding and Alighting on each stations following five scenarios were created by JICA in their travel demand Model.

1. Green & Red Lines on the present road network (2010)
2. Master Plan (2020) network, i.e. Green Line and Red Line + KCR in Operation
3. Master Plan Network (2020) without KCR
4. Master Plan Network (2030), i.e. Blue, Brown, Green, Red Line and KCR in Operation
5. Green & Red Lines + KCR on the 2030 road network

On the abovementioned Scenarios, travel demand and Boarding / Alighting of green line was estimated by JICA in their reports. It is therefore difficult to predict the actual demand of BRT Green line after its construction because all of the above mentioned scenarios may not fit the actual situation i.e. Construction time of Red Line and KCR is un clear, Blue Line which was modeled by JICA for 2030 scenario is in process of design in 2015. However for the purpose of detailed design of BRT Stations two scenarios (Scenario 1 & 3) are considered relevant at this stage.

As per the JICA Report following tables A and B shows the Passenger volume on the corridor the boarding and alighting summary respectively of Scenario 1 & 3.

### 3.3.9. Provision of Bays

The number of bays to be provided at a bus stop

| Sr. No. | Station Name | Station ID | Type of Station | Treatment for station |
|---|---|---|---|---|
| 1 | Muncipal Park | M1 | Decision Regarding these station shall be finalized after availability of profile detail of Blue Line | |
| 2 | Radio Pakistan Station | M2 | | |
| 3 | Garden Square Station | M3 | | |
| 4 | Taj Medical Complex Station | M4 | | |
| 5 | KGA Ground Station | M5 | | |
| 6 | West of Mazaar-e-Quaid Station | St-01 | Elevated | Non Staggered |
| 7 | Gurumandar Station | St-02 | Elevated | Non Staggered |
| 8 | B/W Gurumander and Lasbela | Proposed | Elevated | Non Staggered |
| 9 | Lasbela Chowk | St-03 | Elevated | Non Staggered |
| 10 | Sanitary Market | St-04 | Elevated | Non Staggered |
| 11 | Nazimabad 1st Chowrangi | St-05 | At-Grade | Non Staggered |
| 12 | Model Park | St-06 | At-Grade | Staggered |
| 13 | Haddi Hospital | St-07 | At-Grade | Non Staggered |
| 14 | Public Park | St-7B | At-Grade | Non Staggered |
| 15 | Board Office Chowrangi | St-08 | At-Grade | Non Staggered |
| 16 | KDA Chowrangi | St-09 | At-Grade | Non Staggered |
| 17 | Hyderi Market | St-10 | At-Grade | Non Staggered |
| 18 | 5 Star Chowrangi | St-11 | At-Grade | Non Staggered |
| 19 | Jumma Bazar | St-12 | At-Grade | Non Staggered |
| 20 | Sakhi Hassan Chowrangi | St-13 | At-Grade | Non Staggered |
| 21 | Erum Shopping Mall | St-14 | At-Grade | Non Staggered |
| 22 | Nagan Chowrangi | St-15 | At-Grade | Staggered |
| 23 | U.P Morr | St-16 | At-Grade | Staggered |
| 24 | RD 2400 | St-17 | At-Grade | Staggered |
| 25 | Power House Chowrangi | St-18 | At-Grade | Staggered |
| 26 | RD 4200 | St-19 | At-Grade | Staggered |
| 27 | 2 Minute Chowrangi | St-20 | At-Grade | Staggered |
| 28 | Surjani Chowrangi | St-21 | At-Grade | Staggered |
| 29 | KDA Chowrangi Surjani | St-22 | At-Grade | Staggered |
| 30 | KESC power house | St-23 | At-Grade | Staggered |

**Table 3.1: Green Line Passenger Volume Summary**

| Section | | | Daily Passenger Volume (Both Directions) | | (Scenario 1)Peak Hour Passenger Volume Per Direction (Scenario 3) | |
|---|---|---|---|---|---|---|
| | | | 2010 | 2020 | 2010 | 2020 |
| M1 | - | M2 | 27,331 | 111,176 | 1,025 | 4,169 |
| M2 | - | M3 | 50,652 | 159,635 | 1,899 | 5,986 |
| M3 | - | M4 | 60,626 | 213,086 | 2,273 | 7,991 |
| M4 | - | M5 | 64,356 | 219,097 | 2,413 | 8,216 |
| M5 | - | G01 | 64,356 | 219,097 | 2,413 | 8,216 |
| G01 | - | G02 | 99,988 | 329,634 | 3,750 | 12,361 |
| G02 | - | G03 | 92,630 | 329,187 | 3,474 | 12,345 |

**Table 3.1: Green Line Passenger Volume Summary**

| Section | | | Daily Passenger Volume (Both Directions) | | (Scenario 1)Peak Hour Passenger Volume Per Direction (Scenario 3) | |
|---|---|---|---|---|---|---|
| | | | 2010 | 2020 | 2010 | 2020 |
| G03 | - | G04 | 105,650 | 328,967 | 3,962 | 12,336 |
| G04 | - | G05 | 107,604 | 332,130 | 4,035 | 12,455 |
| G05 | - | G06 | 111,780 | 331,825 | 4,192 | 12,443 |
| G06 | - | G07 | 116,056 | 329,879 | 4,352 | 12,370 |
| G07 | - | G08 | 113,491 | 331,569 | 4,256 | 12,434 |
| G08 | - | G09 | 118,656 | 269,543 | 4,450 | 10,108 |
| G09 | - | G10 | 119,608 | 262,673 | 4,485 | 9,850 |
| G10 | - | G11 | 117,519 | 255,031 | 4,407 | 9,564 |
| G11 | - | G12 | 112,723 | 250,234 | 4,227 | 9,384 |
| G12 | - | G13 | 112,371 | 246,776 | 4,214 | 9,254 |
| G13 | - | G14 | 98,061 | 234,292 | 3,677 | 8,786 |
| G14 | - | G15 | 96,659 | 233,175 | 3,625 | 8,744 |
| G15 | - | G16 | 92,053 | 221,088 | 3,452 | 8,291 |
| G16 | - | G17 | 89,519 | 212,219 | 3,357 | 7,958 |
| G17 | - | G18 | 79,153 | 193,416 | 2,968 | 7,253 |
| G18 | - | G19 | 64,177 | 180,420 | 2,407 | 6,766 |
| G19 | - | G20 | 43,622 | 163,954 | 1,636 | 6,148 |
| G20 | - | G21 | 24,514 | 130,044 | 919 | 4,877 |
| G21 | - | G22 | 15,966 | 116,540 | 599 | 4,370 |

**Table 3.2: Green Line Boarding and Alight Summary**

| Station | Daily Passenger volume Boarding Only | | Peak Hours Boarding and Alight | |
|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 |
| M1 | 19,518 | 36,436 | 2,928 | 5,465 |
| M2 | 17,288 | 24,232 | 2,593 | 3,635 |
| M3 | 11,225 | 26,731 | 1,684 | 4,010 |
| M4 | 4,781 | 3,030 | 717 | 455 |
| G01 | 10,212 | 10,778 | 1,532 | 1,617 |
| G02 | 15,400 | 7,850 | 2,310 | 1,177 |
| G03 | 33,583 | 15,069 | 5,037 | 2,260 |
| G04 | 14,861 | 26,770 | 2,229 | 4,016 |
| G05 | 18,129 | 10,108 | 2,719 | 1,516 |
| G06 | 19,185 | 9,318 | 2,878 | 1,398 |
| G07 | 13,369 | 6,133 | 2,005 | 920 |
| G08 | 17,284 | 35,071 | 2,593 | 5,261 |
| G09 | 24,927 | 4,910 | 3,739 | 736 |
| G10 | 9,850 | 5,117 | 1,478 | 767 |
| G11 | 13,940 | 3,551 | 2,091 | 533 |
| G12 | 7,967 | 2,911 | 1,195 | 437 |
| G13 | 15,879 | 7,710 | 2,382 | 1,157 |
| G14 | 9,354 | 5,550 | 1,403 | 832 |

**Table 3.2: Green Line Boarding and Alight Summary**

| Station | Daily Passenger volume Boarding Only | | Peak Hours Boarding and Alight | |
|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 |
| G15 | 14,374 | 7,159 | 2,156 | 1,074 |
| G16 | 11,802 | 5,029 | 1,770 | 754 |
| G17 | 12,275 | 11,047 | 1,841 | 1,657 |
| G18 | 16,610 | 7,068 | 2,491 | 1,060 |
| G19 | 25,273 | 9,231 | 3,791 | 1,385 |
| G20 | 21,126 | 18,651 | 3,169 | 2,798 |
| G21 | 10,630 | 7,646 | 1,594 | 1,147 |
| G22 | 15,870 | 58,270 | | |

depends upon factors such as volume of passenger traffic, vehicle capacity or length of buses and frequency of buses approaching the stop etc. As per the ITDP BRT Planning Guide Corridor capacity can be calculated using the following formula:

***Corridor Capacity (PPHPD) = Vehicle Capacity (Pas/veh) x Load Factor x Service Frequency x Number of Stopping Bays***

Where,

- Vehicle Capacity is the max passenger carrying capacity of vehicle
- Load Factor is the Percentage of vehicle capacity that is normally occupied
- Service frequency is the total number of vehicles per hour

The corridor capacity has already been estimated using macro modelling exercise as performed by JICA and Boarding Alighting values at every station are available therefore, number of stopping bay can be calculated by following formula:

***Number of Stopping Bays = Corridor Capacity (PPHPD) / {Vehicle Capacity (Pas/veh) x Load Factor***

**Table 3.3: Green Line Boarding and Alight Summary**

| Station | Peak Hour Boarding and Alighting | | No. of Bus bays for Articulated Bus | | No. of Bus bays for Large Bus | |
|---|---|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 | 2010 | 2020 |
| M1 | 2928 | 5465 | 2 | 2 | 3 | 5 |
| M2 | 2593 | 3635 | 1 | 2 | 3 | 3 |
| M3 | 1684 | 4010 | 1 | 2 | 2 | 4 |
| M4 | 717 | 455 | 1 | 1 | 1 | 1 |
| G01 | 1532 | 1617 | 1 | 1 | 2 | 2 |
| G02 | 2310 | 1177 | 1 | 1 | 2 | 1 |
| G03 | 5037 | 2260 | 2 | 1 | 4 | 2 |
| G04 | 2229 | 4016 | 1 | 2 | 2 | 4 |
| G05 | 2719 | 1516 | 1 | 1 | 3 | 2 |
| G06 | 2878 | 1398 | 1 | 1 | 3 | 2 |
| G07 | 2005 | 920 | 1 | 1 | 2 | 1 |
| G08 | 2593 | 5261 | 1 | 2 | 3 | 5 |
| G09 | 3739 | 736 | 2 | 1 | 3 | 1 |
| G10 | 1478 | 767 | 1 | 1 | 2 | 1 |
| G11 | 2091 | 533 | 1 | 1 | 21 | 1 |

**Table 3.3: Green Line Boarding and Alight Summary**

| Station | Peak Hour Boarding and Alighting | | No. of Bus bays for Articulated Bus | | No. of Bus bays for Large Bus | |
|---|---|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 | 2010 | 2020 |
| G12 | 1195 | 437 | 1 | 1 | 2 | 1 |
| G13 | 2382 | 1157 | 1 | 1 | 2 | 1 |
| G14 | 1403 | 832 | 1 | 1 | 2 | 1 |
| G15 | 2156 | 1074 | 1 | 1 | 2 | 1 |
| G16 | 1770 | 754 | 1 | 1 | 2 | 1 |
| G17 | 1841 | 1657 | 1 | 1 | 2 | 2 |
| G18 | 2491 | 1060 | 1 | 1 | 2 | 1 |
| G19 | 3791 | 1385 | 2 | 1 | 2 | 2 |
| G20 | 3169 | 2798 | 2 | 1 | 2 | 3 |
| G21 | 1594 | 1147 | 1 | 1 | 2 | 1 |

***x Service Frequency}***

Using this formula, Number of Bus Bays for Articulated and Normal Large Bus were calculated. In this regard the capacity of articulated bus is assumed to be 170 passengers and capacity of Normal Large Bus is assumed to be 75 passengers. Following are the results.

Another way of calculation of Bus bays mentioned in ITDP BRT Planning Guide is by measuring level of saturation at every station. If saturation is over 0.4 or 40% a second bay are likely to be required. This saturation level can be calculated using following formula:

X = {(TD * F) + (Pb * Tb) + (Pa * Ta)} / 3600

Where,

- X = Saturation Factor

**Table 3.4: Green Line Boarding and Alight Summary**

| Station | Daily Passenger volume Boarding Only | | Saturation Level withOne Bus Bay | |
|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 |
| M1 | 2928 | 5465 | 34% | 56% |
| M2 | 2593 | 3635 | 32% | 40% |
| M3 | 1684 | 4010 | 24% | 43% |
| M4 | 717 | 455 | 16% | 14% |
| G01 | 1532 | 1617 | 23% | 23% |
| G02 | 2310 | 1177 | 29% | 20% |
| G03 | 5037 | 2260 | 52% | 29% |
| G04 | 2229 | 4016 | 29% | 43% |
| G05 | 2719 | 1516 | 33% | 23% |
| G06 | 2878 | 1398 | 34% | 22% |
| G07 | 2005 | 920 | 27% | 18% |
| G08 | 2593 | 5261 | 32% | 54% |
| G09 | 3739 | 736 | 41% | 16% |
| G10 | 1478 | 767 | 22% | 16% |
| G11 | 2091 | 533 | 27% | 14% |
| G12 | 1195 | 437 | 20% | 14% |
| G15 | 2156 | 1074 | 28% | 19% |

**Table 3.4: Green Line Boarding and Alight Summary**

| Station | Daily Passenger volume Boarding Only | | Saturation Level withOne Bus Bay | |
|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 |
| G16 | 1770 | 754 | 25% | 16% |
| G17 | 1841 | 1657 | 25% | 24% |
| G18 | 2491 | 1060 | 31% | 19% |
| G19 | 3791 | 1385 | 42% | 22% |
| G20 | 3169 | 2798 | 36% | 33% |
| G21 | 1594 | 1147 | 23% | 20% |

*Green Cells shown in the abovementioned table shows the need of provision of second bay. This calculation was made for articulated buses on BRT Corridor.

- TD = Dwell Time
- F = Frequency of vehicle (per Hour)
- Pb = Passenger Boarding
- Tb = Boarding time
- Pa = Passenger Alighting
- Ta = Alighting time

Following are the results:

It is recommended that the provision of Bus Bays may initially be made with +1 Bay. However, all stations may be provided with surplus capacity for Bus Bays. When and if a situation warrants an additional Bay could be built to supplement the additional ridership.

### 3.3.10.Turn Details

BRT Encounters fifteen existing U – Turns along the entire alignment. There are many treatments that have been studied for each conflicting movement however after thorough studies following treatments as shown in the table below have been proposed for the said U-turns and for the BRT corridor encountering U-Turns.

| U-Turn ID | U-Turn Location | Proposed Treatment | Geometry |
|---|---|---|---|
| 1 | b/w Board Office and KDA Chowrangi | Shift Under the proposed Flyover of KDA Chowrangi | Two way traffic movement |
| 2 | b/w KDA Chowrangi to Five Star | Shift under propose flyover of KDA Chowranig | Two way traffic movement |
| 3 | b/w KDA Chowrangi to Five Star | Shift under proposed flyover | Two way traffic movement |
| 4 | b/w Five Star and Sakhi Hassan | Shift under proposed flyover at five star | Two way traffic movement |
| 5 | b/w Five Star and Sakhi Hassan | Shift under sakhi Hassan flyover | Two way traffic movement |
| 6 | Sakhi Hassan chowrangi to Nagan Chowrangi | Shift under sakhi Hassan flyover | Two way traffic movement |
| 7 | Sakhi Hassan chowrangi & Nagan Chowrani | Mange by signalized operation | Two way traffic movement |
| 8 | b/w Nagan Chowrangi and U.P Morr | Depressed section proposed f r BRT | Two way traffic movement |
| 9 | b/w U.P Morr and 2400 | Shift over proposed underpass at power house | Two way traffic movement |
| 10 | b/w RD 2400 and Powerhouse Chorwangi | Shift over proposed underpass at power house | Two way traffic movement |
| 11 | b/w Powerhouse Chowrangi & RD 4200 | Shift under proposed overpass at Surjani | Two way traffic movement |
| 12 | b/w 2 minutes Chowrangi to Surjani | Shift under proposed overpass at Surjani | Two way traffic movement |
| 13 | b/w KDA Chowrangi to KESC Power House | Depressed section proposed for BRT | Two way traffic movement |
| 14 | b/w KDA Chowrangi Surjani to KESC Power House | Eliminate | Two way traffic movement |
| 15 | b/w KDA Chowrangi surjani to KESC Power House | Shift after BRT Terminal (BRT U-Turn) | Two way traffic movement |

It has been principally agreed that there must be no significant hindrance due to conflicting movement which can disturb the BRT Bus options.

## 3.4. Intelligent Transport System (ITS) for BRT Green Line

The term Intelligent Transport System (ITS) refers to a seamless integration of information, communication and control technologies that is required to implement an effective and successful Public Transport System. The key stakeholders of this project are the public transport operators, vehicle manufacturers, drivers, passengers, traffic controllers and emergency service providers working in an interactive environment over a complex backbone infrastructure.

The basic components of the ITS are:

- Traffic management system
- Automated vehicle tracking system (including incident and emergency management)
- Electronic fare collection system
- Real time passenger information system
- Operation control / Command Control System

An Intelligent Transport System for the Green Line will facilitate and optimize performance and utilization of the BRT system. The ITS will provide on-line monitoring and control of operations, scheduling, revenue generation, surveillance and security. Additionally, Information generated will be useful for medium and long term planning, employee training and maintenance purposes.

By building in software-enabled features, an unprecedented level of sophistication and capabilities will be available at affordable cost for the Intelligent Transport System of Karachi's first BRT.

The ITS will utilize the most cost effective and currently available technologies and will be responsive to the needs of the public ridership. Hardware components used will be robust and be able to withstand harsh public treatment and environmental conditions including temperatures, impacts and humidity levels.

The comprehensive ITS system is an integration of various products and services that make possible features of the BRT; these are further elaborated in this report. Envisaged Scope of Work during Design and Implementation phases

This comprises of providing:

- System design of ITS Data network
- Functional design and specifications of all ICT related services including:
- Ticketing system
- Bus Terminal on line data services
- Vehicle tracking and signal controls
- Passenger Information
- Command & Control Centres
- Travel Demand Management
- Incident & Emergency Management
- Surveillance Monitoring
- Fleet Maintenance
- Functional design and specifications of ICT hardware
- Functional design and specifications of required customized software modules
- Design of Command and Control room features
- Define ITS related civil infra-structure and mounting requirements
- Specifications for Data Network media

- Specifications for Data Network components
- Requirements for Data Center
- Specify ICT Integration and testing procedures
- Interaction with Infra structure team
- Interaction with Traffic Police Departments
- Interaction with Revenue Collection team
- Interaction with Client representatives
- Interaction with bus manufacturer
- Assist in selection of procurement and sub vendor evaluation process
- Supervise implementation phase of ICT integration

## 3.4.1. Architectural Considerations for Design of ITS services

The ITS infrastructure shall conform to existing standards for ICT (Information Computer Technology) including Data networks and peripherals. The software architecture would permit scalability and integration with other local BRT networks and communication protocols that are to be inducted in Karachi.

DCC's design strategy and system architecture permits a holistic approach and is based upon the following considerations:

- Selection and placement of a variety of automated sensors for voice, images and data along the transit route and on buses
- Interface of above mentioned sensors to the high bandwidth data network through appropriate network components
- Utilize maximum localized distributed processing (on board buses, traffic signals, bus
- stations) using intelligent controllers
- Reliance on software to produce meaningful analyses and outputs that would serve interests of BRT ridership and management.
- Primary and secondary Command & Control Centers that display on-line current status of all data nodes representing terminals, buses, traffic signals and CCTV images along the transit way.
- Ensure redundancy, integrity and security of network data

## 3.4.2. Proposed Features of ITS

### 3.4.2.1. Communication Data Network

The communication media or data highway shall be a combination of laid optical fiber, copper and wireless. The suggested wireless technology will be a mix of Wi-Fi and 3G/4G/LTE. At the depot and terminals, Wi-Fi will be the primary mode of communication whereas mobile cellular network operator services can provide a cost effective way for the wireless communication link without requiring investment for private wireless infrastructure.

A comprehensive Data load analysis will be initiated for the purpose of detailed network design.

### 3.4.2.2. On Board Intelligent Black Box – OBIB

This will be the primary link of each bus with the Intelligent Transport System. This acquires and processes signals related to bus engine states, fuel and rpm gages, passenger counts, proximity sensors, driver interactions, passenger information displays, GPS signals and voice communication. The On board device can be used for communicating over the data highway with the external nodes including Traffic Signal controllers, CCTV cameras and with the Command & Control Centers. The on board controller is capable of exchanging video, voice and data.

### 3.4.2.3. Automatic Vehicle Monitoring (AVM)

The GPS coordinates of each bus will be available within the network for Vehicle Location.

Other vehicle centric data gathered by the on board black box shall be available for various and Bus Maintenance.

### 3.4.2.4. Central Control & Monitoring Center

A Central Command and Control Center will be established with large screen monitors to oversee the current situation of fleet. In case of errors in destination arrival timings, correction speed messages would be auto-generated by the system and dispatched to the affected drivers. The Control Center will send automated messages to the adjacent bus drivers to speed up or slow down to maintain the controlled interval between bus arrivals. A log of bus motion dynamics will also enable examination of the driving habits of drivers.

Current status of buses, terminal stations, and CCTV images along the corridor may be selectively displayed at the Command & Control Center which will have several display and analyses features that are software based. These may be replicated at multiple secondary Command & Control Centers with different display sizes e.g. video walls, large and medium sized LCD displays.

### 3.4.2.5. Simulation model

The simulation model will simulate the intelligent transport system and will provide the ITS operators with a useful tool for simulating vehicle traffic load patterns, passenger load analyses and training tools for better traffic management, emergency handling conditions e.g. road accidents, road blocks and alternate traffic plans.

### 3.4.2.6. Collision Avoidance System

A semi-automated collision detection system would produce alerts for path obstruction from the front and sides. These alerts and alarms are provided to the bus driver and simultaneously relayed to the System Control room. Combination of video image display for the driver, coupled with status of traffic signals will provide rear and front distant views guidance to driver for access to bus way.

### 3.4.2.7. Traffic Signal Integration

Right of way at road intersections will be based on pre-negotiated priorities. This requires harmonization of signaling protocols among traffic signal controllers. Requests for right of ways may be generated by the On- board Intelligent Black Box on buses.

### 3.4.2.8. Handling of 2-Lane to single Lane Intersections

Some parts of the corridor may have a combination of 2-lane and single lane access. A suitable automated signaling system will assist in guiding the driver. Signal violation will be suitably communicated to bus driver with audio alarms and may also disconnect the bus engine through the OBIB.

### 3.4.2.9. Driver Performance Monitoring

The system will generate complete on-line reports of the Driver including his attendance, schedules, driving violations e.g. accidents, breaking traffic rules. Biometric identification of driver and attendant/ conductor (if any) will ensure that only authorized personnel will operate the buses.

### 3.4.2.10. Energy Auditing and provision of renewable energy sources

An on-line energy metering system for terminals and depots would be deployed. This conveys energy consumption analysis and current status of electricity availability. The analysis would be useful for implementing energy conservation policies for the BRT Transit System. Critical nodes which require auxiliary power supply may have redundant sources e.g. Communication equipment may have PV solar source with battery backup.

### 3.4.2.11. Electronic Fare Collection

The fare collection mechanism will be evaluated on the basis of local socio-economic realities as well as compatibility with other proposed BRT lines for Karachi. Transactions records generated by the Automatic Fare Collection system AFCS will be connected to the Data highway and be accessible for summary analyses and reports at designated Business Centers. Public convenience and integrity of fare collection and ticketing is a crucial aspect of the BRT revenue generation. Ticketing system shall be based on both pre-paid electronic coupons for regular passengers as well as pay as-you-board (if desired).

The AFCS design will allow remote purchase of ticketsas well as at bus terminals and onboard manual points. It will accommodate payments through various methods including cash payments, tokens and smart cards. The System design considerations will require interaction with other partnering teams including the Infrastructure designers, client and Operators. Selection of ticketing booths, turnstiles, and access control methods are essential components of the overall design. A holistic approach to revenue collection is mandatory.

### 3.4.2.12. Inventory Management & Tracking

The system will keep track of condition of fixed assets and consumables. It would also monitor rolling stock. Auditing of current status of primary components shall be possible. The data bases will also include pictorial representation of assets.

### 3.4.2.13. Automated Passenger Counts – APCs

Electronic sensors mounted at turn styles and /or near bus doors, will provide passenger head counts for every bus. Data from the APCs will help create passenger load profiles for planning trip frequencies and schedules during different times of days/week for more efficient operation.

### 3.4.2.14. Passenger Information Systems

The networked electronic displays will exhibit the arrival times of the next bus at the stations. There will also be voice based automated announcements as well as electronic displays inside the bus. A website will be developed which will allow users to plan their visits. It will inform about the stations, the frequency of buses at different times of day and the connecting routes of other buses available at each station for the visitor to plan its itinerary.

Third party applications for smart phones for Travel related information including schedules, route planning, fares and announcements will assist in providing a level of public comfort and accessibility for the BRT network.

### 3.4.2.15. Safety, Security and Surveillance System

Each bus will be equipped with surveillance cameras that upon demand will provide the view to the central control room. CCTV cameras will also be installed at every station to monitor activities at vantage points along the transit ways, terminal stops and depots. All of these cameras will be networked to the central operations room and to the Security monitoring desk. An emergency call mechanism will also be provided to the driver and support personnel onboard each bus to generate alarms at the nearest Disaster Assistance Center

### 3.4.2.16. Voice Communication Public Address System

The PA system shall be at each bus stop terminal. An automated computer generated announcement within the bus and /or terminal station shall be synchronized with approach to each location.

### 3.4.2.17. Advertising Bill boards

To enhance revenue collection, the buses will display electronic advertisements at Bus Stops, within the buses and externally on the sides. Special messages and time of arrival of next bus will be displayed at dynamic electronic billboards that are mounted at convenient locations.

### 3.4.2.18. Revenue Accounting

Data from ticketing centers will assist in tabulating revenue collection and correlating the same with ridership counts. The integrated on-line system will enable current and reliable data from all nodes within the network. Data integrity during transmission and storage will be ensured.

### 3.4.2.19. Complaint Management

The Complaint Center will house a telephone line Help Call- Desk. This software-based system will have on-line access to updated status of buses schedules as

| | | | | |
|---|---|---|---|---|
| 2-K | F-16 | G-25 | W-1 | 401-GUL |
| 4 | X-3 | G-27 | U-8 | Khan |
| 4-J | F-18 | W-23 | W-22 | Niaz |
| 1-D | W-11 | C-17 | X-10 | National |
| 4-L | C-25 | P-3 | U | Shiraz |
| 2-D | F-21 | W-55 | G-11 | Shama |
| 4-X | G-17 | W-25 | G-3 | UTS-1 |
| 5-C | W-18 | W-19 | U11 | Masood |
| 6 | Z-A | W-21 | Umer-Coach | |
| 8 | G-13 | W-30 | 201-CITY | |

*Source: JICA Study Team based Public Transport Survey in 2010*

well as latest conditions of the transit way for operators of the Help Desk. Routine text and audio messages will be auto generated and transmitted in response to SMS queries.

### 3.4.2.20. Voice Communication Public

### Address System

The PA system shall be at each bus stop terminal. An automated computer generated announcement within the bus and /or terminal station shall be synchronized with approach to each location.

### 3.4.2.21. Advertising Bill boards

To enhance revenue collection, the buses will display electronic advertisements at Bus Stops, within the buses and externally on the sides. Special messages and time of arrival of next bus will be displayed at dynamic electronic billboards that are mounted at convenient locations.

### 3.4.2.22. Revenue Accounting

Data from ticketing centers will assist in tabulating revenue collection and correlating the same with ridership counts. The integrated on-line system will enable current and reliable data from all nodes within the network. Data integrity during transmission and storage will be ensured.

### 3.4.2.23. Complaint Management

The Complaint Center will house a telephone line Help Call- Desk. This software-based system will have on-line access to updated status of buses schedules as well as latest conditions of the transit way for operators of the Help Desk. Routine text and audio messages will be auto generated and transmitted in response to SMS queries. Project area, reconnaissance survey was carried out by team of experts.

## 3.4.3. Reorganization of Present Bus Network

There are 49 routes which compete with Green Line, in which 18 routes should be discontinued because of these routes overlap Green Line for a long distance. Feeder routes should be provided for the 18 routes outside Green Line route. Table 3.8 is the list of bus routes which compete with Green Line. The route number with silver color is the proposed routes which should be discontinued for Green Line operation.

## 3.5. Drainage and Hydraulics

### 3.5.1. Introduction

This drainage and storm water management section documents the preliminary hydrologic and hydraulic analysis undertaken, addresses the existing drainage characteristics, identifies issues related to drainage and storm water management conditions and proposes a feasible storm water drainage system for the preferred alternative of the proposed route alignment.

### 3.5.2. Objective

The objective of this Drainage system includes:

i. Providing a comprehensive description and mapping of the storm drainage system including lined and unlined drains, bridges and culverts.

ii. Base Map to show locations of storm water drains and facilities, including their size, materials and flow directions.

iii. Analyzing rainfall data collected, including development of IDF curves for different storm frequency periods.

iv. Evaluating deficiencies in the existing storm drainage maintenance program including recommendations for improvement of existing drainage infrastructure to meet requirements.

### 3.5.3. Scope

The Scope of Work for the Drainage system includes the following tasks:

i. Collection and review of existing information as available from the departments.

ii. Detailed topographic survey for drain/branches. The survey shall also pin-point the spots, which are at present acting as bottlenecks and causing obstructions to storm water.

iii. Field investigations to verify existing storm water drainage system, typical cross-sections of storm water drains and culverts.

iv. Rainfall data collection obtained from Meteorological department.

v. Rainfall data shall be analyzed using IDF probability curves.

vi. Hydraulics shall be checked for different return periods:

vii. (Identification of areas/zones where storm drainage system is cross-connected with the sewerage system.

### 3.5.4. Field Reconnaissance

Unlined Drains at Start Point

Unlined Drains at Abdullah Chowrangi


Choking of culverts at start point


Choking of culverts at start point

Field investigations of the existing drainage features including storm drains, catch basins and ditch inlets were conducted by the study team to observe the condition of the existing drainage systems and confirm the background information. Field investigation photographs of the project area are presented below:

## 3.5.5. Collection of Data

The Design team collected basic information about the project area from nodal agencies/department such as historical rainfall, existing drainage system, studied the route alignment, culverts, bridges, Nullahs, depressions, flood prone areas, roads cutting, disposal point and other important factors and features which may affect the design. The major observations made by the team are summarized hereunder:

### 3.5.5.1. Assessment of Existing Drainage Conditions

In absence of the sewerage system in most part of the region, the drains act as carrier of wastewater. Furthermore, there is no proper solid waste management in the nearby vicinity, therefore the major part of the drains are blocked by solid waste.

The existing storm water drainage system is divided into following sections are as under:

1. Zero Chainage to Kareemi Chowrangi (Unlined drain on one side of the road)
2. Kareemi Chowrangi to Surjani Chowrangi (Unlined drain on both sides of the road)
3. Surjani Chowrangi to Sakhi Hassan (Lined Drain

Sewers connecting with existing drains


Sewers connecting with existing drains

Solid waste deposition in unlined drains on both sides)

Choked Lined Drains at Powerhouse

4. Sakhi Hassan towards KDA Chowrangi. (Surface flow)
5. Board office towards KDA Chowrangi. (Surface flow)
6. Board office to Nazimabad underpass. (Surface flow)
7. Inquiry stops towards Nazimabad underpass. (Surface flow)
8. Inquiry stops towards Nazimabad 01 No Chowrangi. (Surface flow)
9. Nazimabad 01 No Chowrangi to Lasbela Bridge/Lyari River. (Surface flow)
10. Lasbela Bridge/Lyari River to Gurumandir. (Surface flow)

Most part of the drains disposes of into the Gujar Nullah and ultimately to Lyari River

### 3.5.5.2. Flood Prone Areas

The information about the ponding area was gathered and following areas identified. The area was physically inspected and problems were discussed with local residents. The details of the problematic areas are as follows:

### 3.5.5.3. KDA Chowrangi

This is the area in the basin of Sakhi Hassan to KDA Chowrangi and in this area the storm water disposes

Perforated Drain at KDA

Openings for surface flow at KDA

of into the perforated drain located at KDA Chowrangi.

#### 3.5.5.4. Nazimabad Underpass:

This is the region in the basin of Board office and Inquiry office towards Nazimabad underpass.

#### 3.5.5.5. Sanitary Market at Golimar

Because of unavailability of proper drainage system the storm water is impounded in this area for approximately 2 days.

### 3.5.6. Conclusions and Recommendations

The essential components of the project include resizing/augmentation of the existing drains based on the hydrologic and hydraulic calculations, proposal of new drains in areas having no existing drainage facilities, and elimination of cross-connections.

Recommendations for Storm Drainage Improvement Authorities concerned include:

i. Provision of new drains

ii. Elimination of cross sewer connections with Drains

iii. Rehabilitation and de-silting of existing drains.

iv. Solid Waste Management.

#### 3.5.6.1. Provision of new drains

The provision of new drains from Zero Chainage to Surjani Chowrangi and Nazimabad 01 No to Gurumandir shall be integrated along with restoration of roads and proper slope should be provided as to drain out the storm water.

#### 3.5.6.2. Elimination of Cross-Connections of Sewers with Drains

By cross-connection between sewer and drain, it is meant any physical interconnection or illegal practice. Basic reason for this cross connection is lack of sewerage facilities in the area. These cross connections should be eliminated and all these eliminated sewage connections should be connected with the existing sewage network.

#### 3.5.6.3. Sewerage System

The existing sewerage system is choked and not functioning due to deposition of solid waste in manholes. The system will require cleaning and desilting.

#### 3.5.6.4. Rehabilitation and de-silting of existing drains

At some locations the existing drainage system need to be repaired, and all the blocked drains by solid waste required to be cleaned/de-silted.

#### 3.5.6.5. Solid Waste Management

The recommendations that may be considered for the improvement of the current situation regarding solid waste management in vicinity includes, provision of proper bins, raising awareness about consequences caused by land pollution due to the solid waste and providing proper system for the collection of solid waste in the vicinity.

## 3.6. BRT Stations

### 3.6.1. Goals & Objectives

BRT Stations shall play a key role in defining BRT System and in the system's performance. The Proposed BRT Station will comprise of following facilities.

- Attract new users.
- Provide consistency among all stations, distinction from other system bus stops and
- connection to the BRT brand. Use shelter design to enhance visibility of the service.
- Explore concepts for integrating existing shelters,


LYARI RIVER
GURUMANDIR
END POINT
GUJJAR NALA
FIVE STAR ROUNDABOUT
KDA ROUNDABOUT
NAGAN FLYOVER
EXISTING NALA
EXISTING DRAIN (LINED)
BRT ROUTE
HIGH ELEVATION LINE
EXISTING DRAIN (UNLINED)
START POINT
FLOW DIRECTION
EA Consulting (Pvt.) Limited
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
CHOWRANGI, SURJANI, KARACHI
ANNEXURE
INCEPTION REPORT
: EXISTING DRAINAGE SYSTEM
WITH FLOW DIRECTION
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN

facilities and public amenities along each corridor while creating an overall design that can be read as an integrated whole.

- Provide consistency (in materials, colors and design) with other site elements, including lighting, railings, signage, litter receptacles, etc.
- Promote visibility and facilitate branding.
- Provide Shelter from the weather. To create naturally ventilated stations with maintenance free finishes.
- Ensure safe accessibility for all, including people with disability & senior citizens.
- Provide passengers with information, including signage, way finding & real-time arrival information.
- Provide passenger with a safe and secure environment by including such items as CCTV Cameras, public address system, lighting & fencing.
- Enable precise berthing at designated stopping points.
- Enable passengers to board through multiple doors.
- Enable level boarding by matching platform height with vehicle floor height and using precision docking.
- Provide passengers with amenities such as signage, trash bins, special lighting, ceiling mounted fans, limited seating & drinking water dispenser facility.

BRT Platform

Signage

Seating

*T Stations will be designed in consideration of the safety of bus passengers and the general public, system reliability, passenger comfort, and ease of maintenance.*

- Provide passengers with an attractive environment.
- Materials and components must be easy to maintain, repair and refurbish; be proven vandal-resistant; be transportable; and have a proven and dependable performance history.

## 3.6.2. Design Features

### 3.6.2.1. Station Architecture

A BRT station will be a substantial facility that will include many of the following attributes like shelter, level boarding, opportunity for advance fare collection, a unique name, a distinctive look & feel, passenger information, lighting & security, seating and other features typically associated with rapid or rail transit stations

The BRT stations will be attractive, convey permanence and will provide more substantial passenger amenities than those found in enhanced stops. They will also offer higher capacity than simple or enhanced stops and will provide easiness for passengers to identify and locate in a street environment. In addition, they may have enhanced security features.

Construction and operation will cause minimum disruption to traffic, local businesses and neighborhoods. The facilities' designs will be economical with respect to construction, maintenance and operations.

BRT facilities will be designed to accommodate articulated buses, and a BRT version that may be used for the BRT service.

Bus facilities will be integrated into the local street network and designs will be compatible with local roadway design standards.

BRT facilities will accommodate rapid loading and unloading of passengers and provide safe pedestrian access between the BRT stations.

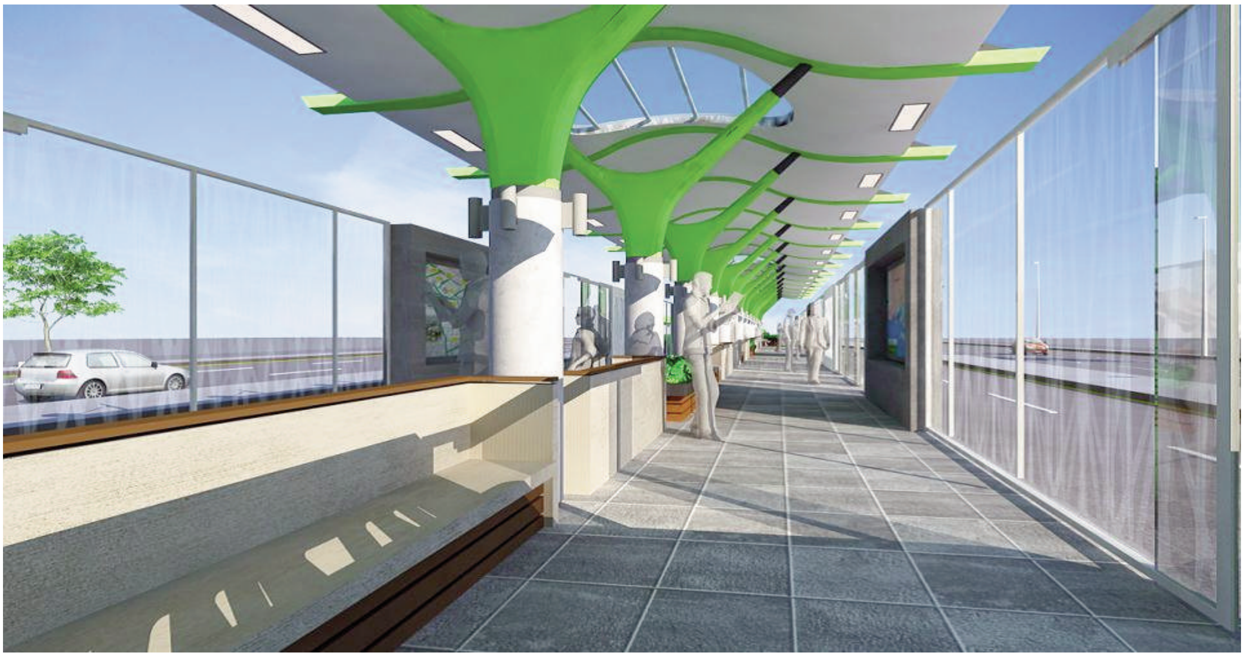
### 3.6.2.2. Platform Width

Platform width is the distance across the station/stop perpendicular to the direction of travel. Width is generally a more challenging problem than length, because width is often the most limiting factor and can cause conflicts with pedestrian and road space. To some extent, however, lack of width can be compensated for by additional length, particularly where stations or stops are located in unused medians.

Width generally is determined by right-of-way constraints. However, if right-of-way is not a constraint, then width generally is a function of the anticipated passenger load and the station/stop operational design. For example, width requirements can be reduced if stop locations on either side of the

station/stop are not located directly across from each other, thus minimizing conflicts between passengers boarding and alighting in opposite directions. Width generally should be derived from the following considerations:

- Width required for passengers to circulate within the station/stop, particularly for purposes of entering or exiting the station/stop.
- Width required to ensure access for passengers with disabilities (e.g, to accommodate wheelchair ramps and to permit maneuvering of wheelchairs).





- Width required for infrastructure (stairs, ramps, elevators, trash receptacles, ticket vending machines, signage etc.) within the station/stop.
- Width for passengers waiting for a vehicle to arrive in the opposite direction, particularly if the stop locations are directly across from each other.

### 3.6.2.3. Platform Height

Platform height refers to the vertical height of the station platform above the roadway or transit way.

Current BRT applications differ as to the optimal treatment of curb heights. Of major consideration in the various options are the additional costs and/or time impacts of the curb treatment. In general, three types of platform heights are available:

- standard curb
- level or near-level boarding
- raised platform

For the GREEN LINE BRT System, the level boarding system will be adopted.

### 3.6.3. Branding

Branding will be used to give a service or product a distinct identity that will result in clear and positive public recognition of the service. BRT stations will be a key element in reinforcing the brand of the service and shall be highly identifiable as a major component of the BRT identity.

As the gateway into the BRT service, strong branding of the station will present the initial opportunity to emphasize the system. The continuation of the brand on all individual station elements shall emphasize a clear and consistent message about the service.


The look of the stations will ensure that they will be easily identified as different from the conventional bus shelters in the city. They shall tie into all other aspects of the overall BRT brand, including the vehicle, colors, logos, signage and other service components.

The BRT brand shall remain prominent at the stations for customer recognition and understanding.

Elements of station branding will be included within the actual design of the station components (e.g., shapes and sizes) or included on all structures, customer information panels and amenities at the station with colors, logos or graphics.

Attention to small details will send an important message. A unique branding feature for consideration will be the inclusion of an "iconic" marker or monument sign at each station to highlight the BRT service.

### 3.6.4. Pedestrian Accesses

To facilitate pedestrian users the stations can be approached by overhead pedestrian bridges. The bridges will be ADA compliant providing pedestrian users the option to use staircase, escalators and passenger lifts.

The bridges will be open to public to simply cross over the roads or also to approach the BRT station.

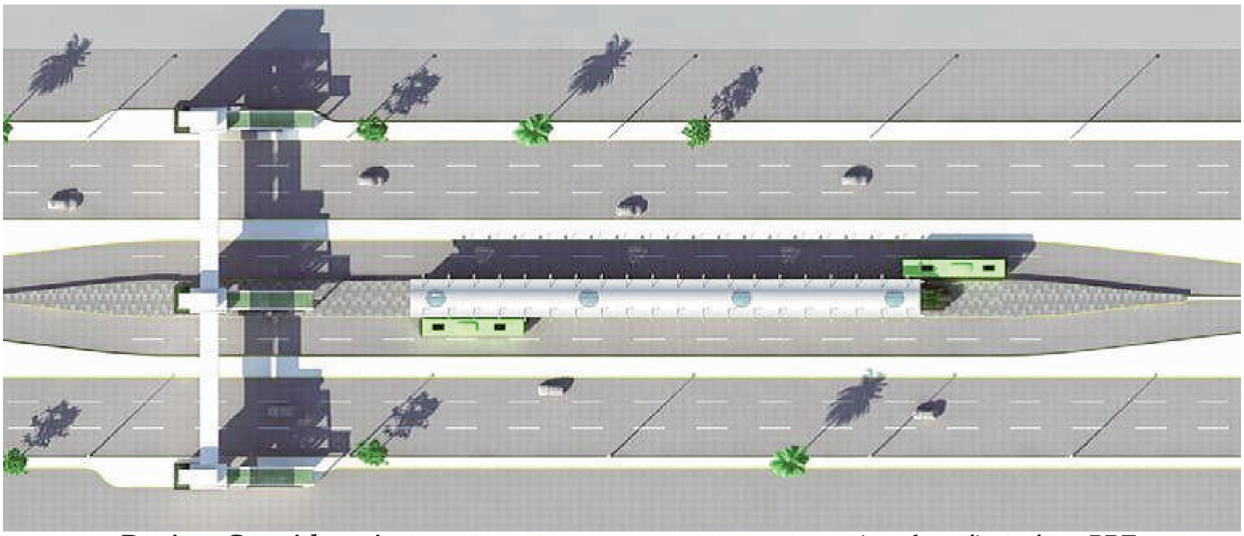
The lift is intended for BRT users with disabilities, heavy luggage or elderly persons. The lift will be monitored at all time by security personnel.

The escalators and staircases will be covered at all times to provide shelter from sun and rain.

The overhead bridge will also have a ticketing office / booth for passengers intending to purchase tickets.

### 3.6.5. Design Characteristics and Amenities

At a minimum, BRT stations shall include platforms, canopies and associated support structures. Additional amenities may increase a station's utility for transit riders and can enhance the appeal of stations for nearby residents and businesses.



#### 3.6.5.1. Design Considerations

Architectural treatments such as specially designed canopies or shelters will help to make stations more visible and will help in developing a brand identity for the BRT system. Creative approaches to designing fencing, stairs and ramps will help to create community support for the BRT system and will add to the riding experience.

#### 3.6.5.2. Visual and Aesthetic Impacts

While concerns may arise about visual and aesthetic impacts of a station, the planning process will provide an opportunity to engage the public in developing a station that will be a source of community pride. This will be achieved through design workshops, concerning architecture, colors, finishing materials, signage and pedestrian access. Installation of art would further enhance the appeal of a new station for residents and businesses.

### 3.6.6. Environmentally Sustainable Materials and Practices

The design phase of a new station will offer opportunities to introduce environmentally sensitive materials and practices into its construction and operation. Assessment of energy usage typically will be performed for the overall project to determine the energy conservation benefits of a BRT system. However, architects will also consider energy conservation measures for BRT stations, such as designs that make use of natural lighting and low-power-consuming lighting, use of solar panels and incorporation of recycled materials in building construction, Transit operators pursuing Leadership in Energy and Environmental Design (LEED) certification for BRT stations may see the added benefit of reduced operating costs and local grants for "green" projects.

### 3.6.7. Noise and Vibrations

In BRT project, stations will present more of a noise concern than the rest of the line or corridor, since noise emissions are greater where vehicles are accelerating from a stop. Noise associated with increased traffic generated by a station also will need to be considered, as will noise associated with other features such as passenger announcements or crosswalk signals. Determination of noise impacts requires identification of sensitive receptors near the station, such as retail establishments, residences, offices, hospitals, child care facilities, public buildings and historic structures.

### 3.6.8. Universal Design

Incorporating elements of universal design will help to improve accessibility of stations, improving accessibility for disabled people as well as other transit patrons, such as travelers with luggage. BRT systems will require the implementation of these elements at stations, either due to an extended platform length or to the need for platform boarding to accommodate BRT vehicles.

### 3.6.8.1. Vertical Panels

Shelter structure will accommodate the placement of advertising, art or information panels within or in place of some vertical panels. Orientation of vertical panels to protect from prevailing winds and wind-driven rain is preferred. Vertical panels will be size to enable portability by one person for purposes of installation and maintenance.

### 3.6.8.2. Shelter and Seating

A primary objective in providing a convenient, comfortable BRT station environment is the provision of basic shelter and seating for passengers. Consistent with the system brand and local design and development requirements, each BRT station shall


incorporate a reasonable degree of weather protection and places to sit while waiting. Benches will be provided for the purpose of seating. Design will discourage the use of seating for sleeping. Backs and arm rests are optional.

### 3.6.8.3. Real-Time Passenger Information

One of the most significant barriers to using buses is customer uncertainty about bus arrival times. Posting schedule information can help reduce the uncertainty, but this may be impractical where BRT stations are served by many different routes, and posted schedules cannot reflect bus delays. Providing real-time information in the form of variable message signs at stations that provide current status of bus operations will eliminate this uncertainty for transit users. As many modern rail transit systems have this feature in their stations, this also will be another important element in making BRT more like a rail system.

### 3.6.8.4. Lighting

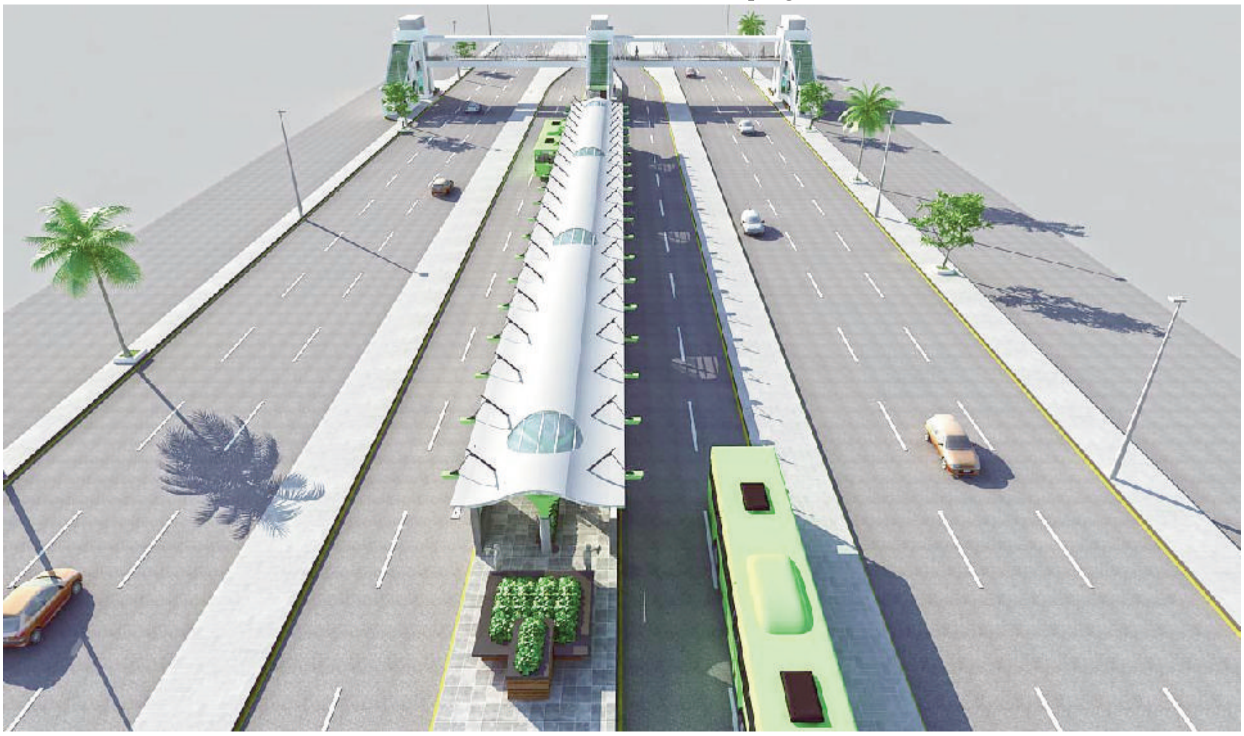
Station lighting will serve several functions. It will provide illumination, assist in station location and identification, and makes station features visible during periods of darkness. It will aid bus operators in locating stations and determining whether passengers are waiting to board. Station lighting will provide a

sense of security for users waiting to board a vehicle. Attractive station lighting will further highlight station architectural and design elements, which will enhance the user's experience and the appeal of the BRT station for the community.

Lighting will also communicate when the station is closed, such as by changing the color and intensity of the lighting when the station is closed.

### 3.6.8.5. Fare Collection Equipment

The Fare Collection System for the BRT project will consist of standard electronic fare equipment at stations to board the vehicle. The technical specifications will be provided in future.



### 3.6.8.6. Trash and Recycling Receptacles

Trash and recycling receptacles are necessary to minimize litter at BRT stations and on buses, as many riders have food and drink containers and other items to dispose of before boarding a vehicle. However, placement of trash containers at transit stations and stops may be considered a security issue, and thus specially designed trash receptacles may be required.

### 3.6.8.7. Maps and Other Way-Finding Devices

Maps and other way-finding devices will help users who have just alighted to orient themselves with the area surrounding a station. Maps will be placed within the station itself. Way-finding can be comprised of special signage as well as special markings within pavement. Integration of design elements and way-finding will be a creative application of station art.

## 3.6.9. Landscaping

Landscaping will add visual interest to both the station and the area around the station. It will also soften the aesthetic impacts of “hard” edges associated with BRT infrastructure. Where sufficient space is available (i.e., along bus ways), landscaping will help to define station areas. Landscaping and other improvements will enhance the appeal of the station to new users and to the community and will make the stations more attractive to potential developers.

Landscaping shall be attractive and blend in well with the local environment. It will be design to make the station or stop a comfortable and desirable place to be. In order to minimize maintenance costs, native species requiring minimal amounts of watering will be use.

# 04 COMPARISON OF ALTERNATIVE OPTIONS

## 4.1. Mass Transit Development and Non-Development Scenario

### 4.1.1. "Do-Nothing" Scenario

"Do-Nothing" scenario means that there is no mass transit system developed but improvement of the existing bus transport services takes place. Thus the following conditions are assumed:

- No mass transit system including KCR is implemented;
- Conditions of population growth, economic growth and urban development remain the same as in the case of demand forecast in "with master plan"; and
- The number of buses would increase according to passenger demand.

In case no action about public transport is taken in the future, as has been in the past 20 years, the number of buses would not increase even if traffic demand increases.

Figure 4.1 illustrates the simulation result of "Do-Nothing" scenario. Orange, red, and brown color indicates the road sections where traffic volumes exceed the capacity i.e. volume to capacity ratio (V/C) exceeds 1.0. The result shows that most roads will suffer from traffic saturation in case of "Do-Nothing" scenario. As a result conditions of urban transportation


**Fig 4.1:** Do-Nothing Scenario (2030)
*Source: KTIP (Preliminary Demand Forecast Model)*

in Karachi should become worse in the future if no transport project was implemented reasons being that 1) the population growth in Karachi is multiplied by 1.67 times from 2010 to 2030; 2) forecasted economic growth will increases the trip rate of urban transportation; 3) forecasted increase in car ownership increases the trip rate and decreases road spaces; 4) Expansion of urbanized area increases the trip length 1.64 times from 2010 to 2030.

In general, the heavier the traffic becomes the more deterioration takes place on bus services. This will further cause modal shift to motorcycle and private cars, and increase the traffic as a result.

### 4.1.2. "Road Development" Scenario

Karachi has developed road infrastructure such as flyovers and underpasses recently. They appear to have improved traffic situation in Karachi. The "Road Development" Scenario is prepared to evaluate the present trend concentrating on road development. The condition of this scenario is the same as that of the "Do-Nothing" Scenario except for the road network used in the traffic assignment. The road network for the "Road Development" Scenario is the same as the road network in KUTMP 2030 which states that there are new road in total length of 740km is developed . Since the road network in the urbanized area in Karachi has already been developed, further development of road network would be very difficult.

Figure 4.2 shows the result of the traffic assignment for "Road Development" Scenario. It is observed that traffic on some roads is significantly improved compared to "Do-Nothing" Scenario while congestion will remain in many roads.

### 4.1.3. Development of KCR Scenario

KCR is a committed project – it has been approved by the Government of Pakistan (GOP) on September 3, 2009 for its implementation. The KCR Development Scenario is the case when only KCR's circular railway


**Fig 4.2:** Road Development Scenario (2030)
*Source: KTIP (Preliminary Demand Forecast Model)*

is developed as mass transit system in Karachi in addition to road development as described above. Figure 4.3 shows the result of the traffic assignment for this scenario. Traffic is improved by KCR project although its impact on road traffic is not clear to date. Since KCR provides passenger transportation services in the circular manner, roads for radial directions should remain congested.

KCR alignment;

3. Planning railway-based system at ground level is unrealistic from the perspective of complete separation between road and rail transportation;
4. If BRT system was built on elevated structure, which has enough strength and width for railway system, it would become extremely uneconomic;


**Fig 4.3:** Development of KCR Scenario and the Road Congestions in 2030
*Source: KTIP (Preliminary Demand Forecast Model)*

## 4.1.4. Development of Existing Plan Scenario

There has been a set of urban transportation development scenario, a set of KCR and Bus as well as light railway lines, during the Master Plan Study period of the KTIP Project as is shown in Figure 4.4.

With this scenario, the following is noted:

1. Development of Corrdior-2 is almost impossible within a feasible scheme;
2. Corridor-4 and Corrdior-6 are duplicated with
5. It is not possible to install underground structure after building elevated urban transportation structure in the future; and
6. Construction of the above 6 corridors and KCR in sequential manner is not possible scenario in view of budget and schedule.

## 4.1.5. Transportation Network Development Scenarios

The public transport network depends on the type of mass transit system. For example, a low capacity system requires dense network while the dense

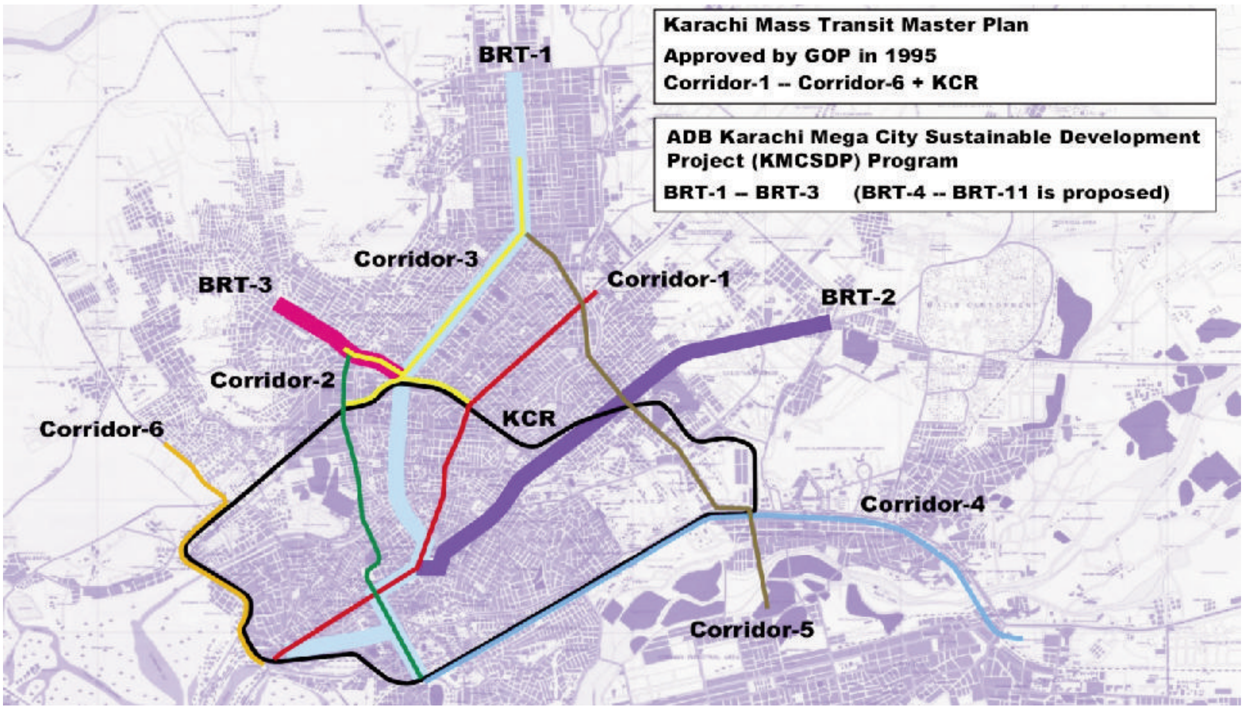



**Fig 4.4:** Existing Mass Transit Plan
*Source: KMTC (Illustration in KTIP)*

network is costly in case of a large capacity transit system. To analysis the best mass transit system, the following three scenarios are evaluated:

Mass Rapid Transit (MRT) development along high priority corridors;

1. Light Rail Transit (LRT) development along major corridors; and
2. Bus Rapid Transit (BRT) development along the existing major roads.

In this analysis, MRT means a large capacity railway system (heavy rail or rail rapid transit) with a number of train cars between 6-12 cars. The concept of MRT scenario comes from the idea that it might be more feasible to construct a large capacity transit system along the priority corridor instead of constructing a lot of parallel LRT routes with short intervals. Although the cost of a MRT line is higher than a LRT line, the total cost of MRT network might be lower than that of LRT network because of the less number of lines on MRT. Feeder service is inevitable for this scenario.

The concept of LRT scenario is similar to that of the approved plan of Karachi Mass Transit Corridors. This scenario provides public transport service along major corridors. Construction period of a line in this scenario is shorter than that of MRT scenario.

The concept of BRT scenario is based on the "Study on a Public/Private Partnership based Environmental-friendly Public Transport System for Karachi" and the BRT study by ADB. These studies proposed 14 BRT routes. The service area is largest among three scenarios.

Table 4.1 shows the comparison of these scenarios.

Note: This table shows only a typical example of a single system. Combination of different systems is not represented. * The possible number of routes in 20 years is just the JICA Study Team's opinion considering financial and political situation in Karachi

The disadvantages in each scenario cannot be

**Table 4.1: Comparison of Scenarios**

| | MRT Network | LRT Network | BRT Network |
|---|---|---|---|
| Train composition | 6 – 12 cars | 3 – 6 cars | 1 – 3 cars |
| Distance between stations | 1 – 2 km | 500 – 1000m | 50 – 500m |
| Schedule Speed | 30 – 40 km/h | 25 – 35 km /h | 15 – 30 km/h |
| Capacity of a car | 200 – 250 | 150 – 200 | 100 |
| Structure | Elevated / Underground / At grade in suburban | Elevated / Underground / At grade | At grade / Elevated in special cases |
| Level crossing | Not used | Used in case of surface section | Used |
| Station | Large scale with long platform | Compact size compared to MRT station | Bus stops on roads |
| Inter-modal facilities | Station plaza for feeder service at many stations | Station plaza for feeder service area at major stations | Bus terminal at both ends and major bus stops. |
| Capacity expansion by doubling track/ lane | Difficult | Difficult | Possible if road space allows |
| No. of routes in Karachi possible in 20 years* | 2 – 3 routes | 3 – 4 routes | 6 – 8 routes |
| Risk of delay | - Financing<br>- Power supply<br>- Land acquisition | - Financing<br>- Power supply<br>- Land acquisition | - Consensus of road users<br>- Opposition from bus transporters |

underestimated. The best scenario would be the mixture of these scenarios but would be a costly operation as KCR is considered as precondition. Conceptual development scenarios are show in the Figure 3-1-5 and Figure 3-1-6.

The master plan network consists of four MRT routes, one LRT route, and five BRT routes. The master plan network attaches great importance to urban development in Gadap Town where the increase in the population of more than 4 million is expected in the

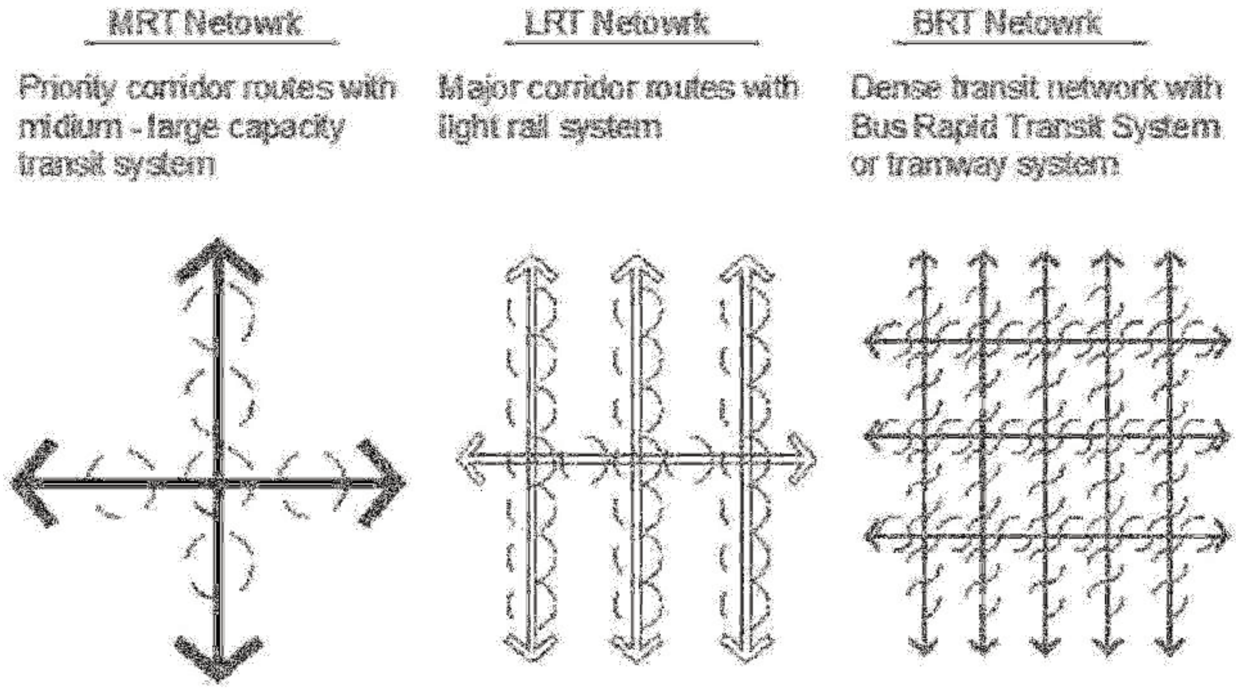
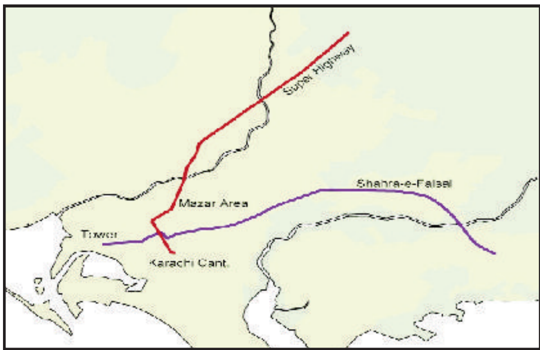



**Fig 4.5:** Conceptual Illustration of Mass Transit Scenario
*Source: JICA Study Team*

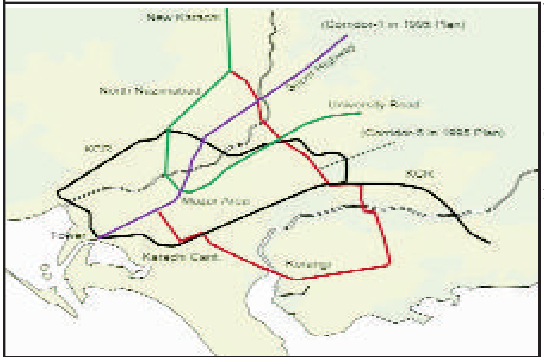



**MRT Network**

Two MRT routes are constructed along the busiest corridors. Only MRT system of 8-car train with 40km/h is introduced.

Coverage area of this scenario is very small. The advantage is that the east-west line (in blue colour) can be constructed as elevated structure and its early implementation would be possible. On the other hand, the north-south line (in red colour) needs underground section.

land use plan. Blue Line and Brown Line

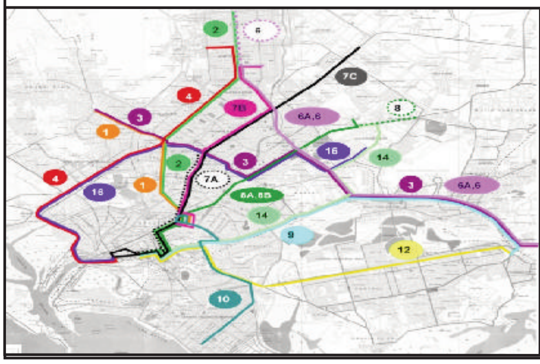



**LRT Network**

Four LRT routes are constructed with a total length of 96 km. Only LRT system of 4-car train with 30km/h is introduced.

The service area is very large but the construction cost is the highest among the different networks. This network requires road widening to avoid underground construction.

formulate urban development corridors



**BRT Network**

The network of this scenario is based on the network proposed in Environment Friendly PPP Study. The KCR line will be converted to BRT routes in this scenario.

This scenario requires road widening in the center of the city. Since BRT system uses a part of lanes of road, which reduces the road capacity, the positive impact on road traffic is not clear.

**Fig 4.6:** Concept of Network Type

*Source: JICA*

crosswise. The summary of the system is shown in Table 4.2. The total length of the mass transit network is 192.2 km in which MRT network accounts for 98.5 km, LRT for 16 km, and BRT for 77.7 km.

**Table 4.2: List of Mass Transit Route in Master Plan**

| Code Name | System | Length | No. of stations |
|---|---|---|---|
| KCR | MRT | 43.1 km | 24 |
| KCR Extension | MRT | 14.5 km | 11 |
| Blue Line | MRT | 22.4 km | 18 |
| Brown Line | MRT | 18.5 km | 16 |
| Yellow Line | BRT | 20.4 km | 41 |
| Green Line | BRT | 12.7 km | 25 |

**Table 4.2: List of Mass Transit Route in Master Plan**

| Code Name | System | Length | No. of stations |
|---|---|---|---|
| Red Line | BRT | 19.2 km | 38 |
| Orange Line | BRT | 3.9 km | 8 |
| Purple Line | BRT | 9.7 km | 19 |
| Aqua Line | BRT | 11.8 km | 24 |

*Source: KTIP*

### 4.1.6. Scenario by Marketing Segment

Marketing is also an important factor for mass transit scenario. Unlike intercity trains, a mass transit system in urban area does not provide differentiated services such as first class, second class and economy class in most cases. Usually, an urban transport system provides the same level of service to all passengers. If the target of the mass transit system is the same as those who cannot afford to pay higher fare than existing minibuses, taking MRT and LRT would be a very difficult choice in terms of fare payment. For example, KCR Project studied by JICA shows that its financial interest rate of return (FIRR) is only 2.3% under the condition of keeping the fare structure similar to that of the existing bus services. If the target passengers are high income class those who use private cars at present, the improvement of road congestion would be very significant i.e. Private cars on the road in Karachi would be reduced.

In the Passenger Interview Survey (PIS), the following two pictures were shown to interviewees and ask their

**Table 4.3: Comparison of Market Segment of Mass Transit System**

| Target | Low Income Passengers | Mid Income Passengers | High Income Passengers |
|---|---|---|---|
| Present transport mode | - Minibus/ Coach<br>- Walk | - Motorbike<br>- Buses (no choice) | - Private car |
| Favorable system | Any type of system | BRT/ LRT/ MRT with air -condition | MRT/ LRT / monorail with air-condition and less congestion |
| No. of buses after mass transit development | Decrease | Decrease a little | Same |
| No. of motorbike after mass transit development | Decrease a little | Decrease | Decrease a little |
| No. of cars after mass transit development | Very low decrease | Decrease a little | Decrease |
| Congestion after mass transit | Improved a little development | Improved | Significantly improved |
| Financing of MRT/LRT | Public budget and soft loan from international organization for capital cost, and subsidy for operation & maintenance | Public budget and soft loan from international organization for capital cost | Public budget and market loan for capital cost PPP scheme |
| Financing of BRT | Public budget and soft loan for capital cost, and soft loan for rolling stock | Public budget and soft loan for capital cost, and market loan for rolling stock / PPP | Public budget for capital cost and full private operation |
| Risk | Opposition from existing bus transporters | Vague target | Small demand |

*Source: JICA*

willingness to pay for using LRT. mass transit than that of the existing bus services, if the

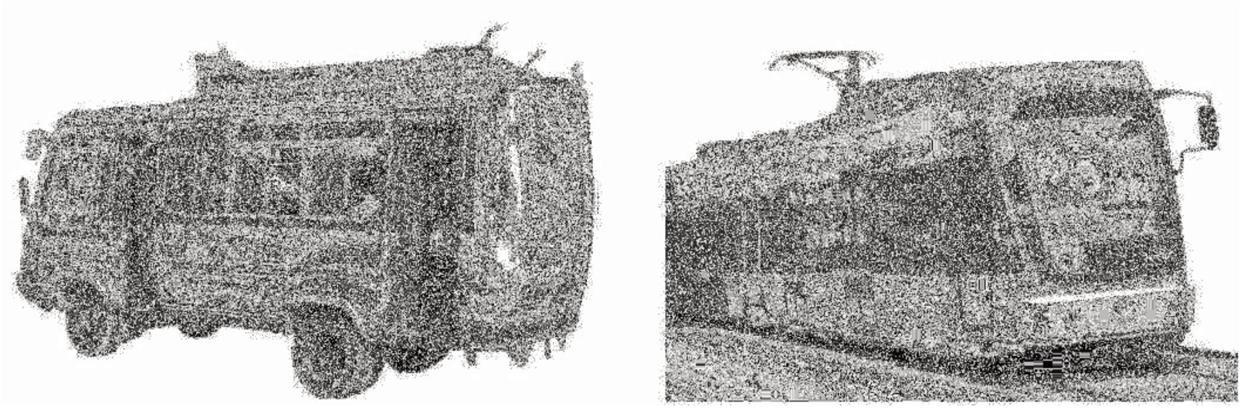


Fig 4.7: Model of Passenger Transportation System
*Source: JICA*

For public transport passengers, bus and rickshaw, the condition of the interview was that fare minibus was Rs. 15 and the travel time was the same of 20 minutes. The left chart of Figure 3-1-8 shows that 60% of bus passengers can pay Rs. 30 or more for LRT when minibus fare is Rs.15, while most of them don't want to pay Rs.80 or more. On the other hand, the right chart shows that 90% of rickshaw passengers can pay Rs. 30 or more under the same condition. However, like bus passengers, most of them don't want to pay Rs. 80 or more. This result implies that public transport passengers can pay Rs.30 – Rs.60 if the transport mode is more comfortable than minibuses.

The willingness-to-pay survey implies that people who are using bikes and cars can pay higher fare for mass transit was developed as a world standard.

Financially sustainable operation is the key for the successful operation of a mass transit system. The present bus fare level is far from the sustainable operation if a similar level of fare is applied to a new mass transit project which requires a large scale of capital investment. As a result, it is proposed to provide the mass transit system for the present bike and car users with adequate development cost while the existing bus routes for low income people are retained.

### 4.1.7. Conclusion of Scenario Analysis

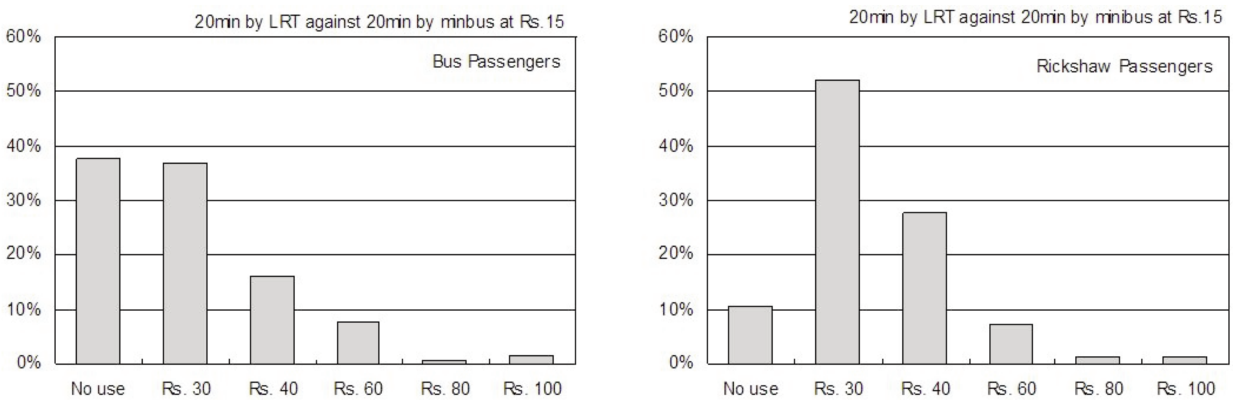



**Fig 4.8:** Willingness to pay for LRT (Bus and Rickshaw)
*Source: JICA Study Team (PIS)*

It can be concluded from the above scenario analysis as follows:

1. Road development will remarkably improve the road traffic along major corridor. However, serious traffic congestion will still remain;
2. KCR will improve the road traffic in CBD to some extent. However, traffic congestion will still remain especially for radial directions;
3. Construction of a number of LRT will not be efficient in terms of cost vs operation performance. A large number of resettlement will also be involved in the case if elevated structure was constructed in CBD;
4. MRT network with one or two lines is not enough for the future demand of Karachi urban setting;
5. BRT network will not be the solution for the increase in traffic demand in the future, because of it capacity and impact on road traffic while cost implication could be viable to some extent;
6. The future mass transit network should be the mixture of MRT and BRT; and
7. The target of mass transit development should be middle income people, who are using motorcycles as transport mode.

## 4.2. Analysis of the Alternatives for Green Line Development Scenario

### 4.2.1. Do nothing Scenario vs. Other BRT Development

Analysis of alternatives for feasibility study is broadly divided into "Do it" or "Do nothing" since any BRT development brings positive effects on the socio-economic environment of Karachi as a whole.

"Do-Nothing" is a scenario analysed during the Master Plan study. It means that the improvement of only the existing bus services should takes place with the current plan of road system improvement. In case no action on the public transport is taken in the future, as has been in the past 20 years, the number of buses would not increase even if traffic demand increases. The following is thus noted:

1. It is obvious that most of the roads in Karachi will suffer from traffic saturation;
2. Population growth in Karachi is multiplied by 1.67 times from 2010 to 2030;
3. Forecasted economic growth will increases the trip rate of urban transportation;
4. Forecasted increase in car ownership should further increases the trip rate and road spaces relatively decreases; and
5. Expansion of urbanized areas should increase the trip length by a factor of 1.64 times from 2010 to 2030.

As a result there will be more deterioration takes place on the bus services as well as the road conditions. Thus "Do-nothing" scenario will further causes modal shift to motorcycle and private cars for further increase of the road traffic. This scenario should lead to the chaotic urban transportation in Karachi in the near future.

### 4.2.2. Green Line Development Scenario

There is no alternative route for Green Line because there is no alternative parallel road along the corridor. It was originally intended to stop as Gur Mandir. However, its southern end has been extended to Jahangir Park where the buses are returning on the loop while there is a strong desire to extend it to Tower area.

The issue of the selection of end point of Green Line as

1) there is a strong requirement of its extension to Tower and 2) it should stop at Jahangir Park. The characteristics of current conditions of M. A. Jinnah Road are observed as follows:

- - The width of M. A. Jinnah Road between Tower and Cloth Market, one way section, is generally narrower than the necessary width of bus station section;
- - The existing traffic congestion in one way section around this area is very high, since this is very busy commercial area and sophisticated urban construction scheme is necessary; and

In the contexts as above, two alternative plans are prepared for the end point of Green Line as per Figure 4.9.

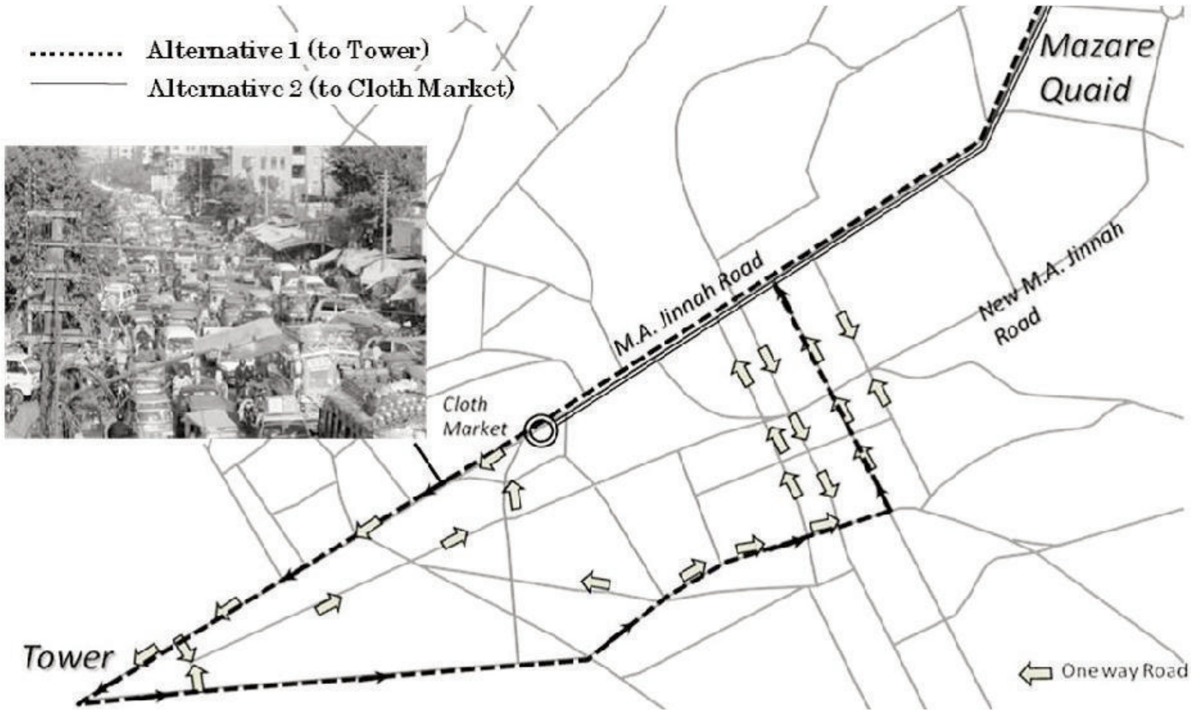



**Fig 4.9:** Examination of the end point in CBD for Green Line
*Source: JICA*

- Alternative 1: This route is planned along one way section of approximately 2.6 km to Tower from Jahangir Park. A detour route from Tower to M.A. Jinnah Road with a total length of approximately 5.5 km will have to be provided; and
- Alternative 2: This route is planned to stop at Jahangir Park/Cloth Market. U-turn loop is planned at Jahangir Park/Cloth Market area.

The environmental examination of the end point of Green Line is summarized as follows:

***As a result, based on the above analysis, Alternative 2 has been selected in terms of environmental aspect.***

Green Line has been selected to construct on the existing major road for passenger convenience for transfer and the conditions of the existing road structures. It is expected to cause minimum negative social impact such as the resettlement and land acquisition does not get involved in the plan.

From the natural environmental view points, only the negative impact of Green Line development is the felling of trees planted on the road side and the road center's green belt.

**Table 4.4: Analysis from Environmental and Social Viewpoints on Green Line**

| Items | Environmental Impacts |
|---|---|
| Environmental pollution | - When Green Line is designed to construct on the ground level to Tower from Jahangir Park, there is a possibility of high traffic congestion during not only construction period but also operation period.<br>- In case of elevated/underground system was constructed to the one way section, traffic congestion due to construction work will be severe.<br>- Impacts of air pollution and noise on the surrounding areas due to the construction works/traffic congestion will be higher in case of Alternative 1 for end point of BRT, compared with the case of Alternative 2. |
| Social Environment | - The case of one way section construction activities would induce the higher probability of causing the land acquisition and resettlement for the area of station facilities. This is compared to the case of two way direction section which would have to double the socio-economic impacts. |

*Source: JICA*

# 05 DESCRIPTION OF ENVIRONMENT

This section of the EIA report describes the existing social and environmental baseline situation of the macro and micro environments of the proposed Green Line BRT corridor. This will prove to be a guideline for overcoming the possible environment hazards imposed during the project.

## 5.1. The Macro Environment

### 5.1.1. Towns along BRT Corridors

Following towns have been identified along the green line (shown on geographical map Figure 5.1 and in Table 5.1):

Table 5.1: Towns of BRT Green Line

| BRT Corridor | Town |
|---|---|
| Green Line | New Karachi Town |
| | Nazimabad Town |
| | Liaquatabad |
| | Jamshed Town |
| | Saddar Town |

#### 5.1.1.1. North Karachi Township

Major land use coving approximately 60% of the township is predominantly urban residential area recently developed for ever increasing population in Karachi. North Karachi is a supplier as well as recipient of work force to and fro the adjacent UC's/Towns including North Karachi Industrial Area. In general there are lower middle to low income families occupy the area. Industrial covers approximately 10 % of the total land area.

#### 5.1.1.2. North Nazimabad Township

Major land use of the township is relatively old but well developed residential area which covers 70 % of the total land area. This township is well planned and compact in respect of infrastructure facility development. The area is a supplier of high level as well as middle level work force to the adjacent North Karachi Industrial Area. Relatively small scale commercial activities are concentrating in the area along major roads.

#### 5.1.1.3. Liaquatabad Township

Major land use is residential and covers around 70% of the urbanized area. The population density is very high with middle class to lower middle class income families. Commercial areas are concentrating along the major road in the south of township.

#### 5.1.1.4. Jamshed Township

Major land use is predominantly urbanized residential area and it covers approximately 70% of the total land area. There is a mixture of high to upper middle income families as well as middle to lower income families. There is approximately 30 % of residential area formed by kachi abadi, or squatter settlement. Heavy concentration of commercial activities along the major road is observed.

#### 5.1.1.5. Saddar Township

Saddar is commercial and administration hub of Karachi city. Major portion of the area is predominantly commercial and Central Business District (CBD) of Karachi City occupies most part of the township. CBD plays a major role of the financial and commercial center in Pakistan. The main financing function such as national bank, stock market and headquarters of major enterprise are located in CBD. Most of federal and provincial offices are also located in this township.

## 5.1.2. Existing Land Use in Urbanized Area

The Karachi City District is spread across an area of approximately 3,600 km2. A large portion of this area consists of vacant land including the area dedicated to the Kirthar National Park. The KSDP-2020 (August 2007) indicated that Karachi has now an urbanized area of approximately 527 km2 which comprises various types of land uses.

Secondly, Infrastructure such as Roads, Airport occupies 26%. Industrial and Government office land use is 11%. The area percentage is less than around 2% for both commercial and mixed land use (0.7%).

**Table 5.2: Land Use by Categories (Class 2), 2010**

| Categories | Area(ha) | Area (%) |
|---|---|---|
| Residential | 32,600 | 41% |
| Commercial | 1,100 | 1% |
| Mixed Land Use | 1,700 | 2% |
| Industrial | 8,800 | 11% |
| Govt. office | 8,800 | 11% |
| Urban facility | 2,600 | 3% |
| Infrastructure | 20,400 | 26% |
| Parks | 1,800 | 2% |
| Restricted Area | 1,800 | 2% |
| **Total** | **79,600** | **100%** |

*Source: Land Use Survey in KTIP (2010)*

Figure 5.1 shows the current land use by 2010 of Karachi City.

## 5.1.3. Characteristics of Land Use

### 5.1.3.1. Residential Land Use

In Karachi City, urbanization is progressing from the old quarter to the area around the Port of Karachi. The inner city area (incorporating all towns except Gadap Town, Bin Qasim Town and Keamari Town) has been almost entirely urbanized. Systematic residential development is in progress in the Clifton cantonment (DHA) area near the city Centre. In contrast, vacant land is conspicuous at urban planning sites in such towns as Gadap and Keamari located away from the city Centre.

### 5.1.3.2. Commercial Land Use

The Central Business District (CBD) is formed by Saddar Town and neighboring Keamari Town and Jamshed Town and is an area of concentrated commercial and business activities. The main municipal administration buildings are also located in the CBD, Keamari Town and Saddar Town accounts for 39% of the land area for commercial use in the city. The third towns in the area table of commercial land use are Clifton Cantonment (12%). In other towns, the commercial use of land is primarily observed along main roads.

### 5.1.3.3. Industrial Land Use

Industrial land use is primarily observed in the hinterland of the Port of Karachi and Port of Bin Qasim, SITE Town and Korangi Town. In Bin Qasim Town, industrial land use is observed in the hinterland of the Port of Bin Qasim and the total land area for industrial use in this town accounts for 46% of the total municipal area for industrial land use. SITE Town has factories of Siemens, Coca-Cola Beverages and other well-known manufacturers. The Karachi industrial area and Landhi industrial area are formed on the left bank of Malir River. Other industrial areas in Karachi City are found in the hinterland of the Port of Karachi and on the right bank of Lyari River.

### 5.1.3.4. Agricultural Land Use

Agricultural land use in Karachi City is primarily observed in Gadap Town and areas along Malir River.

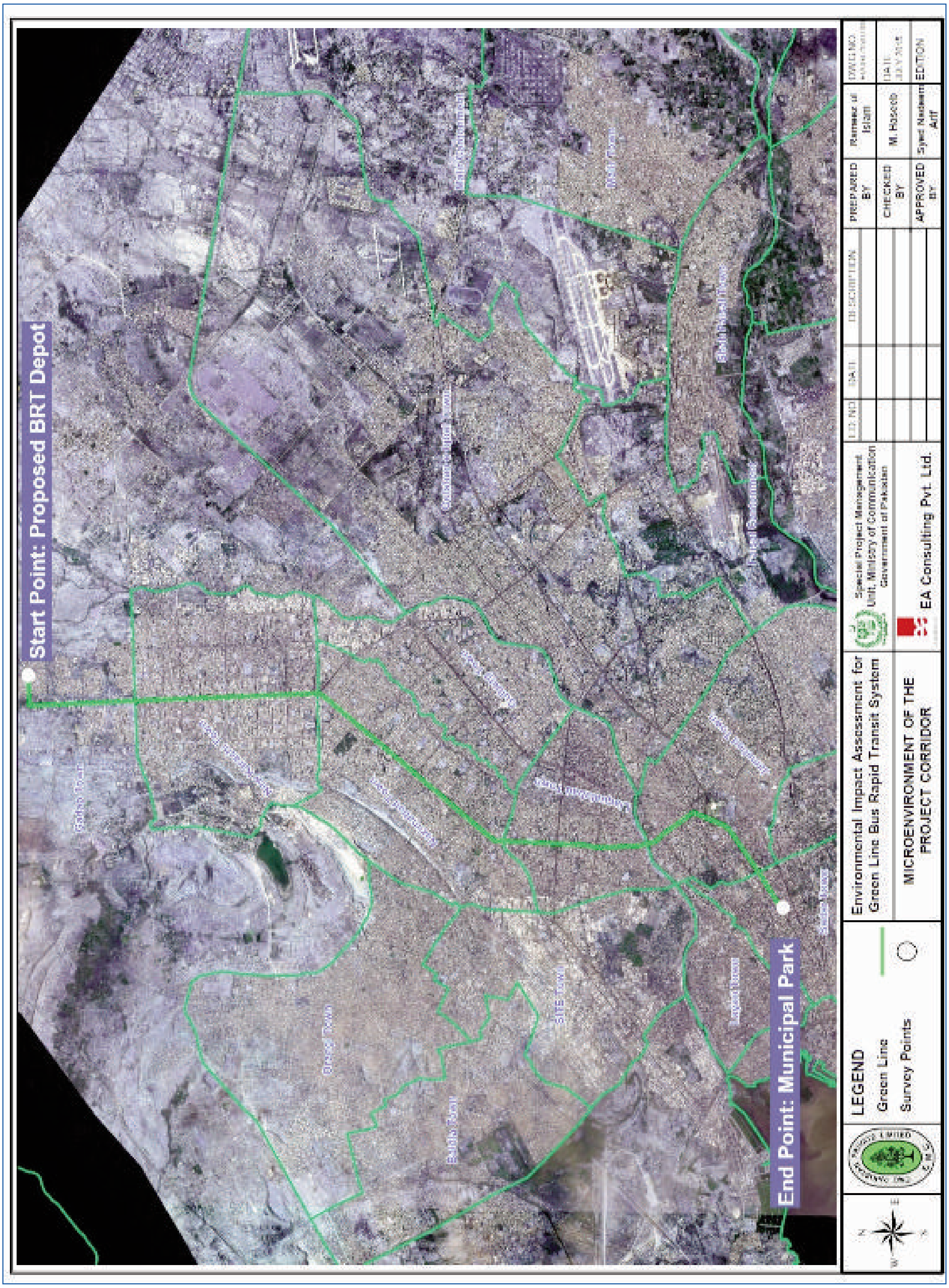



**Fig 5.1:** Towns located along the Green Line Route

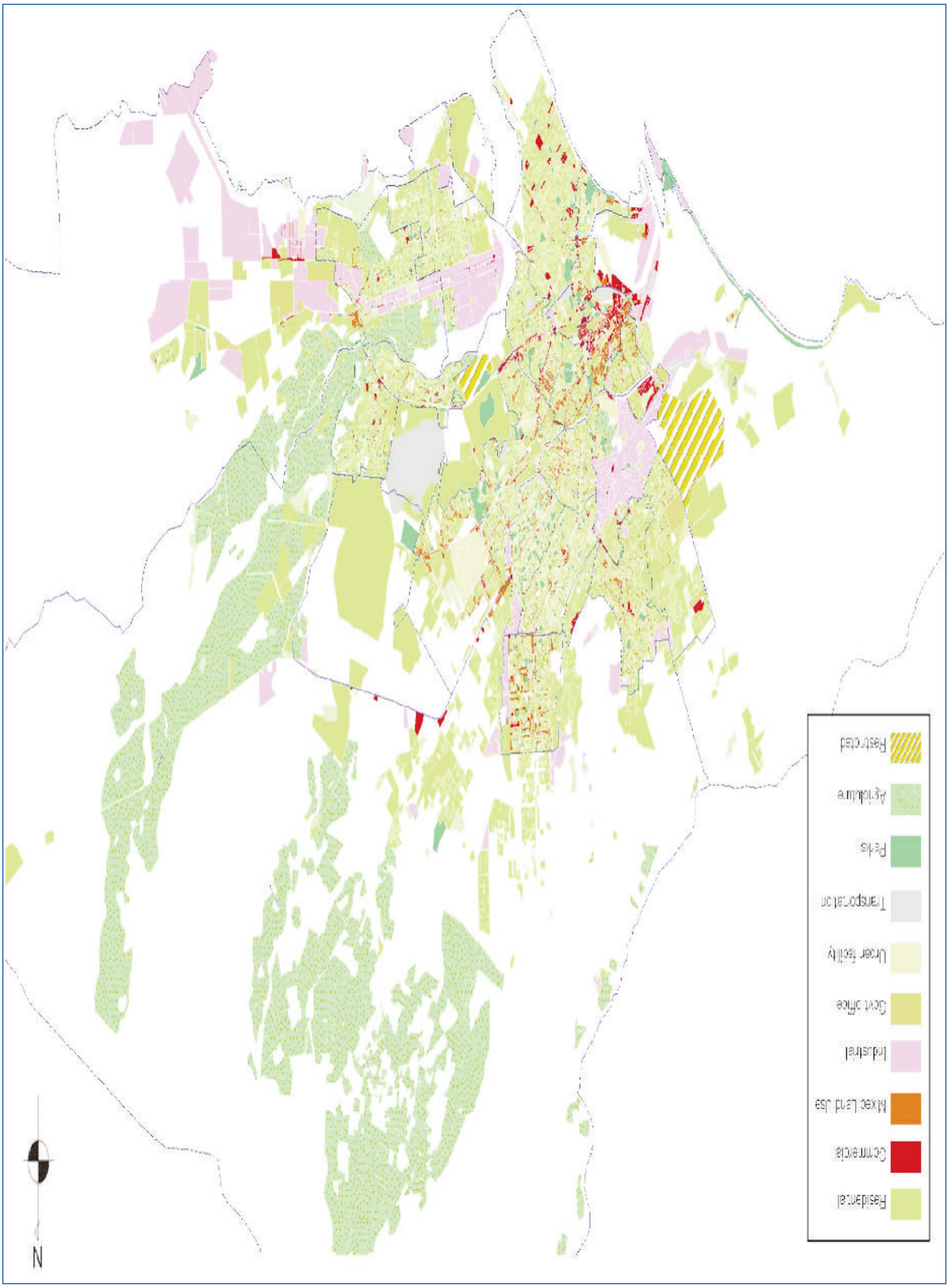



**Fig 5.2:** Current land use (2010) of Karachi (KTIP Study2010)

### 5.1.4. Major land marks by Town

Major and distinguishable land marks of Karachi city includes the Civic center, National Cricket Stadiums, Karachi and NED engineering University, Safari Park in Gulshan Town. Zoological Garden in Garden West Area, International Air Port in Malir Cantonment area, City and Cantt in Karachi Cantonment areas. New Subzi Mundi in Gadap Town, Karachi Port in Keamari Town, Hawkes Bay, Sands Pit Beaches in Keamari Town and Sea view beach in Clifton Cantonment area. The detail listing of important city Land Marks are given below:

**Table 5.2: Major Land Marks**

| Town | Land Mark |
|---|---|
| Keamari | Karachi Port, Sand spit and Hawks bay Beaches, Manora Island, |
| S.I.T.E | Gutter Baghecha, Siemens, Habib Bank Chowrangi, |
| Baldia | Muhajir Camp, Police Training Institute, Murshid Hospital, |
| Orangi | Banaras Chowk, Metro Cinema, Qatar Hospital, |
| Lyari | People Football Ground/Stadium |
| Saddar | City Railway Station, Memon Mosque, Empress Market, Tower, Bagh-e-Jinnah, Frere Hall, KMC Building, Sindh Assembly, Secretariat, Civil Hospital, Marriot Hotel, |
| Jamshed | Zoological Garden (Zoo), Mazar-e-Quaid |
| Gulshan-E-Iqbal | National Cricket Stadium, Safari Park, Alladin Park, NED Engineering & Karachi University, Expo Center |
| Shah Faisal | Shama Shopping Center |
| Landhi | Baber Market, Chirag Hotel |
| Korangi | National Refinery, Zoo, Industrial Area, |
| North Nazimabad | Matric &Intermediate Boards Offices, Hyderi Market |
| New Karachi | Nagan Chowrangi, Kala School, Sindhi Hotel, |
| Gulberg | UBL Sports Complex, Taleem-e-Bagh, Jinnah Ground, |
| Liaquatabad | Liaquatabad Super Market, |
| Malir | Liaquat Market |
| Bin Qasim | Bin Qasim Port, Steel Mill |
| Gadap | Baqai Medical College, |
| Clifton Cantonment | Sea view Beach, Nisar Shaheed Park, Golf Course, Marina Club |
| Cantonment | Jinnah International Airport, Cantt Railway Station, Golf Course, Race Course, Maritime Museum, PNS Shifa Hospital, Jinnah Hospital, |

## 5.2. Physical Environment

The physical environment of Project has been described here in terms of Climate, geology, soil characteristics and seismicity; Seismotectonics events, the airshed, watershed i.e. hydrology.

### 5.2.1. Physiography & Topography

Physiographical classification of Karachi establishes three separate landforms, namely mountain highland, piedmont plain and the valley floor. According to the geological classification, the rocks of Karachi region and its suburbs, upper valleys of Lyari and Malir rivers are almost exclusively of the tertiary system that belongs to the most recent geological period. The lower reach of the Lyari basin constitutes post-tertiary alluvial subsoil while the upper reach constitutes boulders and conglomerate.

The soil type mainly consists of inter-bedded yellow & grey silt stone with sand stone, limestone and clay are exposed at different locations. Lithology consists of Mol member of Gaj formation of Miocene.

Karachi is located in the south of Sindh, on the coast of the Arabian Sea and comprises largely of flat or rolling plains, with hills on the western and northern boundaries of the urban sprawl. The city represents quite a variety of topographic features such as the sea coast, islands, sand dunes, swamps, semiarid regions, cultivated fields, dry stream beds, sandy plains, hillocks. Classified according to physiographic features, Karachi City District can be divided into three broad categories: Hilly Region (Mountain Highland) Alluvial Plain (Piedmont Plain) Coastal Areas (Valley Floor). Among the various physiographic features, low flat-topped parallel hills devoid of vegetation, interspersed with widespread plains and dry riverbeds are the main topographic characteristics of the city. The greatest height of the region is 250 ft that gradually decreases to 5 ft above mean sea level along the coastline.

## 5.2.2. Meteorology and Climate

The climate of the macroenvironment can be characterized by dry, hot and humid conditions and in general terms it is moderate, sunny and humid. There is a minor seasonal intervention of a mild winter from mid-December to mid-February followed by a long hot and humid summer extending from April to September, with monsoon rains from July to mid-September.

### 5.2.2.1. Temperature

Over the course of a year, the temperature typically varies from 13°C to 36°C and is rarely below 9°C or above 39°C (Average Weather for Karachi). The daily average low (blue) and high (red) temperature with percentile bands (inner band from 25th to 75th percentile, outer band from 10th to 90th percentile). The warm season lasts from March 25 to July 13 with an average daily high temperature above 34°C. The hottest day of the year is May 5, with an average high of 36°C and low of 26°C. The cold season lasts from December 18 to February 7 with an average daily high temperature below27°C. The coldest day of the year is January 10, with an average low of 13°C and high of 25°C.

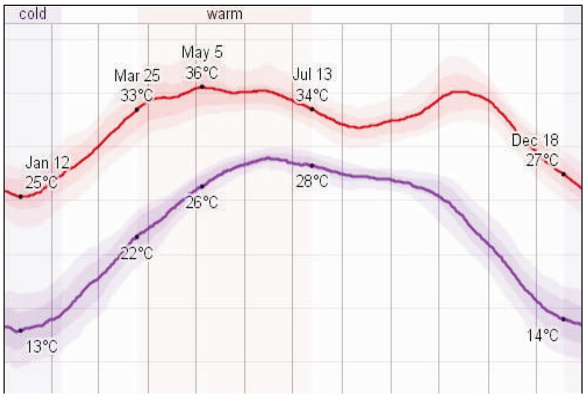



**Fig 5.3:** Daily High and Low Temperature

The following Tables show that for the eleven years (2001-2013) the annual mean minimum temperature ranged between 21.0 and 22.5°C and averaged at 21.8°C at Karachi Airport Meteorological Station. The annual mean maximum on the other hand ranged between 32°C and 33°C and averaged at 32.6°C. During winter the range of variation of temperature is large with respect to maximum and minimum temperatures. The mean monthly minimum temperatures recorded for February has a range of 7°C while the range in the case of mean monthly maximum during the thirteen years (2001-2013) at Karachi Airport Meteorological Station is 5°C. The large range in each case is more likely the result of lower relative heat capacity of the desiccated soil during winter and higher relative heat capacity of soil having higher moisture content.

30, when it is observed during 14% of all days.

**Table 5.4: Mean Monthly Maximum Temperature oC**

| 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 |
| 2010 | 27.5 | 29.2 | 34 | 35.7 | 36.5 | 34.7 | 34.6 | 33.2 | 34.5 | 35.9 | 32.7 | 28 | 33.0 |
| 2011 | 26.9 | 28.5 | 33.2 | 35.8 | 35.3 | 35.3 | 34.2 | 32.8 | 32.9 | N/A | N/A | N/A | N/A |
| 2012 | 25.7 | 26.9 | 31.7 | 35.1 | 35.5 | 34.6 | 33.2 | 32.7 | 33.2 | 35.0 | 32.7 | 28.2 | 32.0 |
| 2013 | 26.7 | 28.0 | 33.3 | 34.0 | 35.1 | 36.5 | 33.8 | 32.1 | 33.0 | 35.7 | 32.3 | 28.3 | 32.4 |

*Source: Pakistan Meteorological Department*

**Table 5.5: Mean Monthly Minimum Temperature oC**

| 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 |
| 2010 | 12.2 | 14.7 | 21.3 | 25.1 | 28 | 28.2 | 28.3 | 27.2 | 25.8 | 23.9 | 17.4 | 11.1 | 21.9 |
| 2011 | 11 | 14.5 | 19.7 | 23.1 | 27.1 | 28.8 | 27.8 | 28.6 | 26.5 | N/A | N/A | N/A | N/A |
| 2012 | 11.2 | 11.9 | 19.1 | 24.5 | 27.2 | 28.0 | 27.9 | 26.9 | 26.4 | 22.7 | 18.6 | 14.2 | 21.5 |
| 2013 | 11.6 | 15.1 | 19.2 | 24.2 | 27.1 | 29.3 | 28.0 | 26.6 | 25.5 | 25.4 | 18.1 | 13.0 | 21.9 |

*Source: Pakistan Meteorological Department*

### 5.2.2.2. Precipitation

The probability that precipitation will occur has been found to vary from different days of July and August at Karachi throughout the 1992-2012 period. Precipitation most likely occurs around August 4, in 35% of all days. Precipitation is least likely around April 27, occurring in 2% of all days.

Thunderstorms are the most severe type of precipitation observed during 38% days precipitation. They are most likely around August 12, when it is observed during 12% of all days. Drizzle is the most severe precipitation observed during 34% of those days with precipitation. It is most likely around July

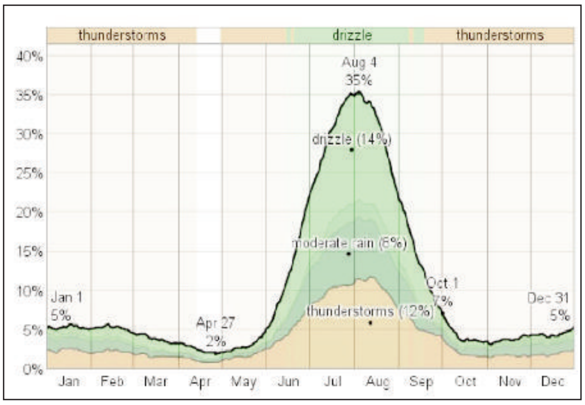



**Fig 5.4:** Fraction of days on which different types of precipitation are observed

Moderate rain is the most severe precipitation observed during 22% of those days with precipitation. It is most likely around July 28, when it is observed during 8% of all days. When precipitation does occur it is most often in the form of thunderstorms (40% of days with precipitation have at worst thunderstorms) and cloud burst, drizzle (36%), moderate rain (19%), and light rain (5%).

The rainfall in Karachi is extremely low and erratic; accordingly this region falls in the semi-arid climatic zone. The following Table shows the last thirteen years precipitation data recorded at Karachi Airport station.

The wet years have been found to follow a 3-year cycle during the first 9 years of the 3rd 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. In July and August 2011 again there was heavy rainfall all over Sindh. Hyderabad received about 74 to 103 mm rain in 24 hours and the same amount poured in Karachi and the villages in its outskirts. The torrential rains resulted in flooding of several villages in Karachi District.

**Table 5.6: 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 | 33.46 |
| 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 | 13.87 |
| 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 | 54.15 |
| 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 | 13.18 |
| 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 | 18.34 |
| 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 | 60.22 |
| 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 | 52.26 |
| 2008 | 8.0 | Trace | 1.1 | 0.0 | 0.0 | 0.0 | 54.0 | 37.5 | Trace | 0.0 | 0.0 | 21.0 | 24.32 |
| 2009 | 3.0 | Trace | 0.0 | Trace | 0.0 | 2.6 | 159.9 | 44.0 | 68.9 | 0.0 | 0.0 | 1.5 | 55.68 |
| 2012 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | Trace | Trace | 8.1 | 121.0 | 0.0 | 0.0 | 22.8 | 152.1 |
| 2013 | Trace | 20.0 | 2.8 | 30.0 | 0.0 | Trace | 5.5 | 105.4 | 4.0 | 1.2 | 0.0 | 0.0 | 168.9 |

*Source: Pakistan Meteorological Department*

The rainfall data 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 294 mm in 2009. Karachi received 147 mm of rain between the evening of 17 July and the morning of 19 July and another 147 mm on August 30 and 31. The year 2013 was not as eventful as in the past. Karachi reportedly received 140mm of rain and only the low lying areas were affected.

Major inundation and land submergence was noticed in Karachi in July 2003 and August 2006. On both occasions precipitation pattern and intensity was almost similar. The downpour on both occasions was a cloud burst. For estimating the impact of inundation on the six corridors, the maximum intensity of Rainfall of 18th August 2006 at 77mm in about 3 hours i.e. 25.7mm/hour will be considered critical and adopted for making estimates on land submergence.

### 5.2.2.3. Wind Speed and Direction

The meteorology of Karachi is governed by the seasonal variations in the quality of air over the North Arabian Sea. The wind blows throughout the year with high velocities during the summer months, when the direction is southwest to west. During winter the wind blows from north to northeast, shifting southwest to west in the evening hours. The wind usually carries sand and salt resulting in severe wind erosion and corrosion. The 2001-2013 data wind velocity and direction indicates that the velocity varied and ranged between 2.6 m/s to 12.6 m/s during the period. The wind direction is unsettled and speed is low during the period intervening the two seasons viz. summer and winter.

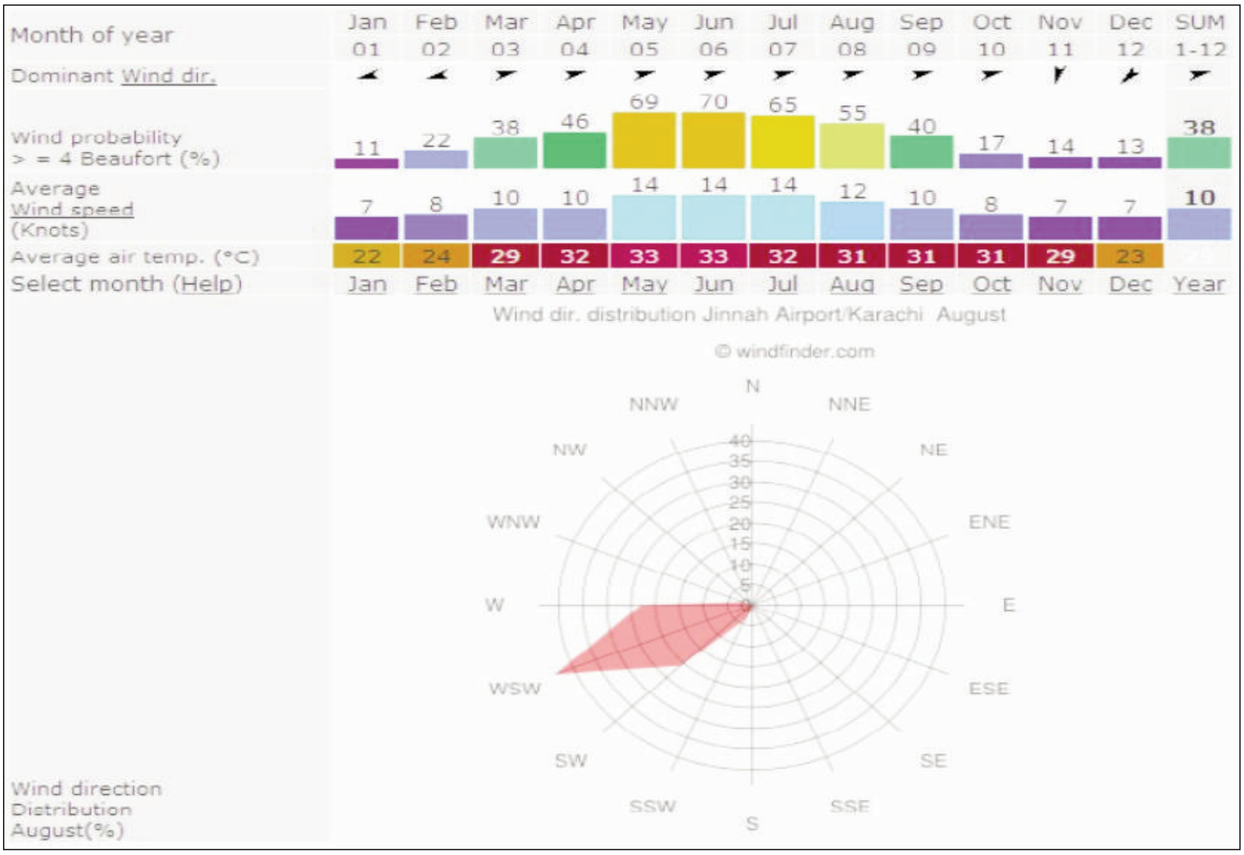



**Fig 5.5:** Wind rose for Karachi (Data Source: PMD)

### 5.2.2.4. Humidity

The relative humidity has been found to range from 25% (dry) to 91% (very humid) over the 1992-2012 period. The air is driest around Feb 9, at which time the relative humidity drops below 33% (comfortable) three days out of four; it is most humid around August 2, exceeding 83% (humid) three days out of four.

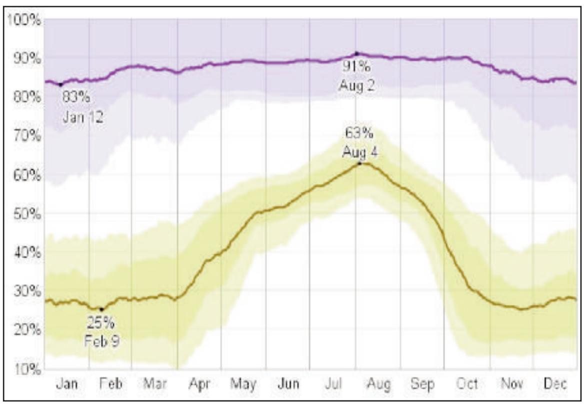



**Fig 5.6:** Humidity record of Karachi

The average daily high (blue) and low (brown) relative humidity with percentile bands (inner bands from 25th to 75th percentile, outer bands from 10th to 90th percentile). The trend of variation of humidity is similar to that followed in the case of temperature and precipitation as is evident from the following Figure:

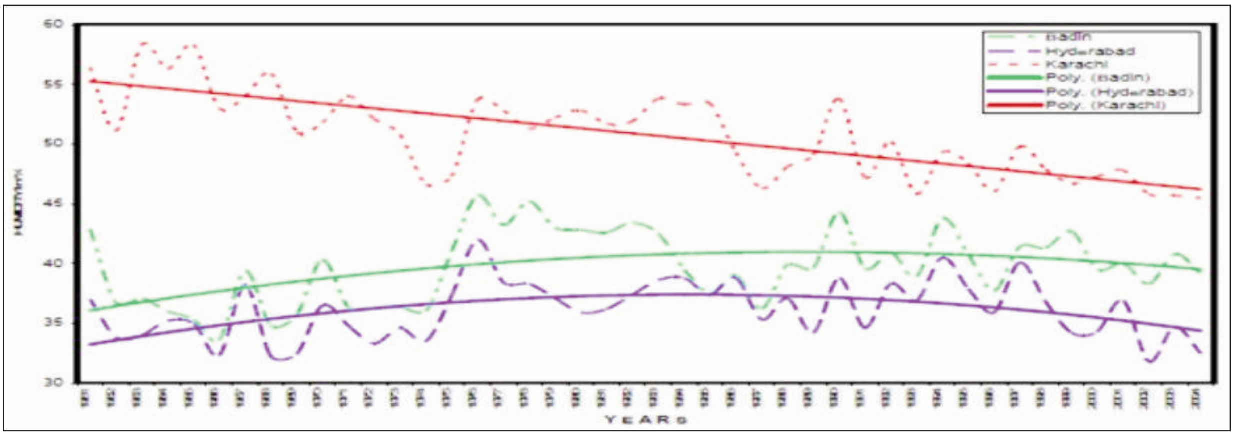



**Fig 5.7:** Graphical presentation of Humidity curves for lower Sindh region (1981-2004)

It has been observed that below normal evapotranspiration given by ETo and above normal relative humidity (RH) provide ideal conditions for crop production. Contrarily below normal RH and above normal ETo places the area under water/moisture stress, a condition that negatively

**Fig 4.8:** Heavily polluted industrial wastewater being discharged into the Malir River and being used by vegetable growers who find a ready market for green vegetables in Karachi.

affects normal growth/yield of crops in the warmer days of summer. It is the stress situations created by high evapotranspiration, high aridity and hence desiccation of the soil that are largely responsible for the observed changes in climatic norms. This is why vegetable growers around Karachi feel free to use sewage (sometimes!) mixed with Industrial wastewater discharged by Industries on the banks of the river and sewage from the nearby squatter settlements.

### 5.2.2.5. Ambient Air Quality Monitoring

Air Quality Measurement has been conducted by EMC at 07 locations (Figure 5.8) for 24 hours for one location each on weekday (Monday-Thursday). EMC has utilized the services of SUPARCO for ambient air quality assessment. They have conducted field survey through their mobile testing stations for air quality measurement. Air quality measurement was carried out on the following locations on BRT corridor.

**Table 5.7: Field survey location for Air Quality Measurement**

| BRT | No. | Survey Points |
|---|---|---|
| Green Line | G-1 | Depot- CNG Green Bus Terminal, Surjani |
| | G-2 | Shara-e-Usman- Opposite Ghazi Public School near Power House Intersection |
| | G-3 | Shara-e-Sher-Shah Suri- Opposite Farooq-e-Azam Mosque, North Nazimabad |
| | G-4 | Nawab Sadiq Ali Khan Road- Anu Bhai Park- Pedestrian Bridge, Nazimabad No. 1 |
| | G-5 | Business Record Road- Business recorder road- Opposite Subhani Mosque |
| | G-6 | M.A Jinnah Road- Numaish intersection near Rangers |
| | G-7 | M.A Jinnah Road- Opposite Radio Pakistan near Sabri- KMC Orangzaib market |

Ambient air data has been collected for the criteria pollutants CO, NO, NO2, SO2, Lead, PM10, PM2.5, as well as SPM with meteorological parameters at the selected points around the site. Duration of measurement for each pollutant was 24 hours with 15 minutes interval. The sample collection procedures used for air quality assessment are in accordance to the SOP based on the methods of United State Environmental Protection Agency (USEPA).

**Analysis of Air Quality Data**

Analytical data for air quality measurement on green line is given in the Table 5.8 and air quality data analysis is given below:

- **Sulphur Dioxide**

The average prescribed NEQS limit of sulphur dioxide (SO2) is 80 µg/m3. It has been noted from the analysis of data (green line) that the 24 hourly average value of SO2 at each location is within the permissible limit.

- **NO**

The recommended average NEQS 24 hours value of nitrogen oxide (NO) at 40 µg/m3. At most of the locations NO emission value is high as compared to NEQS limit.

- **NO2**

The NO2 emission is within the permissible limit (NEQS) i.e. 80 µg/m3 for 24 hours except location at G-6 and G-7.

- **Carbon Monoxide**

The average level of CO is 4.6 (8 hrs) within the recommended safe limit. CO was found to be maximum at 4.7 and minimum at 4.2. CO emission also does not find limiting concentrations in the NEQS or World Bank Guidelines. WHO has proposed a limit of 10,000 µg/m3 or 9 ppm as 8:00 hours average. The average concentration of CO at all the mid-sections is noted below 9 ppm while the average of the maximum has been recorded at 4.7 ppm and the minimum found to 4.2 ppm at quite mid-sections.

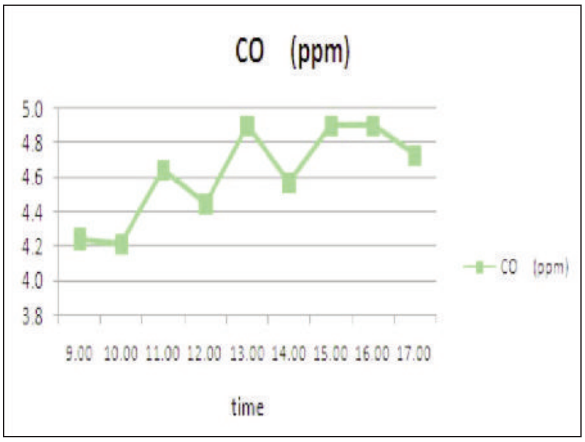
The contribution of primary pollutants in terms of percentage is as follows:

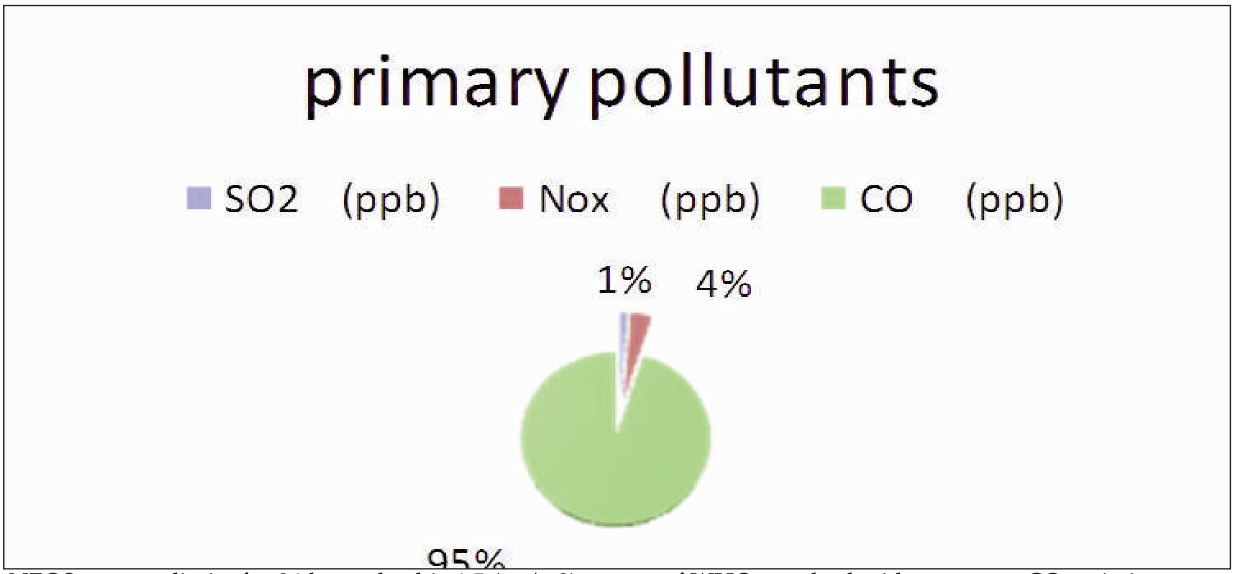
- **SPM/PM10/PM2.5**

The 24 hours average concentration of SPM/PM10/PM2.5 prescribed by NEQS 24 hourly are 500/150/35 µg/m3. At all locations of green line are within permissible limit.

- **Lead (Pb)**

| Green Line | |
|---|---|
| Time | CO (ppm) |
| 9.00 | 4.20 |
| 10.00 | 4.20 |
| 11.00 | 4.60 |
| 12.00 | 4.40 |
| 13.00 | 4.90 |
| 14.00 | 4.60 |
| 15.00 | 4.90 |
| 16.00 | 4.90 |
| 17.00 | 4.70 |
| Total Average | 4.60 |



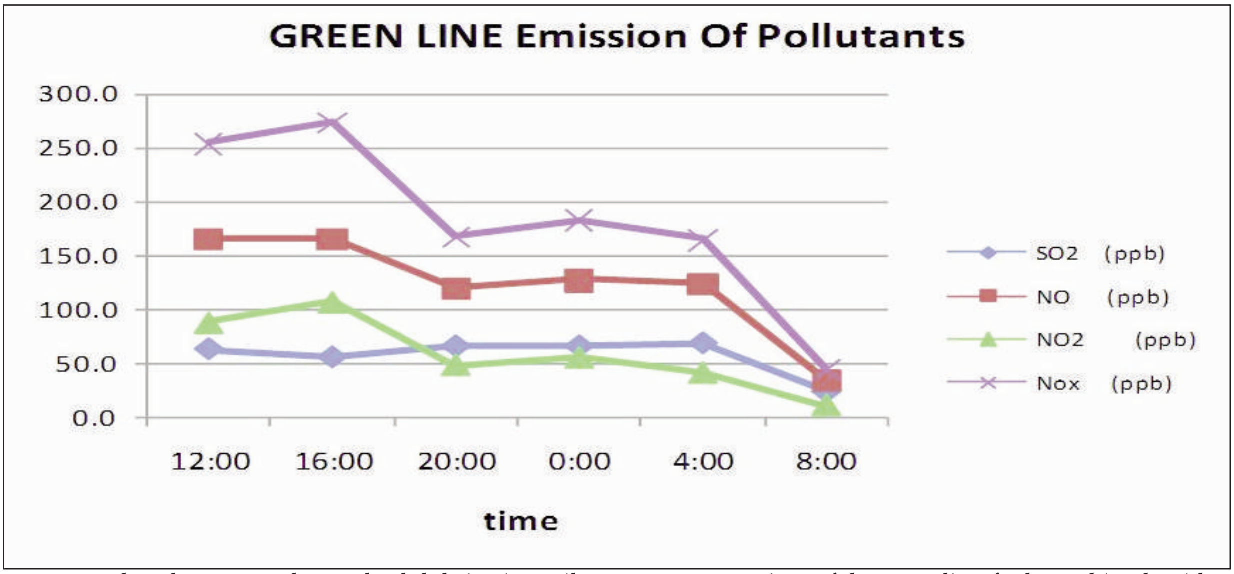




NEQS average limits for 24 hours lead is 1.5 (µg/m3). Air quality monitoring data suggests that the concentration of lead is high at all intersections except G-1, varying from 1.3 to 4.2. This reflects that heavy traffic movement on these intersections in addition to outdated vehicles resulting in emission of lead.

Data on pollution level were analyzed for each pollutant to correlate with emissions from different modes of traffic it has been found that the CO concentration at different observation points in the city (during 9:00 hours morning to 17:00 hours) remains between 3.7 ppm minimum and 4.9 ppm maximum and an average of 4.1 ppm at green line corridor. At traffic intersections there was no violation of WHO standard with respect to CO emission.

The emission level of CO is attributed to inefficient performance of automobile engines and the resulting incomplete combustion of fuel leading to emission of this gas, and lower as well as disproportionate emission of CO2. The high concentration of NOx at the traffic intersection is attributed to the use of diesel oil and increasing conversion of vehicles on CNG usage, besides higher temperature reached as a result of long and continuous running of the engines on congested roads.

Particulate matter emissions reported here as PM10 is characteristics of diesel oil as well as vehicles with two stroke engines like rickshaws, Suzuki trucks and




motor cycles that use sub-standard lubricating oil. High level of volatile organic constituents, VOCs is related to inefficient use of diesel oil. The overall level of pollutants is lower than the estimates based on fuel usage and high volume of traffic. One of the reasons for this observation may be the low wind velocity which does not allow accumulation of pollutants at the time of observation.

The impact of emission is therefore not just on the micro-environment of the vehicular traffic but is dispersed along the Green Line in the direction of the wind that is generally towards the northeast.

The histograms and tables given below indicating the maximum, minimum and average level of a particular matter i.e. SPM, PM10 and PM2.5 along the intersections of green line.

consumption of low quality fuel combined with a dramatic expansion in the number of vehicles on the road, has led significant air pollution problem. The ambient air quality of green line with respect to Sulphur Dioxide, Nitrogen Oxide and Nitrogen Dioxide is out of NEQS limits of those locations where number of traffic volume is high especially of rikshaws and motorcycles.

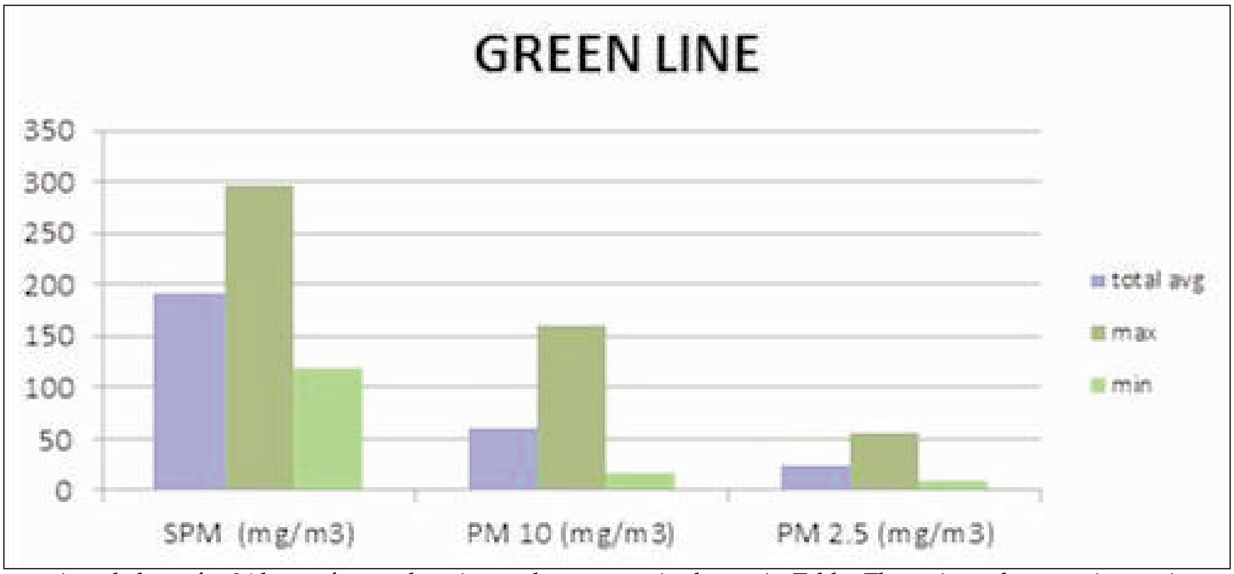
The problem of air pollution is more acute in highly business congested area of green line where movement of air is minimal. The problem has been compounded by the presence of old model vehicles which has completed their lifetime. Old model automobiles are energy inefficient and emit more hazardous gases than the standard adopted by auto industry.

#### 5.2.2.6. Noise & Vibration Monitoring

| Green Line | SPM (mg/m3) | PM 10 (mg/m3) | PM 2.5 (mg/m3) |
|---|---|---|---|
| Total avg | 191.7 | 61.0 | 24.3 |
| Max | 296.0 | 160.0 | 55.0 |
| Min | 120.0 | 16.0 | 10.0 |

Fuel quality and vehicle emissions are closely link and affect the level of pollution. The wide spread

Noise and vibration level measurement is also conducted on the same 07 locations (Figure 5.8) as




mentioned above for 24 hours for one location each on weekday (Monday-Thursday). Noise and vibration level has measured per 10 minutes and subtotal hourly.

Following are the recommended national environment quality standards (NEQS) values for noise level in different areas.

Table 5.10 gives the range of average, maximum and minimum noise level at the different locations along the green line.

The average noise level recorded on green line between the minimum of 63 dB(A) at 4:00 am and maximum of 76 dB(A) at 9:00 am to 7:00 pm.

The noise level of all locations except CNG green bus terminal surjani town (G-1) is high as compared to NEQS noise level for commercial area and less than for industrial area. These values, however, do not represent the actual scenario, since the peak noise emitted by rickshaws, motor cycles and heavy vehicles are higher than the recorded at the edge of the road or at a distance of 7.5 meters. The noise level recorded on the various mid-sections of the green line exceeds 65 dB(A) in each case i.e. it exceed the values recommended for commercial areas by NEQS, which is shown in Table. The noise values are increasing as the number of vehicles increasing on the road suggesting that the vehicles are main contributor of noise. The noise level is at its peak level i.e. 76 dB(A) and almost constant from 8:00 am to 8:00 pm. The minimum noise level is recorded at 4:00 am. The data is presented according to NEQS, day time (6:00 am-10:00pm) and night time (10:00 pm-6:00am).

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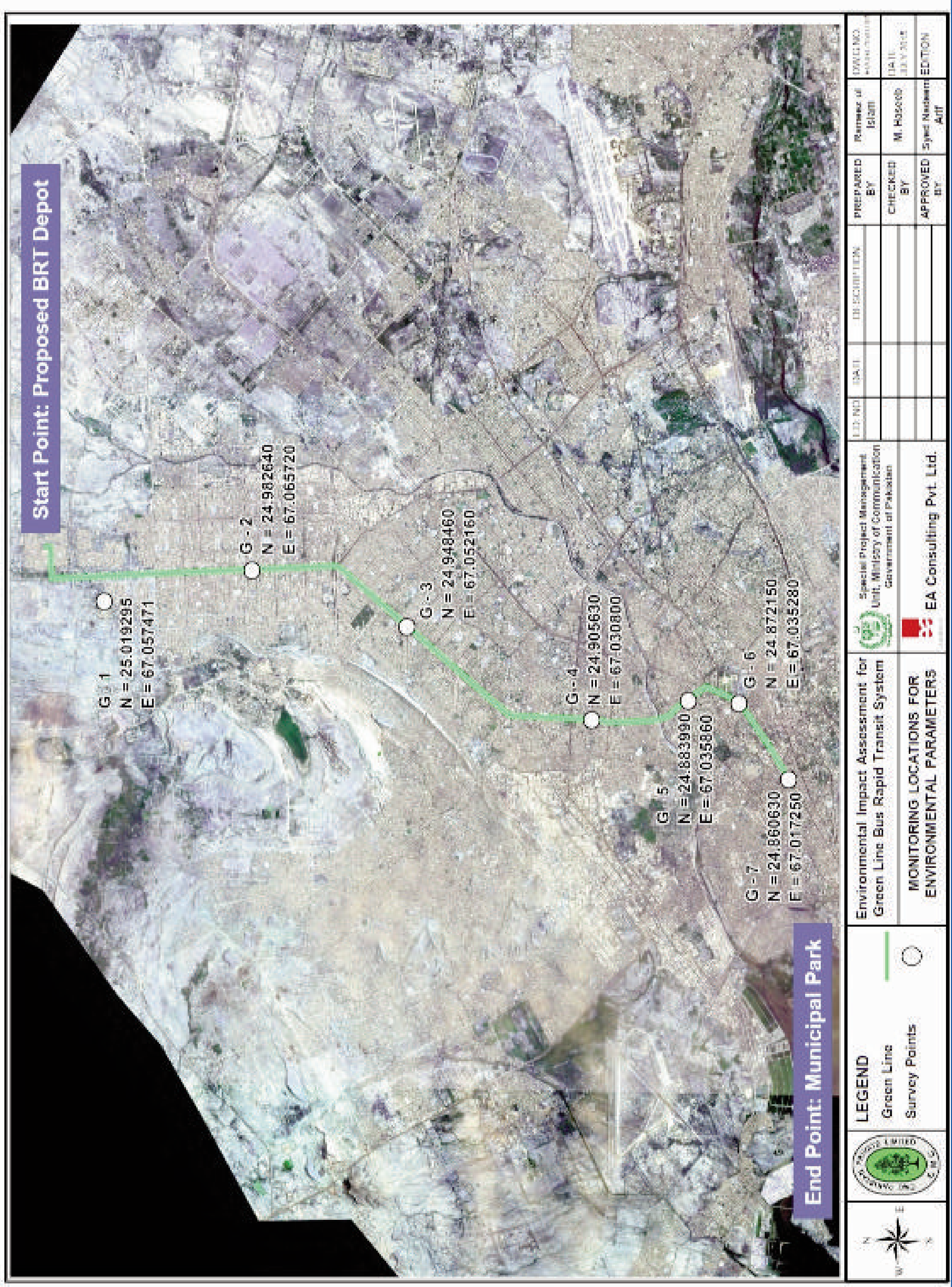



**Fig 5.9:** Monitoring Locations of Environmental Parameters

**Table 5.8: Air Quality Data Green Line**

| Location | Parameter | SO2 (ppb) | NO (ppb) | NO2 (ppb) | NOx (ppb) | CO (ppm) | SPM (mg/m3) | PM10 (mg/m3) | PM2.5 |
|---|---|---|---|---|---|---|---|---|---|
| G-1 | Min | 10 | 20 | 7 | 27 | 1.20 | 120 | 20 | 10 |
| | Max | 32 | 48 | 18 | 60 | 2.90 | 215 | 130 | 40 |
| | Average | 22.26 | 30.25 | 11.01 | 41.26 | 2.07 | 180.21 | 44.69 | 18.67 |
| G-2 | Min | 14 | 25 | 10 | 35 | 2.10 | 150 | 16 | 10 |
| | Max | 36 | 47 | 19 | 59 | 4.20 | 296 | 160 | 55 |
| | Average | 23.34 | 34.99 | 13.02 | 48.01 | 3.27 | 185.73 | 57.67 | 22.80 |
| G-3 | Min | 49 | 41 | 12 | 61 | 2.10 | 135 | 20 | 15 |
| | Max | 99 | 196 | 66 | 250 | 5.60 | 196 | 80 | 40 |
| | Average | 71.62 | 115.94 | 42.61 | 158.55 | 3.45 | 171.27 | 51.43 | 25.37 |
| G-4 | Min | 35 | 52 | 24 | 77 | 4.30 | 125 | 20 | 10 |
| | Max | 125 | 196 | 96 | 281 | 8.60 | 296 | 130 | 52 |
| | Average | 73.09 | 120.70 | 54.15 | 174.86 | 6.06 | 209.94 | 67.02 | 28.27 |
| G-5 | Min | 41 | 88 | 18 | 108 | 2.30 | 120 | 20 | 10 |
| | Max | 99 | 175 | 96 | 246 | 8.30 | 263 | 120 | 50 |
| | Average | 62.72 | 122.70 | 49.30 | 172 | 4.33 | 173.65 | 40.82 | 21.18 |
| G-6 | Min | 32 | 41 | 52 | 120 | 2.10 | 156 | 40 | 18 |
| | Max | 91 | 325 | 196 | 421 | 8.60 | 296 | 140 | 35 |
| | Average | 59.90 | 189.40 | 104.13 | 293.53 | 5.52 | 226.73 | 80.04 | 24.45 |
| G-7 | Min | 41 | 52 | 41 | 128 | 3.10 | 145 | 40 | 20 |
| | Max | 115 | 298 | 145 | 403 | 9.50 | 263 | 160 | 45 |
| | Average | 71.86 | 177.84 | 92.46 | 270.30 | 5.42 | 194.13 | 85 | 29.31 |
| NEQs | Annual Average | 80µg/m3 | 40µg/m3 | 40µg/m3 | - | - | 360µ/m3 | 120µ/m3 | 15µ/m3 |
| | 24 Hours | 120µg/m3 | 40µg/m3 | 80µg/m3 | - | - | 500µ/m3 | 150µ/m3 | 35µ/m3 |
| | 8 Hours | - | - | - | - | 5mg/m3 | - | - | - |
| | 1 Hour | - | - | - | - | 10mg/m3 | - | - | 25µ/m3 |

**Table 5.9: National Environment Quality Standards (NEQS) for Noise**

| S.No | Category of Area/Zone | limit in dB(A) Leq | |
|---|---|---|---|
| | | Day time | Night time |
| 1 | Residential area | 55 | 45 |
| 2 | Commercial Area | 65 | 55 |
| 3 | Industrial Area | 75 | 65 |
| 4 | Silence Zone | 50 | 45 |

*Source: The Gazette of Pakistan, Extra, November 26, 2010.*

is shown in Table. The noise values are increasing as the number of vehicles increasing on the road suggesting that the vehicles are main contributor of noise. The noise level is at its peak level i.e. 76 dB(A) and almost constant from 8:00 am to 8:00 pm. The minimum noise level is recorded at 4:00 am. The data is presented according to NEQS, day time (6:00 am-10:00pm) and night time (10:00 pm-6:00am).

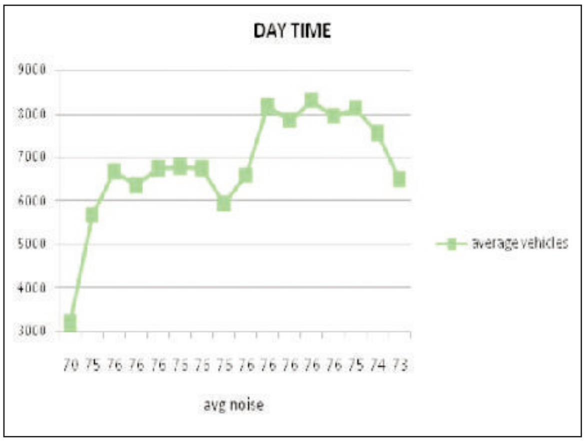
**Analysis of Noise Pollution Data**

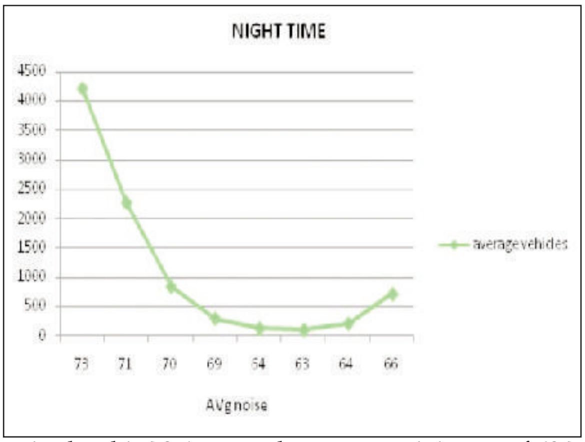
The noise level data recorded at the mid-sections were used for the identification of noise stress zones in the study area. Areas with an average noise level of 75.5 ±1.5 dB(A) between an average of peaks of 85 + 2 dB(A) and the average minimum of 69 ± 1 dB(A) were placed in category-1 designated as "Under Stress"

**Table 5.10: Noise quality along green line**

| S.No. | Location | Noise Level | | |
|---|---|---|---|---|
| | | Average | Max | Min |
| G-1 | CNG Green Bus Terminal, Surjani | 61.7 | 65.6 | 57.5 |
| G-2 | Shahrah-e-Usman, Opposite Ghazi Public School near Power House Intersection | 77.5 | 81.3 | 70.9 |
| G-3 | Sharah-e-Sher Shah Suri, Opposite Farooq-e-Azam Mosque, North Nazimabad | 75.9 | 80.2 | 66.2 |
| G-4 | Nawab Sadiq Ali Khan Road, Munnu Bhai Park Pedestrian Bridge Nazimabad No. 1 | 73.4 | 78.0 | 60.6 |
| G-5 | Business Recorder Road Opposite Subhani Mosque | 72.2 | 77.7 | 58.6 |
| G-6 | M.A. Jinnah Road Numaish Intersection near Rangers | 73.7 | 82.0 | 62.8 |
| G-7 | M.A. Jinnah Road Opposite Radio Pakistan near Sabri KMC Orangzeb Market | 73.9 | 77.4 | 62.8 |

| Day Time | Avg. Noise | Average Vehicles |
|---|---|---|
| 7:01 | 70 | 3200 |
| 8:01 | 75 | 5660 |
| 9:01 | 76 | 6669 |
| 10:01 | 76 | 6353 |
| 11:01 | 76 | 6740 |
| 12:01 | 76 | 6769 |
| 13:01 | 76 | 6737 |
| 14:01 | 76 | 5928 |
| 15:01 | 76 | 6572 |
| 16:01 | 76 | 8168 |
| 17:01 | 76 | 7837 |
| 18:01 | 76 | 8299 |
| 19:01 | 76 | 7951 |
| 20:01 | 75 | 8114 |
| 21:01 | 74 | 7547 |
| 2201 | 73 | 6485 |
| **Night Time** | **AVG Noise** | **Average Vehicles** |
| 23:01 | 73 | 4210 |
| 24:01 | 71 | 2263 |
| 1:00 | 70 | 838 |
| 2:01 | 69 | 293 |
| 3:01 | 64 | 125 |
| 4:01 | 63 | 99 |
| 5:01 | 64 | 209 |
| 6:01 | 66 | 711 |

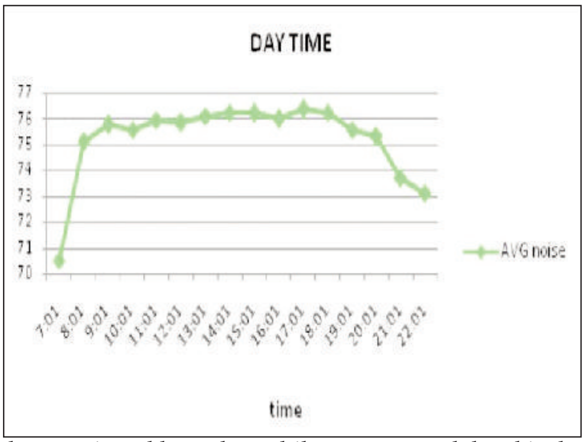


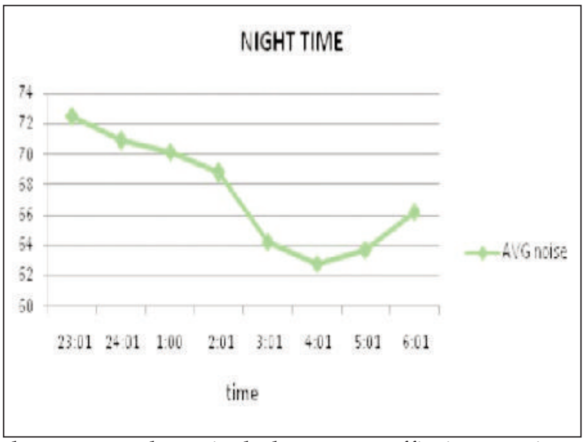




while those with higher average of 79 ± 2 dB(A) and ranging between an average of peaks of 90 + 2 dB(A) and the average of minimum of 72.5 + 2.5 dB(A), were placed in category-2, designated as "Potential Hazardous". According to this classification the green line is marginally in the safe zone since the average noise level is 72.6 ranges between a minimum of 62.7 dB(A) and maximum of 82.5 dB(A).

Average Peak Noise Level – Average Minimum Level = Impact of Noise Level

Above relation indicate the noise impact level to which the persons on the roadside are exposed. It may




be mentioned here that while average peak level is the average of peak emissions, the low is in fact the back ground level when there is no disturbance due to noise. The difference viz. (Average Peak Noise Level) – (Average minimum Noise Level) therefore, represents the range of noise level and the virtual impact may have on the sensitivity of the auditory systems in the living environment.

The range of deviation when calculated for 24 hours implies the amount of energy resulting from noise pollution, made to flow continuously and to shower it on the hearing sense cells whose task is to convert the mechanical energy into nerve impulses. This amount of energy is sufficient to cause a drop in bioelectric nerve potential and to create an oxygen deficiency in the micro-environment of the sound transmission system of the body. Unfortunately this damage to the ear cannot be calculated since hospital records do not classify the ear diseases. However, there is a general consensus among the Ear, Nose and Throat (ENT) Specialists that 30 to 40% psychological abnormalities, hyper-tension, etc. can be attributed to vehicular traffic related ailments particularly noise level rise in specific areas.

**Noise Pollution Zones**

The noise level data generated from the detailed survey suggest that the vehicular traffic is the main source of noise pollution. It is wide spread all along the route and particularly so as traffic intersections and congestion points. The noise level, however, decreases with increasing distance from source. It was observed that the noise level in the vicinity increased only at times when a noisy vehicle entered the premises. The areas with noise level above tolerable limits are located on the front of the roadsides. Such areas where the noisy vehicles e.g. the rickshaws, motor cycles are in abundance have the limits of this zone (viz. the one whose level exceeds tolerable limits) stretched over to more than one lane. The zone of noise level, which is above the level of distress, has been observed to lie between the two sides of the road, while the zone, which is highly hazardous, lays in the middle of the road particularly the road islands.

The footpaths along the two lines fall in the distress zone. The front of the shops and households adjacent to the footpaths also fall in the distress zone while the inside of the shop and households unless exposed to noise emission from the vehicles marginally in the safe zones since the noise level is about 65 dB(A).

**Vibration**

Traffic-induced vibration is a low frequency disturbance, which can be transmitted through the air or ground. Air-borne vibration from traffic is produced by engines and exhausts, whereas ground-borne vibration is produced by the interaction between rolling wheels and the road surface. There are two effects of traffic vibration that need to be considered, these being the effects on buildings and the disturbance caused to occupiers of properties.

Extensive research has been carried out on a range of buildings of various ages and types, and no evidence has been found to support the theory that traffic induced ground-borne vibration is a source of significant damage to buildings. Ground-borne vibration is also much less likely to be the cause of disturbance to occupiers than air-borne vibration. Neither is there any evidence that traffic-induced air-borne vibration can cause even minor damage to buildings. However, it can be a source of annoyance to local people, causing vibrations of doors, windows and, on occasions, floors of properties close to the route. It can be transmitted through the feet and legs, the hands and arms but most commonly through the buttocks while seated in a vehicle. The magnitude of the effect of vibration depends on the severity and length of exposures.

Vibration is directly proportional to noise level on green line. The vibration is maximum in day time when traffic at its peak.

**Table 5.11: Vibration Level Measurement (Green Line)**

| S.No. | Location | Average | Max | Min |
|---|---|---|---|---|
| G-1 | CNG Green Bus Terminal, Surjani | 65.2 | 69.3 | 61.0 |
| G-2 | Shahrah-e-Usman Opposite Ghazi Public School near Powerhouse Intersection | 80.6 | 84.5 | 74.0 |
| G-3 | Shahrah-e-Shershah Suri Opposite Farooq-e-Azam Mosque, North Nazimabad | 78.9 | 82.8 | 68.8 |
| G-4 | Nawab Sadiq Ali Khan Road, Munnu Bhai Park, Pedestrian Bridge, Nazimabad No.1 | 76.4 | 81.3 | 63.8 |
| G-5 | Business Recorder Road Opposite Subhani Mosque | 75.3 | 81.8 | 61.0 |
| G-6 | M.A.Jinnah Road Numaish Intersection near Rangers | 76.9 | 85.2 | 66.0 |
| G-7 | M.A.Jinnah Road Opposite Radio Pakistan near Sabri KMC Orangzeb Market | 77.0 | 80.5 | 67.18 |

### 5.2.2.7. Metrological Factors

The metrological factor is very influencing in air pollutants dispersing, and it could be influence to air pollutant in the atmosphere. Air pollutant phenomenon could not only be described by pollutant concentration from the emission source, but also we should estimate the metrological condition. Some important factor could influence the air pollutant concentration which is wind and temperature. Table 5.12 shows the meteorological data monitored on green line route.

- **Wind Speed**

Wind speed will affect the particulate matter dispersing, while wind rose will affect the direction of air pollutant dispersion. Therefore, wind is one factor could influence air pollutant concentration in the ambient air.

- **Temperature**

In general there are two turbulent processes in ambient air e.g. mechanical turbulence and thermal turbulence. The unstable air in the earth surface can be caused by temperature differences and could make wind flow with the medium speed or high speed, until the air pollution substance could fast disperse into atmosphere and their concentration could decrease. If the ambient air is stable and wind speed is low, so there is limitedness of air pollutant dispersion while concentration of the emission is still high in around its sources.

- **Atmosphere Stability**

It is commonly categorized into six stability classes.

These are briefly described in table given below.The radiation, increasing in size gradually from sunrise to

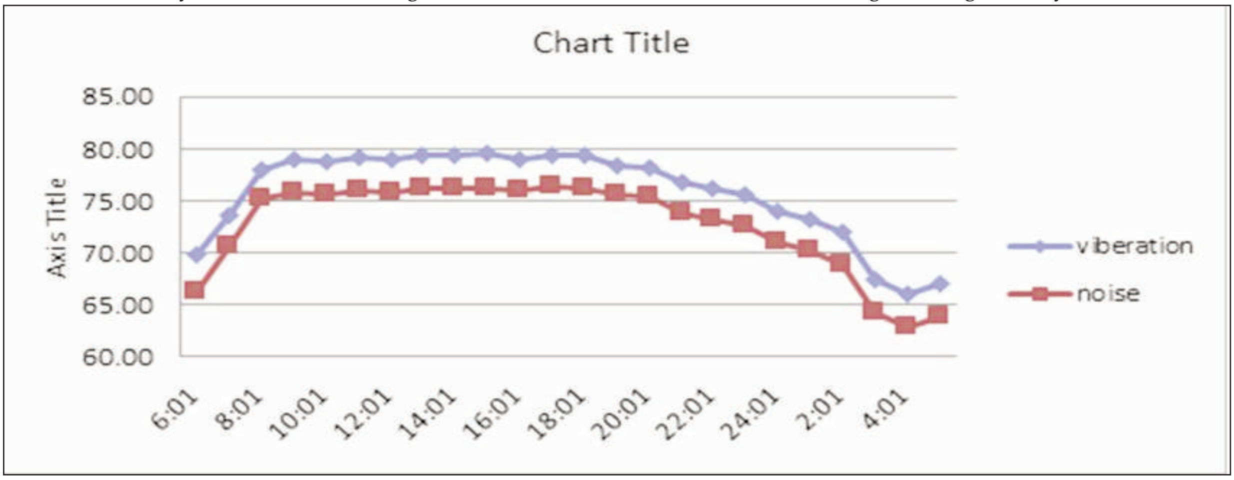



**Fig 5.10:** Noise and Vibration Level on Green Line

**Table 5.12: Meteorological data monitored along Green Line**

| Location | Value | Wind Speed (m/s) | Pressure (mbar) | Wind Direction (degree) | Air Temp. (oC) | Humidity (%) | Solarimeter (W/m2) |
|---|---|---|---|---|---|---|---|
| G-1 | Min | 0.00 | 1001.21 | 6.86 | 15.34 | 54.82 | 4.72 |
| | Max | 6 | 1007.90 | 359 | 28.07 | 96.47 | 657.13 |
| | Average | 1.18 | 1004.01 | 134.57 | 21.01 | 76.04 | 185.60 |
| G-2 | Min | 0.08 | 1005.77 | 4.91 | 17.24 | 32.12 | 4.64 |
| | Max | 2.81 | 1011.02 | 359 | 29.48 | 82.48 | 585.31 |
| | Average | 0.08 | 1007.71 | 132.01 | 22.79 | 61.77 | 160.09 |
| G-3 | Min | 0.00 | 1010.68 | 11.54 | 14.67 | 45.05 | 4.56 |
| | Max | 5.76 | 1015.98 | 349.14 | 23.48 | 85.28 | 718.55 |
| | Average | 2.39 | 1012.72 | 174.47 | 20.21 | 63.35 | 198.41 |
| G-4 | Min | 0.02 | 1010.92 | 9.95 | 14.20 | 11.29 | 4.64 |
| | Max | 3.05 | 1019.90 | 359 | 25.23 | 51.48 | 574.47 |
| | Average | 1.04 | 1013.99 | 143.10 | 19.85 | 32.15 | 146.56 |
| G-5 | Min | 0.00 | 1012.75 | 0.83 | 13.81 | 13.84 | 3.92 |
| | Max | 5.23 | 1017.07 | 359 | 27.33 | 66.96 | 643.60 |
| | Average | 1.71 | 1014.79 | 158.70 | 19.84 | 47.53 | 173.21 |
| G-6 | Min | 0.00 | 1008.43 | 1.99 | 17.38 | 11.66 | 7.68 |
| | Max | 2.67 | 1017.90 | 359 | 28.54 | 50.60 | 503.13 |
| | Average | 0.81 | 1012.95 | 171.96 | 22.93 | 28.86 | 139.44 |
| G-7 | Min | 0.00 | 1015.56 | 2.18 | 15.89 | 25.38 | 7.41 |
| | Max | 1.35 | 1020.74 | 352.95 | 24.74 | 59.45 | 457.07 |
| | Average | 0.19 | 1017.64 | 157.50 | 19.75 | 43.56 | 42.84 |

atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of sector reach maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During night time a stable layer, with limited vertical mixing exists.

| Type | Classes | Conditions |
|---|---|---|
| A | Very Stable | calm in, clear skies, hot day time conditions. |
| B | Moderately Stable | clear skies, day time conditions. |
| C | Unstable | moderate wind, slightly overcast, daytime conditions. |
| D | Neutral | high winds or cloudy and nights are cold. |
| E | Stable | moderate wind, slightly overcast, night time conditions. |
| F | Very Stable | low wind, clear skies, cold night time conditions |

During cloudy conditions, the atmosphere is normally a neutral.

More the calm condition during winter higher is a level of CO. usually the concentration is maximum in winter. At plausible explanation of these result may be found by examining metrological conditions. The general metrology during the winter is dominated by high pressure causing increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses. Stagnant air masses allow accumulation of pollutants in any given area.

During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as dispersed. Wind velocities will allow for pollutant transport away from sources.

Air pollutants show variation in their levels. During the day time, solar heating causes maximum turbulence and strongest vertical motions. This causes the maximum amount of momentum exchange between the various levels in the atmosphere. On clear height with night winds, heat is radiated from the earth surface resulting in cooling of the ground and air adjacent to it. This result is in extreme stability of the atmosphere near the earth's surface. Under these conditions turbulence is at a minimum.

| Soil Quality Measurement | Description |
|---|---|
| Methodology | Open Pit |
| Sample depth | 1.5 meter |
| Soil Quality Parameters | pH, Color, Smell, Volatile Organic Compounds, Heavy metals (As, Zn, Pb, Cu, Cd, Ag, Cr6+), Oil and Grease, Pesticide PCB. |

### 5.2.3. Soil Quality of the Project Area

Soil Quality Measurement was conducted at three locations along BRT Corridor. Soil samples were sent for the laboratory analysis.

The analytical results from the soil sub-matrix have shown significant values (shown in table given below)

**Table 5.13: Soil Quality Measurement Analytical Result**

| Compound | LOR | Unit | SP1-1.5M | SP2-1.5M | SP3-1.5M | EQSMinistry of Environment Government of Japan |
|---|---|---|---|---|---|---|
| pH Value | 0.1 | pH Unit | 9.9 | 9.1 | 9.6 | |
| Moisture Content (dried @ 103oC) | 0.1 | % | 9.1 | 10.6 | 2.4 | |
| Antimony | 1 | mg/kg | <1 | <1 | <1 | |
| Arsenic | 1 | mg/kg | 11 | 12 | 5 | 0.01mg/l ~ 15 mg/kg |
| Beryllium | 0.5 | mg/kg | 0.5 | 0.6 | <0.5 | |
| Cadmium | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | 0.01 mg/l ~ 150 mg/kg |
| Chromium | 1 | mg/kg | 34 | 41 | 15 | 0.05 mg/l~ 250 mg/kg 7x10-6 mg/kg |
| Copper | 1 | mg/kg | 16 | 16 | 8 | 125 mg/kg |
| Lead | 1 | mg/kg | 9 | 8 | 6 | 0.01mg/l~ 150 mg/kg |

**Table 5.13: Soil Quality Measurement Analytical Result**

| Compound | LOR | Unit | SP1-1.5M | SP2-1.5M | SP3-1.5M | EQSMinistry of Environment Government of Japan |
|---|---|---|---|---|---|---|
| Nickel | 1 | mg/kg | 33 | 42 | 8 | |
| Selenium | 1 | mg/kg | <1 | <1 | <1 | 0.01 mg/l~ 150 mg/kg ~2.0x10-6 mg/kg |
| Silver | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | |
| Thallium | 0.5 | mg/kg | <0.5 | <0.5 | <0.5 | |
| Zinc | 1 | mg/kg | 36 | 37 | 21 | |
| Mercury | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | 0.0005 mg/l~ 150 mg/kg 3.6 x10-8 mg/kg |
| Benzene | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | 0.01mg/l 1.1x10-5 mg/kg |
| 1.1.1-Trichloroethane | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | 1 mg/l 7.5 x10-4 mg/kg |
| 1.1-Dichloropropylene | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | |
| Carbon Tetrachloride | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | 0.002 mg/l 1.2 x10-6 mg/kg |
| 1.2-Dichloroethane | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | 0.004 mg/l ~ 3.1 x10-6 mg/kg |
| 1.1.2-Trichloroethane | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | 0.006 mg/l ~ 4.1 x10-6 mg/kg |
| Simazine | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | 0.003mg/l ~ 2.3 x10-6 mg/kg |

than the standards for all three samples.

All samples are low as compared to National Environment Standards for Soil Contamination as per Japan Standards.

## 5.2.4. Geology & Geomorphology

According to AH Kazmi, the entire lower Indus plain in whose fringes lies the Karachi Plain, is underlain by Eocene limestone (Geology of the Indus Delta, AH Kazmi, in Marine Geology & Oceanography of Arabian Sea and Coastal Pakistan, ed. BU Haq, JD Milliman, Van Nostrand Reinhold Company, New York 1984). It was deposited in a shallow sea, the remanat of the Tethys seaway, which was gradually eclipsed as a result of the northward drifting of the Indo-Pakistan plate and its ultimate collision with the Eurasian plate to the north.

The shoreline of the Indus plain had, during the Oligocene and Miocene era, a north-south orientation and extended from the area presently occupied by the Kirthar fore deep up to Karachi and beyond. A relatively shallow sea washed its shores. According to Kazmi as well as DeJong (A. Farah and KA DeJong, Geodynamics of Pakistan, 1979), it is likely that a number of offshore islands, formed parallel to the coastline as a result of the earliest phase of Himalayan Orogeny, dotted this sea.

Between these islands and the Indus coastline the sea formed relatively shallow and narrow gulf which is most likely the Kirthar Gulf. The Middle Miocene phase of Himalayan orogeny suddenly obliterated the Kirthar Gulf, moving the coastline rapidly to the vicinity of Karachi. The Kirthar Fore deep replaced the Kirthar gulf. This fore deep may have been occupied by one of the major streams of the Indus plain, most probably the Lyari, if not by Indus itself.

Karachi and adjoining areas have plains, hills, rivers, valleys and coasts as diversified physical features. Rocks ranging in age from Eocene to recent, deposited under shallow marine to deltaic conditions are exposed. Karachi is a part of major synclinorium stretching from Ranpathani River in the east to Cape Monze in the west. Mehar and Mol mountains lie in the north. Within the synclinorium a number of structures such as Pipri, Gulistan-e-Jauhar, Pir Mangho and Cape Monze are exposed. The presence of concealed structures under the Malir River Valley, Gadap and Mauripur plains can fairly be deduced (GSP, 2001).

Various rock units described above have been folded to form anticlinal hills and synclinal valleys, with moderate to gentle dips. The fold axes run approximately north-south. Structurally the area may be divided into two zones. First zone is to the east and northeast and it is characterized by relatively more intense folding and faulting. Rocks ranging in age from Paleocene to Oligocene are also exposed in this zone. The second zone is located in the centre and to the west and southwest and comprises the large area, which opens out towards the south and largely consists of horizontal or near horizontal strata which form gentle structural undulations in the form of synclines and anticlines with low dips of 2 to 6 degrees (rarely up to 10 degrees). These folds have a general southward plunge direction.

These structural features clearly indicate that the structure of the Gaj basin (Khadeji basin) is more suitable for the accumulation and storage of ground water by virtue of more extensive recharge zones, locations of probable groundwater aquifers at shallower depths and several shallow synclinal structures.

Karachi and its surrounded area are exposed by middle and upper tertiary rocks, shale-clay, sand stone and lime stone. The lowest of this exposure are sand stone and lime stone of nari formation of Oligocene age. About the Nari lies the Gaj limestone and shale of Miocene to Pliocene and partially of Pleistocene age.

The Nari formation is represented usually by soft sand stone intercalated/ interlayer with lime stone, shale and siltstone. The Gaj formation is represented by limestone with sub-ordinate shab and sandstone. A large part of Gaj formation has alkaline soils due to the presence dolomite / gypsum in the underline bed

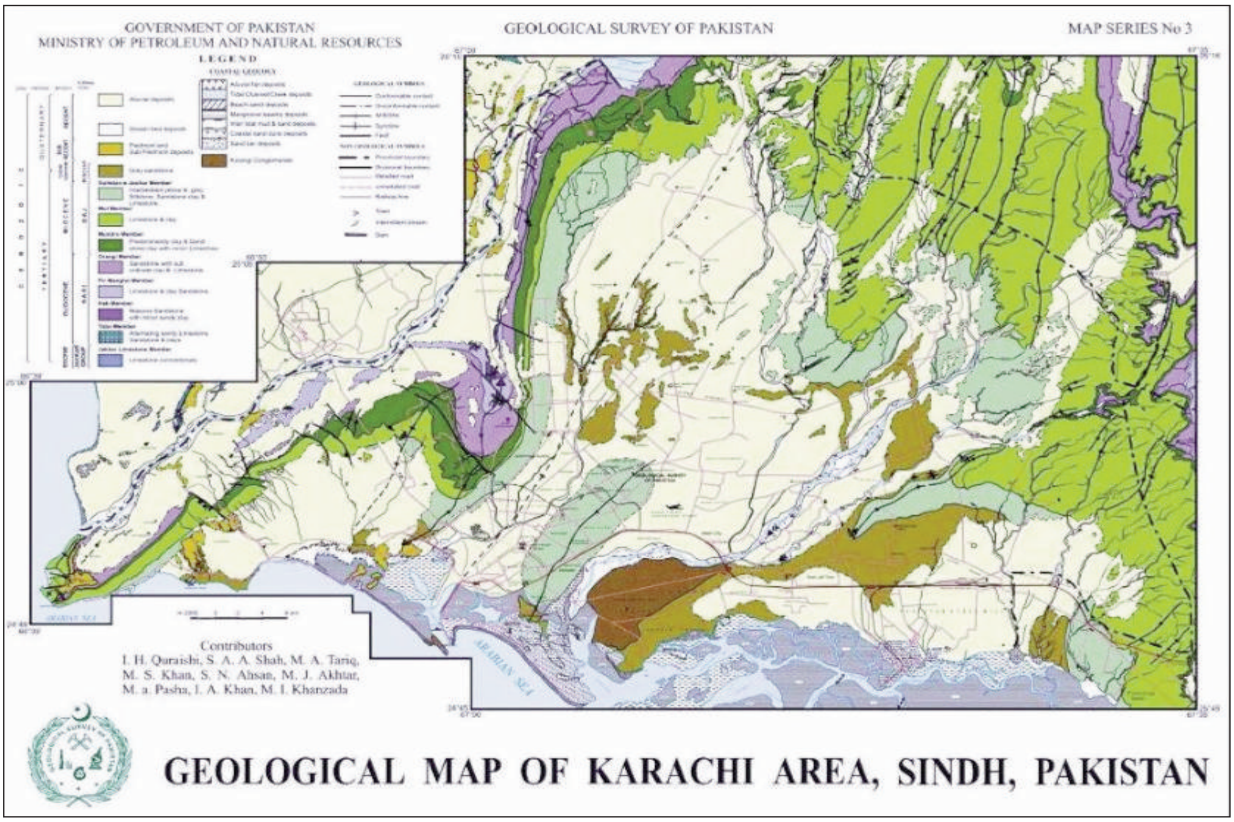



**Fig 5.11:** Geological Map of Karachi showing fold and fault structures

rocks Quaternary deposits are represented by conglomerate which overlies the Mianchar formation.

### 5.2.5. Land Form Types

A variety of landforms can be identified and mapped within the length and breadth of Karachi region (Ahsanullah, Research Report #9 (HP – RR/9) Master Plan for Karachi Region, Master Plan Department, KDA). These fall into three broad groups:

- Mountain Landforms which occur in the highlands or mountainous areas
- Low Lands comprising river valleys, their flood plains, alluvial plains, piedmont and exposed bedrock plains
- Marine Landforms of the coastal region comprising beaches, beach ridges, coastal cliffs, tidal mudflats, and mangrove swamps.

### 5.2.6. Seismicity

Karachi Building Control Authority has placed Karachi in Zone 2, based on the actual events, the past observance of fault movement and other geological activities. It has been inferred that Karachi is situated in a region where moderate earthquakes of magnitude 5.0 to 6.0 equivalents to intensity between VI and VIII on Modified Mercalli Scale may occur. On the basis of correlation of different scales and zoning, Karachi has been established as being situated in a noticeably moderate earthquake zone.

On the basis of magnitude of earthquake experienced in the past from 1970 to 2005, four seismic zones have been identified in and around Karachi.

1. One seismic zone lies to the west of Karachi, passing across the Sonmiani area. It extends south-westwards into the Arabian Sea having alignment with the submarine Murray Ridge and seems to extend towards Uthal-Bela areas in the north.
2. The second seismic zone seems to follow the south-eastern margin of Kirthar Range from the north to the south, swinging ultimately towards the southwest. This zone includes Karchat, Thano Bula Khan, Lakhra, Jhimpir, Jungshahi, Thatta and areas further south.
3. The third zone passes across the eastern vicinity of Badin in the northeast-southwest direction along the eastern margin of the Indus Delta.
4. The fourth seismic zone lies across the Pakistan-India border. Earthquakes of low to moderate magnitudes - 3.1 to 4.0M and 4.1 to 5.0M - dominate in these zones.

Karachi is situated close to the junction of three tectonic plates (Indo-Pakistan, Arabian and Eurasian Plates). The significant faults in the vicinity include Rann of Katch Fault in east and Pub-Null Fault in west. The Rann of Kutch-Karachi fault, also known as Karachi-Jati-Allah Bund fault, passes close to the Eastern Industrial Zone of Port Qasim. It has three other segments namely the Jhimpir fault, the Pab fault, and the Surjani fault.

The earthquake hazard in the Indus Delta and the estuaries on the passive continental margin is mainly from intra-plate active faults particularly Rann of Kutch Fault and Pab Fault and their strands. The most spectacular effect of the active fault of Rann of Kutch which grazes the vicinity of Karachi was due to severe earthquake of June 1819. It resulted in the 6 m uplift of 16 km wide and 81 km long tract of alluvial land which blocked on eastern band of the Indus River and therefore the locals called it Allah Band. The main faults between Karachi and Rann of Kutch are generally oriented easterly and slightly concave to the north.

Historically two sever earthquakes in the vicinity of

Karachi have been reported one in the year 1050 at Bhanbore in which 0.15 million casualties were taken place and the other in the year 1668 at Pipri near Steel Mill which was only 60 km away from Karachi, however the details of which are not available (Iqbal Mohsin, 2005). The earthquake of Bhoge in the year 2001 (Ahmedabad 300 km east and Karachi 300 km west) has also been reported however Karachi remained safe.

Historically this region has suffered a number of earthquakes. A list of earthquakes, since 1977 to date, which may affect the proposed area and its vicinity, are given in Table 1. The largest earthquake occurred in 1819. It had a magnitude of 8.0 on Richter scale and was felt over a wide swath of the Indian subcontinent.

Eastern branch of the Indus River was blocked. Long tract of alluvial land (81 Km long, 6m height, 16 Km wide) got uplifted as a result of earthquakes. This earthquake was also associated with surface faulting and subsequent subsidence in the epicenter area. This fault produced a scarp called "The Allah Bund". The effects of recent earthquake on January 26, 2001 have also been noticed in the deltaic areas.

These earthquakes occurred along an approximately East West direction trending the thrust fault at a shallow depth of less than 25 Km.

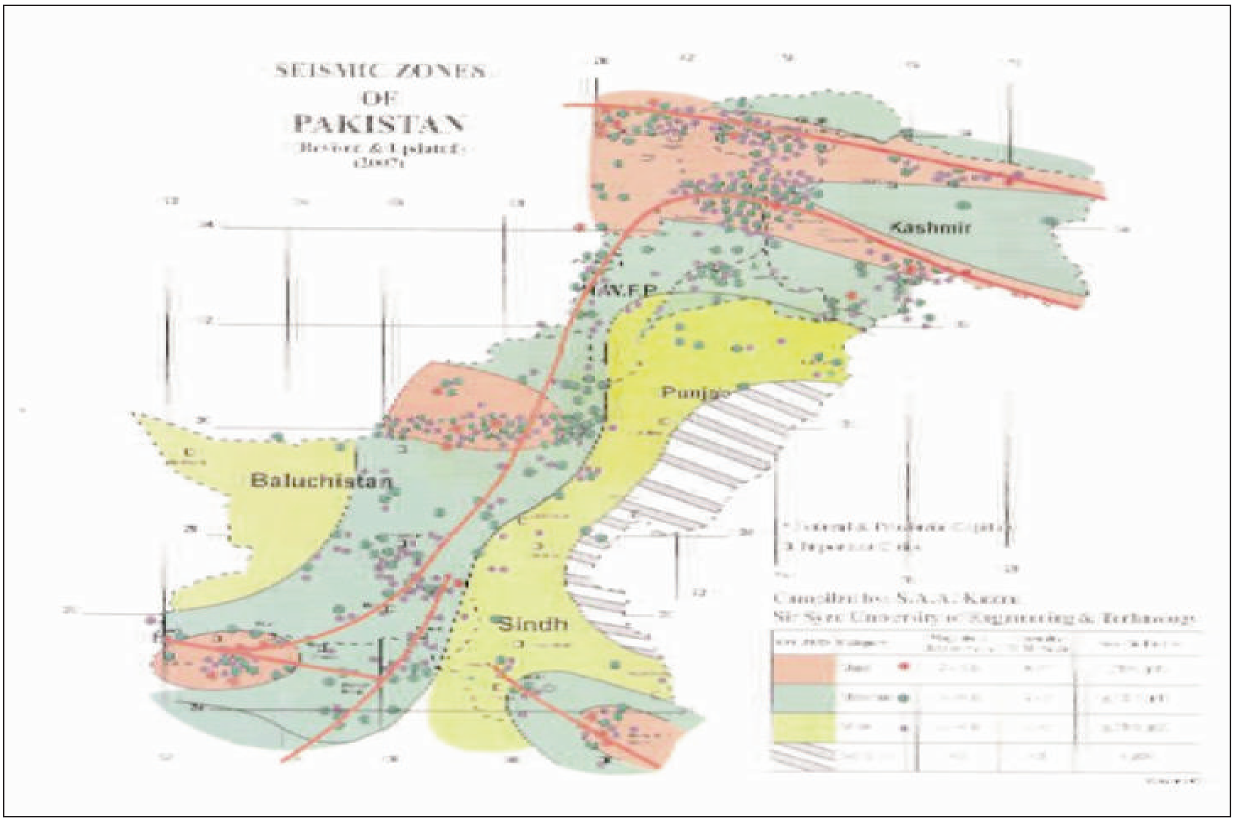



**Fig 5.12:** Seismic Zone of Pakistan

Quakes of higher magnitudes (above 5.0M) take place only in the Rann of Kutch, which is a known high-risk area.

Records show that earthquakes of low to moderate magnitudes occurred in the zones -Murray Ridge-Sonmiani-Uthal, south-eastern Kirthar, and NE-SW Badin areas. Moderate magnitude earthquakes in Jangshahi, Thatta, Jhimpir and Thano Bula Khan Area which produced low to moderate intensity shocks in Karachi as experienced in 1985.

Interestingly, some earthquakes of more than 4M that took place to the west of Karachi in the Arabian Sea at about the same distance as that of the 1985 earthquakes were not felt in Karachi. Similarly, the great Bhuj earthquake of 2001 - which measured 8.0 on the Richter scale and which caused enormous damage in Ahmedabad and its surrounding areas – did not cause much damage in Karachi or Hyderabad even though these two Pakistani cities are situated as far away from the epicenter as Ahmedabad. Much like the tremors resulting from the micro-quakes occurring from July to October of 2005, jolts were felt as well between August and September of 1998. During the two-month period, some 11 micro-earthquakes, with magnitudes ranging from 2 to 3.9M, took place in addition to numerous smaller ones.

**Table 5.14: List of Earthquakes in Indus Deltaic region and surroundings with latitude 23.0-25.0° N and longitude 67.5-71.0° E**

| Date | LAT.( °N) | LONG(°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 |
| 06.01.2001 | 23.4 | 70.32 | 7.6 | 7.6 |

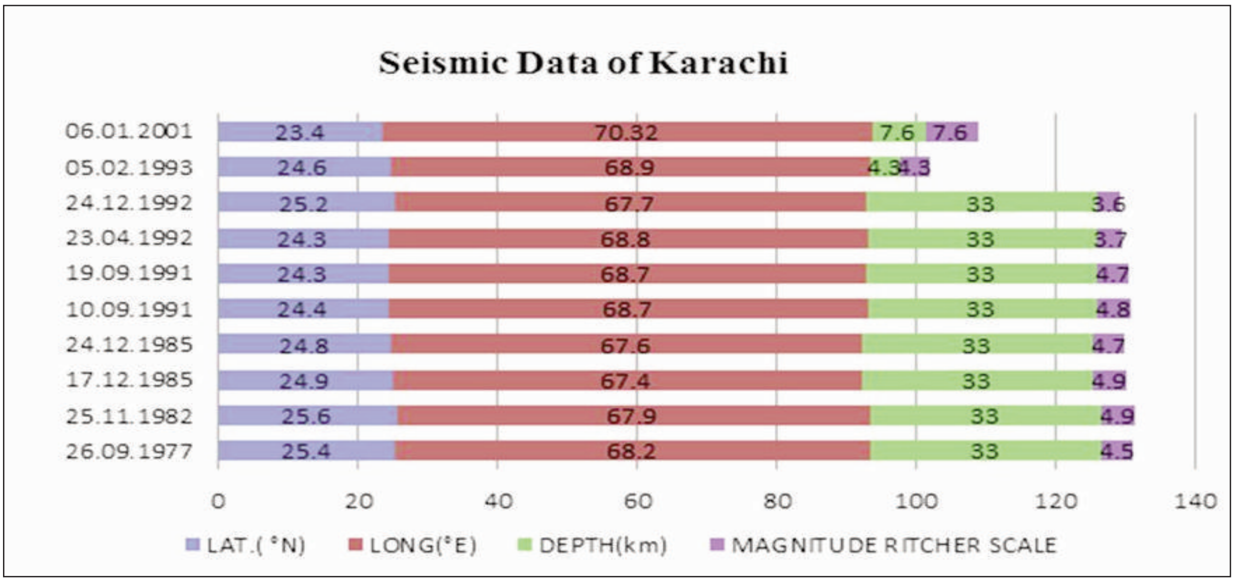
*Source: Final Technical Report Impacts of Proposed Water Front Development Project on the Hydraulic Regime, 2005.*

These events were only recorded at PMD's Karachi Seismic Station. Major active faults around Karachi Metropolis are:

(1) Surjan Fault (2) Jhimpir Fault (3) Pab Fault (4) Hab Fault and (5) Rann of Kutch Fault is discussed below.

### 5.2.6.1. Surjan Fault

Along the Kirthar Range front, there is N-S trending active faults. They are dip-slip or bedding-plane faults. North of Karachi and west of Lakhra, the north-south Surjan Fault cuts across the Quaternary deposits. West of Jhimpir, the southern end of this fault is intersected by the northwest trending Jhimpir Fault. The interaction of these two faults is characterized by at least four tele seismic events of



shallow focal depth and magnitude 3-6.The maximum magnitude of the earthquake associated with the Surjan Fault is of the order of M ~ 6-1.

#### 5.2.6.2. Jhimpir Fault

N-W trending: A number of epicenters are located on this fault. The fault has produced an earthquake of M ~ 5.6 on Richter scale.

#### 5.2.6.3. Pab Fault

The Pab fault on is 135 Km in length and is oriented on north-south. The maximum magnitude of the earthquake associated with this fault is of the order M ~ 7.0 on Richter scale. The Pab fault has dislocated vertically the Quaternary alluvial fans.

#### 5.2.6.4. Hab Fault

The Hab valley is traversed by this fault.

#### 5.2.6.5. Rann of Kutch Fault

The orientation of the Rann of Kutch 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.

In 1819 and 1956, this fault has been responsible for sever earthquakes in Gujrat, Tharparkar and Indus delta. Previous studies have revealed that this fault traverses the Karachi Metropolitan area and possibly passes through D.H.A. buildings in Karachi (Mirza et.al., 1984).

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 for the later.

Dr. Iqbal Mohsin (2005) in his book 'Zalzala, 8 October, 2005' has mentioned about two sever earthquakes in the vicinity of Karachi; one in the year 1050 at Bhanbore in which 0.15 million casualties are reported and the other in the year 1668 at Pipri near Steel Mill which was only 60 km away from Karachi however the details of this are not available. He has also referred the earthquake of Bhoge in the year 2001 in which Ahmedabad was 300 km towards east and Karachi was 300 km towards west, however fortunately Karachi remained safe. According to Iqbal Mohsin (2005), presently Karachi is in Zone 3 of Risk zones in the light of Geological Survey Map (1984). He also refers that in 1997, US Geological Survey and UBC have included Karachi in the list of those cities which come under the category of Risk 4 zone.

### 5.2.7. Tsunami

Due to presence of active fault system present in the Arabian Sea in the region close to Karachi, the likelihood of occurrence of tsunami is higher than experiencing an earthquake of a disastrous magnitude. The past seismic activity and records of the coastal region studies on disaster management suggests that Karachi is prone to tsunami and a warning system and monitoring station needs to be established for the warning and in time information of the occurrence of the natural disaster in order to minimize its impacts and curtail the loss of life.

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

## 5.2.8. Storms and Surges

High heat content of the Arabian Sea that is adjacent to the extensive heat zone of Pakistan usually upsets the heat balance and hence 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 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 east.

Tropical cyclones that come near the proximity of Karachi are generally weakened. 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.

In late May 2007 the heat zone in Pakistan attracted the Tropical Cyclone Gonu, and by Tropical Cyclone 03A from the south of Mumbai, and thereafter by Tropical Cyclone 04B nicknamed Yemyin, and then a series of depressions travelling almost directly to the heat zone in Pakistan. 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.

Storm Surges are oscillations of the water level in a coastal or inland water body, ranging for the period from few hours to a few days as a result of forces created in the atmospheric weather system. The factors responsible for the generation of storm are the variations in the atmospheric pressure coupled with the wind accompanying the meteorological disturbances which produce normal and tangential stresses along the sea surface and induce the movement of the sea water as well as an inclination of the sea surface.

The peculiar topography, shallowness of the water body, combined with a large tidal range, makes the storm surges more dangerous. By transferring the wind energy into the water the surges get amplified, an effect which is noticed to be more pronounced in the shallow coastal water. In the process of movement of storm the surge level is predicted on the basis of the wave condition getting developed due to the effects of cyclonic forces.

Indus deltaic creeks are located on the path of cyclones that are generated in the north Arabian Sea during the period from May to October and cross the coast near the Rann of Kutch. 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 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 depressions 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 wave in the open sandy coast thereby increasing tide water level favoring tidal inundation.

According to the studies hitherto carried out, the Sindh coast falls in a dangerous zone. In this belt the frequency of the storm striking the coast is low (for over a 75 year period only four storms struck the coast between 18 and 18oN and only three of these struck between 19 and 20o N). Since the tidal range in this belt is quite high unless peak surge occurs close to the time of high tide no major water level oscillation occurs in this region. In between Dewar-ke (India) and Karachi there is, sparsely populated extensive marshy area known as Runn of Kutch. The frequency of storm in the region is generally low and the tracks are not usually favorable for major surge development.

Tidal data recorded at Qasim as well Karachi ports was obtained and analyzed for the separation of surges on the basis of the recorded values. 1982 was selected for analysis due to the fact that the data for both the parts was available for that particular year. It was observed that maximum surge was never more than 2.0 feet. Quraishee, G.S et al (1984), analyzed the tidal data for Karachi for the period of fourteen years and extracted the data about the surges mentioned in the Table 5.15.

Table 5.15: Surges Based on 14 Year Tidal Data of Karachi

| Month | Height of Tide | Height of Surge |
|---|---|---|
| Jun 58 | 9.7 | 1.3 |
| Jul 58 | 8.2 | 1.3 |
| Oct 58 | 9.6 | 1.4 |
| Nov 58 | 8.1 | 0.8 |
| May 59 | 9.9 | 1.8 |
| Jun 59 | 6.9 | 1.6 |
| Jun 59 | 9.2 | 1.5 |
| Jun 64 | 8.6 | 1.7 |
| Jun 70 | 8.4 | 2.0 |

## 5.2.9. Aquatic Environment- Status in Macroenvironment

### 5.2.9.1. Hydrology

Karachi city is spread over an area of about 1200 sq.km in which developed area is 500 sq.km. Of this developed area about 40% comprise of industrial and the remaining 60% as residential areas. The Karachi city and its environs can be divided into four following distinct storm water catchment:

- Malir River Catchment: Draining the east area of the City and surrounding areas.
- Lyari River Catchment: Draining land beyond the northern limits of the City and the inner western city area.
- The Coastal Belt Catchment: Draining the southern area in the close proximity to the sea shore and creek areas.
- Hub River Catchment: Beyond the recognized city boundary to the west.
- Both Lyari and the Malir Rivers carry the bulk of the wastewater from the City and dispose off into the creeks. This situation is expected to continue, until sewers are re-conditioned, replaced, existing sewage treatment works refurbished and new plants constructed.

The complex creek system south east 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 water logging 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 flows 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 hypo saline 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 harbor, Pakistan Journal of Marine Sciences, 4(2), 159 74, 1995]. The observation with respect to water logging 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 taking up to Kotri during the high tides in particular during the middle of Lunar months and around the time of solar and Lunar eclipse.
2. Fresh water being supplied to Karachi marginally meets the drinking quality standards, while treatment of wastewater remains unattended.
3. Extensive excavation of sand and gravel from the reverine 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.

### 5.2.9.2. Topography and Drainage Pattern

Karachi is located in the south of Sindh, on the coast of the Arabian Sea. It covers an area of approximately 3,600 km2, comprised largely of flat or rolling plains, with hills on the western and northern boundaries of the urban sprawl. The city represents quite a variety of habitats such as the sea coast, islands, sand dunes, swamps, semiarid regions, cultivated fields, dry stream beds, sandy plains, hillocks. Classified according to physiographic features, Karachi City District can be divided into three broad categories: Hilly Region (Mountain Highland) Alluvial Plain (Piedmont Plain) Coastal Areas (Valley Floor). Among the various physiographic features, low flat-topped parallel hills devoid of vegetation, interspersed with widespread plains and dry riverbeds are the main topographic characteristics of the city. The greatest height of the region is 250 ft that gradually decreases to 5 ft above mean sea level along the coastline.

The old creeks receive the water and wastewater from the CBD through two storm water channels that flow through the heart of the city and have the capacity to carry 8000 gallons per second. One of them discharges into the Chinna Creek at Pakistan Cotton Committee Building while the second, meant to carry storm water but carries sewage from the Soldier Bazaar, Ranchhor lines area and flowing just past the Dawn Office through railway territory crosses MTK Road into the creek at Hijrat Colony. The third channel starts from the old golf course (near cantonment station), and weaving along past Glass Towers and Hilale Ahmer building towards the present Nahr-e-Khayyam, on to the Boat Basin. It has only 3000 gallons per second capacity to drain into Chinna Creek.

The Jamshed Town areas have their wastewater drainage system directed into the channel that crosses Shara-e-Faisal at Shahrah-e-Quaideen while that from the PECHS hills just north of Nursery area have a totally inadequate system. A culvert was provided for the nalla at the Nursery and this was discharging the storm water into the nalla that led past Chanesar Goth into Mahmoodabad Sewage Treatment Plant. The nalla has been converted into the Nursery Furniture Market in the north and residential/commercial areas in the south. This area at Nursery is invariably inundated with minimal rainfall.

The hilly area comprising the Hill Park have their storm water drainage system directed into the channel that flows through Tipu Sultan Road and crosses Shara-e-Faisal at this point to flow through the Administration society into the Mahmoodabad Sewerage network.

The nalla that drains the hills north of HIR Intersection - Drigh Road Railway Station, crosses Shara-e- Faisal at Mehran and discharges into Malir River shortly thereafter. Malir River also provides the drainage basin for Drigh Road Hills in the north of Drigh Road – Karachi Airport Jinnah Terminal through three nallas crossing Shara-e-Faisal at (i) Natha Khan Goth, and (ii) Jinnah Terminal Intersection. Both the crossings are inundated by even minor rainfall events. The nalla that drains into Malir River on crossing Shara-e-Faisal at Natha Khan Goth has an extensive watershed that includes the entire north of Karachi Air Port, Gulistan-e-Jauhar and the Civil Aviation Authority facilities. It had acquired perennial character owing to the discharge of wastewater and sewage from the Air Port while its upper reaches became perennial after the emergence of settlements in Gulistan-e-Jauhar Housing complex, which suggests that the nalla carries and discharges wastewater including sewage into Malir River.

The inundation at the Natha Khan crossing after each rainfall event is not because of the nalla as much as that caused by lack of drainage system for the Shah Faisal Colony Bridge, with the result that storm water inundates at both ends of the bridge. The inundation at the Jinnah Terminal Intersection is due to inadequacies of the drainage system on the south of Shara-e-Faisal. On the one hand the catchment area is too large for the small channels designed to cater to large volumes and on the other hand the channels that would carry the storm water past Shara-e-Faisal are blocked. Similar situation exists at Malir Halt, Kala Board, and Bus Stop #15 intersections where the small channels that are designed to carry sewage are unable to cater to large volumes of storm water generated by even minor rainfall events.

It is apparent that inundation of Shara-e-Faisal occurs due to paucity of a designed storm water drainage system. The storm water drains in the CBD carry sewage are thus not in a position to receive the massive volume of storm water flow caused by heavy rainfall of the 70 mm in three hours. This calls for remedial measures in terms of provision of a suitably designed storm water drainage system for the City.

#### 5.2.9.3. Water Resources in Karachi

The Indus River about 120 km to the east of Karachi city and the Hub River, a perennial stream that originates in Balochistan and marks the boundary between Karachi Division and Balochistan are the sources of water in Karachi.

Approximately 2.02 million m3/d (445 mgd), which amounts to 89% of the total supply to Karachi, is transported to the city from the Kotri Barrage on the Indus River through a system of canals and conduits. Hub River located north of Karachi, which supplies about 0.13 million m3/d (29 mgd) of water to the city. In addition to these surface water sources, an estimated 0.09 million m3/d (20 mgd) is supplied from private and public groundwater wells in and around Karachi. Except for a few Karachi Water and Sewerage Board's (KWSB) wells, all of which are connected to the piped supply system, the water from the groundwater wells is distributed through water tankers to various parts of the city.

The Lyari and Malir Rivers that passes through the area (Karachi City) do not have any natural flow, except during the monsoons. Malir River is ephemeral and is constituted from two major tributaries, i.e. Mol and Khadeji as well as some minor tributaries. Khadeji is a perennial stream that originates at Khadeji falls and gains flow as it travels across the Malir Basin.

Groundwater resources in Karachi area are limited. The aquifers close to the coastal belt are mostly saline and unusable for domestic purposes. The aquifers near the Hub River bed are well developed and are source of water for agriculture and other domestic purposes. The aquifers are estimated to lie at depths of 50-100 m.

### 5.2.9.4. Water Supply Network in Karachi

**Table 5.16: Bulk Water Supply Capacity**

| S.No | Bulk Water System | Rated Capacity (mgd) | Actual Supply (mgd) |
|---|---|---|---|
| 1. | GK system* | 280 | 300 |
| 2. | Haleji system | 20 | 30 |
| 3. | K-II system | 100 | 120 |
| 4. | K-III system | 100 | 100 |
| 5. | Dumlottee Well | 20 | 0 |
| 6. | Hub system 80 | 80 | |
| Total | | 600 | 630 |

**downstream of Fore Bay*
*Source: KW&SB*

The existing bulk water supply system for Karachi City has a capacity of 600 mgd as summarized in Table 5.16. Actually as of the end of year 2006, KW&SB supplied bulk water of about 630 mgd beyond the capacity as shown in Table 5.16. The existing bulk water supply system conveys water to Karachi from

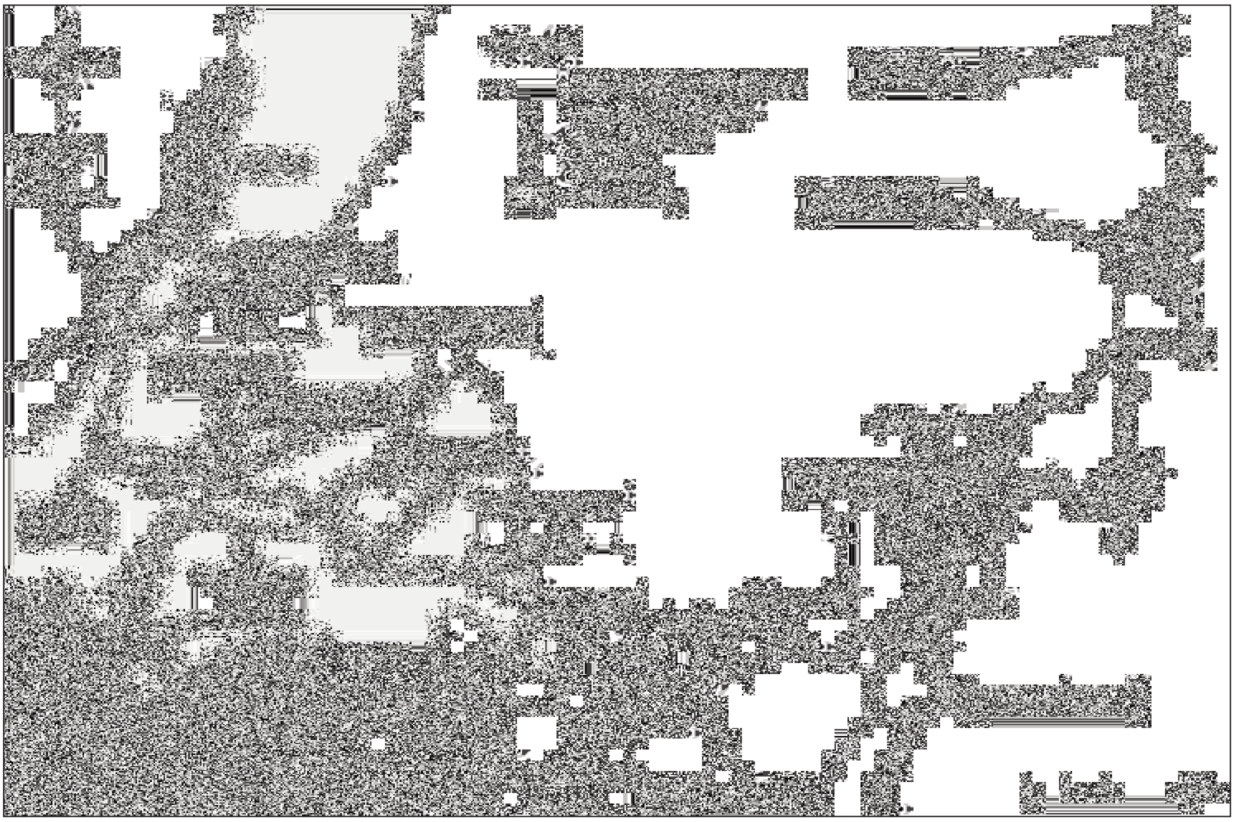


**Fig 5.13:** Bulk Water Supply system of Karachi

two main sources, namely, Indus River and Hub Dam.

The water distribution network in Karachi covers 18 towns that include the four towns that comprise the macro-environment. These 18 towns are included in 5 administrative water supply zones classified by KW&SB as shown in figure 5.17. Water is supplied through water trunk mains from water filtration plants, reservoirs, pumping stations or Dumlottee Wells in the city of Karachi.

m3/d). The untreated sewage is disposed of into the sea through nallahs and rivers including the Lyari and Malir Rivers. The total length of sewers is approximately 3,290 km and ranges from 8 inches (200 mm) to 84 inches (2,130 mm) diameter of trunk sewers, secondary sewers and laterals.

Both Lyari and Malir rivers carry the bulk of the wastewater from the city and dispose off into the creeks. This situation is expected to continue until

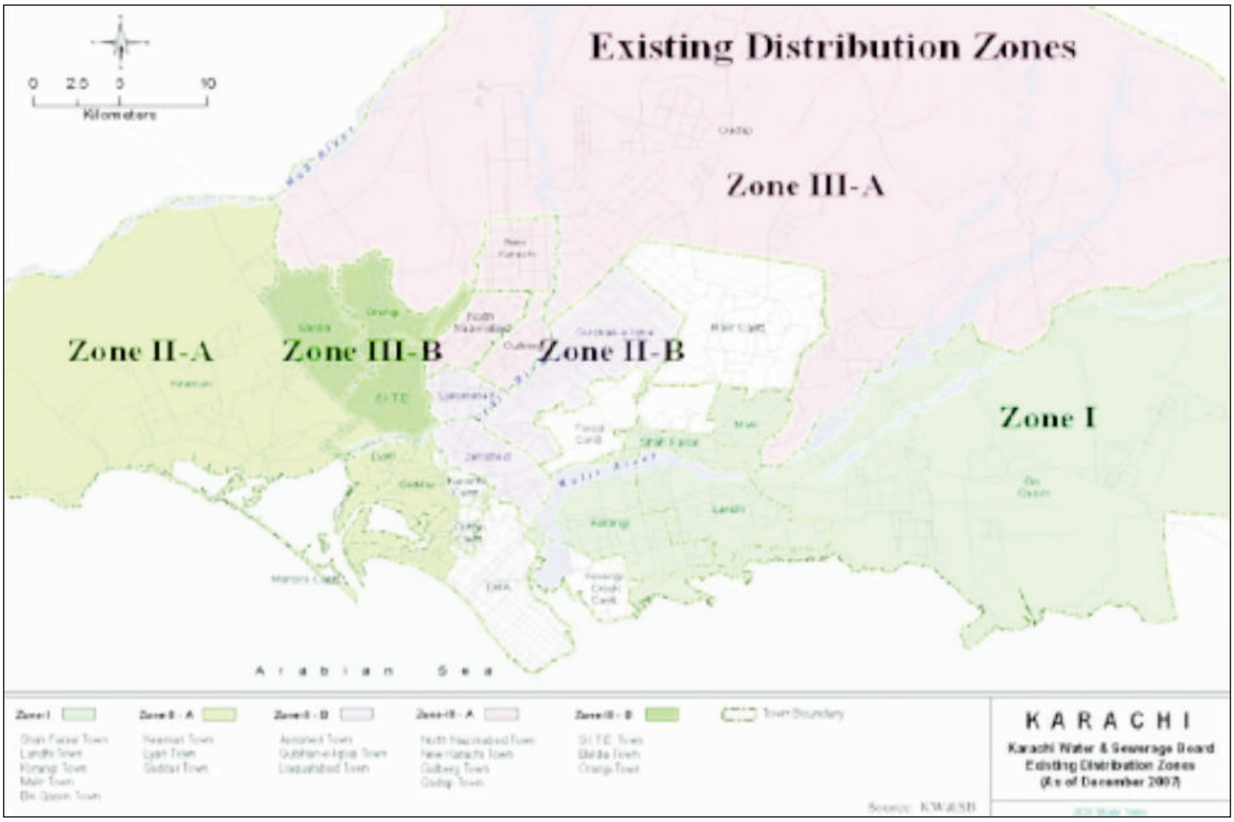



**Fig 5.14:** KW&SB present Water Supply Zones

### 5.2.9.5. Water Drainage & Collection System

About 60-70% of the water supplied to Karachi City is said to return as sewage. A total quantity of 315 mgd (1,432,000 m3/d) of domestic and toxic industrial wastewater is generated in the city. There are three sewage treatment plants in Karachi. The total design capacity of these treatment plants is 151 mgd (686,000

sewers are re-conditioned, replaced, existing sewage treatment works and refurbished and new plants constructed

### 5.2.9.6. Sewerage Collection System

There are three sewer districts in Karachi City, namely TP-1, TP-2 and TP-3 districts. New Karachi and Orangi Towns both at the right bank side of Lyari

River will be included in sewer district of TP-3 after construction of new sub main sewers to Lyari Interceptor. Korangi and Landhi Towns at the left bank side of Malir River have been isolated from sewer district of TP-2 after pressure main from these towns to TP-2 was destroyed by the flood in 1974. KW&SB has proposed new sewage treatment plant for these towns at the left bank side of Malir River. Table 5.17 outlines sewer districts in Karachi City.

**Table 5.17: Sewerage Collection System**

| Sewer District | Related Towns |
|---|---|
| TP-1 District | SITE, North Nazimabad, North Karachi, Gulberg, Liaquatabad |
| TP-2 District | Saddar, Jamshed, Faisal |
| TP-3 District | SITE, Baldia, Lyari, Saddar, Jamshed, Gulshn –e- Iqbal |
| (Korangi District) | Landhi, Korangi |
| (Orangi District) | SITE, Orangi |
| (North Karachi District) | North Karachi |

### 5.2.9.7. Storm water Drainage System

There is no exclusive pumping facility for storm water drainage in Karachi City. However, many pumping stations called "ejectors", which were constructed for sewage discharge to natural nallahs or rivers have worked as storm water pumping facilities in rainy season.

The Karachi city and its environment can be divided into four distinct storm water catchment which are as;

- Malir River Catchment: Draining the east area of the city and surrounding areas.
- Lyari River Catchment: Draining land beyond the northern limits of the city and the inner western city areas.
- Coastal Belt Catchment: Draining the southern areas in the close proximity to the sea shore and creek areas.
- Hub River Catchment: Beyond the recognized city boundary to the west.

### 5.2.9.8. Surface Water Quality Status in Microenvironment

The surface water quality testing was carried out by EMC for Green Line BRTS Project at Lyari River Stream on June 16, 2015 which gives the following results:

**Table 5.18: Water Quality Analysis for the Study for Green Line**

| S.No | Parameters | Site | Range | | NEQS Limit |
|---|---|---|---|---|---|
| | | | Min | Max | |
| 1. | Temperature | Liyari River Stream | 34°C | ≤ 30 | |
| 2. | pH | - | 8.26 | 8.34 | 6-9 |
| 3. | DO | | 3.8 mg/l | 4.4mg/l | - |
| 4. | TDS and EC | - | 1224 mg/l/1857Us/cm | 1958mg/l and 2970 US/cm | 3,500mg/l |
| 5. | BOD | - | 80mg/l | 109mg/l | 80mg/l |
| 6. | COD | - | 207mg/l | 262mg/l | 150mg/l |
| 7. | Oil& Grease | - | 3.5 mg/l | 4mg/l | 10mg/l |
| 8. | Phenolic compounds | - | 0.013mg/l | 0.017mg/l | 0.1mg/l |
| 9. | Anionic detergent | - | 1.01 mg/l | 1.12 mg/l | 20 mg/l |
| 10. | Sulfates | - | 182 mg/l | 299 mg/l | 600 mg/l |
| 11. | Chloride | - | 390 mg/l | 684mg/l | 1000 mg/l |

**Table 5.18: Water Quality Analysis for the Study for Green Line**

| S.No | Parameters | Site | Range | | NEQS Limit |
|---|---|---|---|---|---|
| | | | Min | Max | |
| 12. | Sulfide | - | 13mg/l | 15mg/l | 1mg/l |
| 13. | Fluoride | - | - | 0.88mg/l | 10mg/l |
| 14. | Nitrogen Ammonia | - | 3.87mg/l | 5.74mg/l | 40mg/l |
| 15. | Total kjeldahl organic Nitrogen and Free Ammonia Nitrogen | - | 26 mg/l | 31 mg/l | 40mg/l |
| 16. | Total Phosphorous | - | 6.08mg/l | 9.71mg/l | - |
| **Depicted Pesticidal Components** | | | | | |
| 1. | Prefenofos | Shahrah-e-Pakistan Bridge | | 14.52ug/l | - |
| 2. | Carbaryl | Shahrah-e-Pakistan Bridge | | 3.27ug/l | - |
| 3. | Triazophos | Shahrah-e-Pakistan Bridge | | 0.41ug/l | - |
| 4. | Tabuconazole | Jehangir Sethna road Bridge | | 7.08ug/l | - |
| 5. | Carbofuran | Jehangir Sethna road Bridge | | 2.88ug/l | - |
| 6. | Tabuconazole | Mauripur Road Bridge | | 7.92ug/l | - |
| 7. | Carbaryl | Mauripur Road Bridge | | 3.41ug/l | - |
| 8. | Prefenofos | Mauripur Road Bridge | | 15.81ug/l | - |
| 9. | TSS | - | | 273mg/l | 200mg/l |
| **Biological Analysis** | | | | | |
| 1. | Coliform | Mauripur Road Bridge | | 2,300 MPN/100ml | - |

Overall perspective on Physical, Chemical and Biological Analyses, indicates the waters are not hostile enough to viably disregard the existing ecology of the effluent stream and its final out-fall into Arabian Sea. The Effluent stream appears to be viably stabilized in terms of many parameters including DO, BOD, COD, S2-, Nitrogen Ammonia, Detergents and Phenolic compounds etc.

The main stream has many sub-stream points with charging of fresh effluent all along its 15 KM length but its average characteristics are not varied sharply which indicates the stream is only charged with domestic induced wastewater.

### 5.2.9.9. Wastewater Quality

About 60-70% of the water supplied to Karachi City returns as sewage. An approximate 315 mgd (1,432,000 m3/d) of domestic and toxic industrial wastewater is generated in the city. The current volume has been arrived at due to more water being made available to the supply/ distribution system that has only rudimentary facility for treatment of wastewater.

The total length of sewers is approximately 3,290 km and ranges from 8 inches (200 mm) to 84 inches (2,130 mm) diameter of trunk sewers, secondary sewers and laterals. There are three sewage treatment plants in Karachi. The total design capacity of these treatment plants (TP) is 151 mgd (686,000 m3/d). None of the TPs run to capacity and almost 60 to 70 percent of the sewage that flows in is allowed to bypass.

Thus almost 90 percent of the sewage is disposed of into the sea through nallahs including the Sengal nallah that brings the sewage and industrial effluent from the area past the Air Port and from Gulistan-e-Jauhar and drains into Malir River; the Gujjar nallah that brings the sewage from Buffer Zone, North Karachi, and Gulshan-e-Iqbal Towns besides North Karachi and Federal B Area Industrial Areas and discharges into the Lyari River, and Orangi nallah that brings sewage from Orangi, SITE, North Nazimabad, Nazimabad Town and Liaquatabad Towns besides the Sindh Industrial and Trading Estate (SITE) and discharges into the Lyari River.

The Lyari River flows into the Arabian Sea through the Lyari Estuary that drains into Manora Channel, which houses the Karachi Port and harbor facilities, besides a large mangrove forestation. Tests conducted in the harbor area have indicated Dissolved Oxygen (DO) and BOD to be at critical levels. The wastewater discharged into the harbor carries human pathogens and the concentrations of these on the sediments increase the risk of uptake into shell fish and other benthic organisms and hence into the food chain.

Garbage transport vehicle

There are two landfill sites in the outskirts of Karachi. 1) The Jam chakro landfill site having coordinates 25o01’640N, & 67o01’980E at the altitude of 285 ft. This site is spread over 500 acres. The garbage/composite consists of silver, metal, glass, bones, polythene shoppers etc. This landfill is in the north west of Umar goth having 1000 houses in deh Bund Murrad, Gaddap, Mangho Pir area. About 8-9 kms of garbage is dumped at the height of 285ft. below the datum. About 2000-3000 tons of garbage is dumped in the area, 2) Gond Pass Landfill Site is located in between 25o00’634N and 66o55’262E. Gond pass is an old landfill established about 40-50 years ago and spread over an area of 500 acres. About 1000 tons/day of municipal waste is transferred from various garbage collection points. The landfill is scientifically maintained by placing PVC filtered pipes for the escape of gases.

Guidelines for Solid Waste Management have been drafted by Pakistan Environmental Protection Agency (PEPA) in collaboration with JICA and UNDP in 2005. These guidelines provide for safe and sustainable mechanism for collection, handling, storage and disposal of solid waste including hazardous waste.

## 5.3. Biological Environment

Natural vegetation is restricted all over the urban area to depression areas where moisture would be available for greater part of the year and longer period of time. The native vegetation is of the desert scrub type comprising a wide variety of bushes and shrubs, including Capris aphylia (karir), Acacia nilotica (babul), Acacia senegal (khor), Salvadora oleoides (khabar) and Prosopsis senegal (kandi), Acacia arabica (kikar), Tamarix gallica (lai), tamarix aphylla, willo or bahan (populus euphratica), Aerua javanica, Maerva arenaria, Abutilou sp, Amaranthus viridis, Cordia gharaf, Rhazya sticta, karil (capparis aphyila), acacia or siris (acacia lebbek), papal (ficus religiosa) and tamarind (tamarindus indica).

### 5.3.1. Vegetation

The biodiversity of vegetation on the sandy plains and low hills of urban Karachi is characterized by ephemeral species plus trees and shrubs, including Prosopis cineraria, Acacia nilotica, Tamarix aphylla, Lycium shawii, Salvadora oleoides, Zizyphus sp., Calligonum polygonoides and Leptadenia pyrotechnica.

Species on calcareous hills in Gulistan-e-Jauhar, for example include Vernonia cinerascens, Commiphora wightii, Grewia tenax and Euphorbia caducifolia. The shallow slopes with varied soils on recent and sub-recent substrates at low altitudes chiefly on plains have the trees Zizyphus nummularia, Salvadora oleoides, and Capparis decidua, and shrubs Grewia tenax, Seddera latifolia, and Rhazya stricta that are the most commonly found species, together with the grasses Ochthochloa compressa, Cymbopogon jawarancusaand Aristida funiculata. With Prosopis cineraria, Indigofera oblongifolia and Euphorbia caducifolia, the above combination of species makes up most of the total vegetation coverage of Karachi City District. Tables show list of vegetation, including varieties of trees, shrubs, herbs, and grasses reported for the Karachi City District.

**Table 5.19: Trees**

| Local Name | Botanical Name | Family |
|---|---|---|
| Khor | Acacia Senegal | Mimosaceae |
| Kandi | Prosopis cineraria | Mimosaceae |
| Babul | Acacia nilotica | Mimosaceae |
| Vilayati Kikar | Acacia farnesiana | Mimosaceae |
| Lai | Tamarix diodica | Tamaricaceae |
| Ghaz | Tamarix aphylla | Tamaricaceae |
| Willo/ bahan | Populus euphratica | |
| Yar, Peelu | Salvadora oleoides | |
| Jhile | Indigofera oblongifolia | |

Ecological risk of high order has been induced by land clearance and removal of natural vegetation from the plains during the urban sprawl to make room for agriculture and urbanization. These zones include extensive flat alluvial plains, covered by relatively similar vegetation, mostly small trees and dwarf shrubs. Tall, clump-forming desert grasses are

**Table 5.20: Shrubs**

| Local Name | Botanical Name | Family |
|---|---|---|
| Booi | Aerva javanica | Malvaceae |
| | Maerve arenaria | |
| | Abutilon sp.Malvaceae | |
| | Amaranthus vidis | |
| Thuhar | Euphobia caducifolia | |
| Liar | Cordia gharaf | Boraginaceae |
| Wena, Shahnar | Rhazya stricta | Apocynaceae |
| Khabar Salvadorecee | Salvadora persica | |
| Karer Capparidaceae | Capparis deciduas | |
| Dahi | Prosopis juliflora | Mimosaceae |

**Table 5.21: Grasses**

| Local Name | Botanical Name | Family |
|---|---|---|
| Ak | Calotropis procera | Asclepiadaceae |
| Lussan | Medicago lupulina | Papilionaceae |

common. Signs of extensive drought damages done by land clearing activities are apparent and hence the natural vegetation that has survived in these areas has adapted to harsh conditions.

The two principal habitat types on the course of Lyari and Malir Rivers to central areas of Karachi City District are arid hills, and low-lying sandy areas. Vegetation of the hill slopes and hillsides comprise mainly camel thorn (Prosopis spicigera), wild caper (Capparis decidua) and large succulents such as Euphorbia caudicifolia.

Calotropis procera (akk) that used to be common on generally poor sandy soil is barely surviving. Only one species of the vegetation community, Tamarix pakistanica, is endemic to Pakistan. It is salt-tolerant, and often a dominant species in saline areas. There are no areas in the three zones where water table is high, and hence the vegetation that grows best and forms dense patches of good height is not found.

Wide distribution of vegetation ensures survival of botanical species. Promotion of vegetation was neither an objective of any development activity in the Towns, nor was an ecological risk assessment carried out to identify the long term and short term risks involved in tree felling activities. Furthermore mitigation measures that need to be taken to minimize the risks were neither recommended nor adopted. Accordingly no organized re-plantation of the earlier trees or shrubs has been noticed.

## 5.3.2. Fauna, Endangered Species, Protected Areas

Much of the natural fauna has succumbed to the process of urbanization. Following rare species have been identified in Karachi City District.

## 5.3.3. Biological Environment-Status in Microenvironment

EMC has conducted field Survey for the collection of primary data with respect to Plants and Animals of the proposed project Area.

### 5.3.3.1. Flora

As many as 72 species of plants were recorded from the Project area Green line. The total of tree count on the corridor is given below:

The dominant plant species are obviously Conocarpus, Eucalyptus and Lignum species. The flora included some medicinal plants such as Azadirachta indica, Aerva javanica, Calotropis

**Table 5.22: Rare Species in Karachi City District**

| Common Name | Zoological Name | Status |
|---|---|---|
| **Mammals** | | |
| Indian Hedgehog | Paraechinus micropus | Very rare |
| Asiatic Jackal | Canis aureus | Rare |
| Chinkara | Gazalla bennetti | Very rare |
| Indian Fox | Vulpes bengalensis | Rare |
| Small Indian Mongoose | Herpes javanicus | Common |
| Indian Pangolin | Manis crassicaudata | Rare |
| Indian Desert Cat | Felis silvertris ornate | Rare |
| Indian crested porcupine | Hystrix indica | Rare |
| Ratel or Honey badger | Mellivora capensis | Vulnerable |
| Hog Deer | Axis porcinus | Very rare |
| Cairo Spiny Mouse | Acomys cahirinus | Rare |
| Grey spiny mouse or Rock mouse | Mus saxicola | Rare |
| Desert cat | Felis libyca ornate | Rare |
| **Bovidae: antelope, gazelle, cattle, sheep & goats** | | |
| Domestic Sheep | Ovis aries | |
| Domestic Cattle | Bos Taurus | |
| Domestic Goat | Capra hircus | |
| Indian Water Buffalo | Bubalus arnee | |
| Arabian Camel | Camelus dromedaries | |
| Domestic Horse | Equus caballus | |

**Table 5.22: Rare Species in Karachi City District**

| Common Name | Zoological Name | Status |
|---|---|---|
| **Leporidae: Hares & rabbits** | | |
| Hares rabbits | | Common |
| Reptilia | | |
| Spiny tailed lizard | Uromastyx hardiwickii | Common |
| Krait | Bangarus caerulus | Vulnerable |
| Indian Python | Python molurus | Very rare/ Endangered |
| Mugger | Crocodylus palustri | Vulnerable |
| Gharial | Gavialis gangeticus | Endangered |
| Marsh crocodile | Crocodulus palustris | Endangered |
| **Aves** | | |
| Dalmatian pelican | Pelicabus crispus | Vulnerable |
| Marbled teal | Marmaronetta angus tirostris | Vulnerable |
| Pallid harrier | Circus macrourus | Lower risk |
| White backed vulture | Gyps bengalensis | Lower risk |
| Pallas' fish eagle | Haliaeetus leucoryphus | Rare/ Vulnerable |
| Houbara Bustard | Chlamydotis undulata macqueenii | Endangered |
| Chukor | Atectoris chukar chukar | Endangered |
| Closed-Barred Sand grouse | Pterocles indicus | Endangered |

procera, Cassia fistula, Fagonia indica, Melia azidarach, Morinaga oleifera, Ricinus communis, and Tecomela undulata. The shade trees were also commonly found such as Albizzia procera, Azadirachta indica, Eucalyptus citriodora, Fiscus bengalensis, Fiscus religiosa, Melia azidaroch, Pithcellobium dulce, Tamarindus indica and Zizyphus nummularia.

The fruit trees included Mango, Jaman, Naryal, Badam, Jangal jalebi, Imli, Lahsora, Gondni, Ber, Date palm, and Amla.

### 5.3.3.2. Fauna

As regards the fauna, 16 species of animals were recorded comprising of 4 species of mammals, 10 species of birds and 3 species of reptiles.

## 5.4. Traffic Management in the City

**Table 5.23: Total Tree Count**

| BRT corridor | Left Lane | Median Lane | Right Lane |
|---|---|---|---|
| Green Line | 1701 | 13456 | 1480 |

**Table 5.24: Trees**

| S.No | Botanical Name | Common Name |
|---|---|---|
| 01 | Abutilon indicum | Abutilon, Indian Mallow |
| 02 | Acacia nilotica | Babur (Pakistan) |
| 03 | Achyranthesaspera | Prickly Chaff Flower |
| 04 | Aervajavanica | Woody Amonthum |
| 05 | Albizziaprocera | Sirin |
| 06 | Alstoniascholaris | Devil's Tree |
| 07 | Arnebiahispidissma | Arabian primrose |
| 08 | Averrhoabilimbi | - |
| 09 | Azedorachtaindica | Morgosa |
| 10 | Bambusaarindiaceur | - |
| 11 | Bauhinaretusa | - |
| 12 | Bougainvillaglabra | Bougainvillea |
| 13 | Buteafrondosa | Flame of the Forest, Dhak,Palas |
| 14 | Callistemon citrines | Bottle Brush |

**Table 5.24: Trees**

| S.No | Botanical Name | Common Name |
|---|---|---|
| 15 | Calsapinnapulcherimma | - |
| 16 | Calvillearacemosa | - |
| 17 | Cassia fistula | Laburnum pudding pipe tree |
| 18 | Cassia holocericea | - |
| 19 | Celatropisprocera | - |
| 20 | Cenchrusbiflonces | - |
| 21 | Chrysopogonaucher | - |
| 22 | Clerodendroninerme | - |
| 23 | Cocosnucifera | Coconut |
| 24 | Conocarpuslanceolata | Ghalab ethiopian tank |
| 25 | Conocorpuslatifolia | Ghalab ethiopian tank |
| 26 | Cordiagharaf | Liyaar |
| 27 | Dalbergiasussor | - |
| 28 | Delonixregia | Flamboyant |
| 29 | Erythrinaindica | Indian Coral Tree |
| 30 | Fagoniacretica | - |
| 31 | Fiscusbengalensis | Banyan |
| 32 | Fiscus elastic | Rubber Plant |
| 33 | Fiscusramphii | - |
| 34 | Guacamofficinale | Wood of life, Lignum tree |
| 35 | Heliotropaeumcurrasavicum | - |
| 36 | Kigeliapinnata | Sausage tree |
| 37 | Launanudicalus | - |
| 38 | Leuceneleucophala | Leucina |
| 39 | Margiferaindica | - |
| 40 | Meliaazedarach | chinaberry |
| 41 | Milletiapenguinensis | Milletis |
| 42 | Moringaoleifolia | Drum Stick |
| 43 | Myrtuscommum | - |
| 44 | Parkinsorua aculeate | Jerisalem Thorn |
| 45 | Peltophorumferruginea | - |
| 46 | Phoenixsylvestris | Date Palm |
| 47 | Phragmiteskarka | - |
| 48 | Phragmiteskarka | - |
| 49 | Phyllanthusemblica | Indian Gooseberry, Amla |
| 50 | Pithocoeloliumdulce | Manila Tamarind |
| 51 | Polyalthialongifolia | Mast Tree |
| 52 | Pongomiaglabra | - |
| 53 | Prosopis cineraria | jandi, kandi, thand |
| 54 | Prosopisjulifor | Mesqite |
| 55 | Pyhoenixdactylifera | Date Palm |
| 56 | Reciniscommurus | Castor oil plant |
| 57 | Roystonearegia | Cuban royal palm, |
| 58 | Saccharrummunja | Tall Grass |
| 59 | Salsolafoetida | - |
| 60 | Salvadorapersica toothbrush tree | mustard tree, salt bush, |
| 61 | Serna glauca | - |
| 62 | Sonchusasper | Spiny Sow thistle |
| 63 | Syzygiumcumini | Black Plum Black Berry |
| 64 | Tamaraxaphylla | - |
| 65 | Tamarindusindicus | Tamarind |
| 66 | Tecomella undulate | Tecoma |
| 67 | Terminaliaarjuna | Arjuna |
| 68 | Termiraliacatappa | Country almond |
| 69 | Thespeciapopulnea | Bhends |
| 70 | Thevetiaperuviana | - |
| 71 | Ziziphusnumnularia | - |
| 72 | Zizyphusmauritiana | Jujuba |

## 5.4.1. Strategy for Development of Karachi City

The Karachi Development Plan 1974-1985 proposed a corridor pattern to make better use of existing infrastructure and minimize future investment. It highlighted the crisis confronting the Karachi Metropolitan Area with regard to infrastructure and other public services. It recommended restraint on development in the old town, with new growth guided in the northeast direction to Baldia and Orangi, southeast to Korangi and northeastward to Khanto and eastward to Pipri.

In order to curtail industrial expansion of the SITE, two new industrial areas were developed in north Karachi, to alleviate unemployment in the area and take advantage of the Super Highway leading to the hinterland. The plan recommended sites for sub-metropolitan trade and service centres and proposed green belts separating industrial from residential areas in the north of the city. Fiscal incentives such as a regional bias in the tax holiday structure were

**Table 5.26: List of Fauna along BRT corridor**

| S.No | Order | Family | Common Name | Scientific Name |
|---|---|---|---|---|
| **Mammals** | | | | |
| 1. | Carnivora | Herpestidae | Small Indian Mangoose | Herpestes javanicus |
| 2. | Rodentia | Sciuridae | Five Striped Palm Squirrel | Finambulus pennant |
| 3. | Rodentia | Muridae | Roof Rat | Rattus rattus |
| 4. | Rodentia | Muridae | House Mouse | Mus musculus |
| **Reptiles** | | | | |
| 1. | Squamata | Agamidae | Common Tree Lizard | Calotes versicolor |
| 2. | Squamata | Geckkonidae | Common House Gecko | Hemidactylus flaviviridis |
| 3. | Squamata | Varanidae | Bengal Monitor | Varanus bengalensis |
| **Birds** | | | | |
| 1. | Cuculiformes | Cuculidae | Indian Koel | Cudynamus scolpacea |
| 2. | Columbiformes | Columbidae | Blue Rock Pigeon | Columba livia |
| 3. | Passeriformes | Sturnidae | Indian Myna | Acridotheres trists |
| 4. | Passeriformes | Sturnidae | Bank Myna | Aeridotheres ginginanus |
| 5. | Accipitriformes | Accipitrdae | Common Kite | Milvus migrans |
| 6. | Accipitriformes | Accipitrdae | Shikra | Accipiter badius |
| 7. | Accipitriformes | Pyenonotidae | White-cheeked Bulbul | Pycnonotus leucogengs |
| 8. | Accipitriformes | Pyenonotidae | Redvented Bulbul | Pycnonotus cafer |
| 9. | Accipitriformes | Corvidae | House Crow | Corvus splendens |
| 10. | Accipitriformes | Nectarinidae | Purple Sunbird | Nectarinia asiatica |

introduced by the Government to encourage decentralization of large scale industries. However, review of this policy shows that it had little impact on growth of Karachi, since the recommendations were only partially implemented. The defunct Karachi Development Authority (KDA) developed its large scale project in Surjani Town in the northern part of the city, which in the 1974 Master Plan was designated as a green belt.

Karachi Development Plan 2000 had taken into account the development of Karachi Port and establishment of container terminals at Karachi Port as well as Port Qasim. It was realized that the new modes of transportation and the container terminals would increase the freight traffic from the port to National High¬way and the Super Highway. It was also expected to increase the activity in the Sharae Faisal-National Highway-Super Highway corridor.

The Plan further proposed two bypass roads, one in the north and the other in the south. They were to serve as a ring road cir¬cling half of the city circumference and to relieve much of the port related congestion. This was meant to shift the growth of the city from the central areas to the north and south.

### 5.4.2. Current Corridors of Vehicular Traffic

Population pressure and economic development induced northward expansion of the City to Nazimabad, Liaquatabad and Sindh Industrial Estate, and eastward to Landhi Industrial Estate, and Korangi Industrial Area. Economic development has, since the initial stages remained largely in the Port environs, Central Business District (CBD), and Industrial Estates. Accordingly all approach roads and the road network of Karachi comprising numerous major and minor arterials are oriented towards the following corridors that radiate from Merewether Tower in Saddar Town. The traffic movement is oriented towards the following corridors (Table 5.30 & Figure). towns of CDGK including its peripheral areas of Federal B Area; Gulshan-e-Iqbal; Gulistan-e-Jauhar; Gulistan-e-Jauhar Extension; Surjani Town; Hawkes Bay; Korangi; Landhi; Meroville 1 (SITE); Nazimabad; North Karachi; Qasba Township; North Nazimabad; Dilkusha; Clifton; Metroville 2 (Landhi); Metroville 3 (Scheme 33), and Shah Latif Town.

| Corridors | Routes |
|---|---|
| Corridor 1 | Keamari ➔ Chinna Creek ➔ Hardinge Bridge ➔Merewether Tower ➔II Chundrigar Road ➔ Shah Rah-e-Liaquat ➔ Burns Road ➔ Tibbet Center ➔Garden Road Intersection ➔Old Numaish ➔Tin Hatti ➔Liaqatabad # 10 ➔ Karimabad ➔ Shah Rah-e-Pakistan ➔ Sohrab Goth ➔ Super Highway |
| Corridor 2 | Keamari ➔ Chinna Creek ➔ Moulvi Tamizuddin Khan Road ➔ Lovers Bridge ➔ PIDC House ➔ Club Road ➔ Metropole Hotel ➔ Sharae Faisal ➔ Finance & Trade Centre ➔ Karsaz/Habib Ibrahim Rahimtoola Road ➔ Drigh Road ➔ Karachi Air Port ➔ Malir City ➔ Malir River Bridge/National Highway N5 ➔ Quaidabad ➔ Port Qasim ➔ Pakistan Steel Mills ➔ Link Road to Super Highway. |
| Corridor 3 | Keamari ➔ Chinna Creek ➔ Hardinge Bridge ➔KPT West Wharf ➔ Mauripur Road ➔ Gulbai ➔ SITE ➔ North Nazimabad ➔ Sohrab Goth ➔ Super Highway. |
| Corridor 4 | Merewether Tower (CBD) ➔Karachi Port Trust/West Wharf➔ Mauripur Road ➔ Gulbai ➔ SITE ➔ RCD Highway➔ Hub River Chowki ➔ Northern Bypass ➔ Super Highway. |
| Corridor 5 | Keamari ➔ Hardinge Bridge ➔Merewether Tower ➔II Chundrigar Road ➔ MR Kayani Road ➔ Strachen Road ➔ Abdullah Haroon Road ➔Metropole Hotel ➔ Shara-e-Faisal➔ Finance & Trade Center ➔ Karsaz/Habib Ibrahim Rahimtoola Road ➔Drigh Road ➔Karachi Air Port ➔ Malir City ➔ Malir River Bridge/National Highway N5 ➔ Quaidabad ➔ Port Qasim ➔ Pakistan Steel Mills ➔ Link Road to Super Highway. |
| Corridor 6 | Karachi Port Trust/West Wharf ➔ Mereweather Tower ➔Tibbet Center ➔ Garden Road Intersection ➔Old Numaish ➔Tin Hatti ➔Liaqatabad # 10 ➔ Karimabad ➔ Shah Rah-e-Pakistan ➔Sohrab Goth ➔ Super Highway. |
| Corridor 7 | Merewether Tower ➔ Shah Rah-e-Liaquat ➔ Burns Road ➔Preedy Street ➔Empress Market ➔Old Numaish ➔ Guru Mandir ➔ Las Bela Chowk ➔ Golimar ➔ Nazimabad ➔ North Nazimabad ➔ Sakhi Hasan ➔ Nagan Chowrangi ➔ Surjani Town. |
| Corridor 8 | Karachi Port Trust/West Wharf ➔ Merewether Tower ➔ II Chundrigar Road Metropole Hotel ➔ Shara-e-Faisal ➔ Finance & Trade Center ➔Drigh Road ➔ Malir ➔ Landhi ➔ National Highway N5. |
| Corridor 9 | Keamari/Karachi Port Trust/West Wharf ➔ Moulvi Tamizuddin Khan Road ➔ Mai Kolachi Intersection/Southern Bypass ➔ Teen Talwar ➔ Sunset Boulevard ➔Korangi Industrial Area ➔ Quaidabad. |
| Corridor 10 | Merewether Tower ➔ Karachi Port Trust ➔Mauripur Road ➔ SITE ➔ Banaras Chowk ➔ Orangi Town ➔ Manghopir. |
| Corridor 11 | Merewether Tower ➔Karachi Port Trust ➔Mauripur Road ➔ SITE ➔ Hub River Chowki ➔ RCD Highway ➔ HITE. |

**Fig 5.15:** Current Corridors of Vehicular Traffic

The above 11 corridors serve the CBD and the 18 The system of roadways inside the CBD is narrow as seen above, but outside the CBD the major arterials radiate outward from Merewether Tower which is central to CBD and the Port of Karachi. The roads are generally wide with 3 to 6 lanes, paved, provided with markings and sidewalks but inadequately maintained, often divided by high curbs, with signals or traffic police constable controlling important intersections. Major roadways in the city are complemented with numerous local roads, which permit accessibility to residences and businesses. Local roads are narrow, loose-surface, with low design standards; the required maintenance is lacking and traffic control devices are either simply not there or are non-functional.

The highway system approaching Karachi ties directly into the major arterials with.

- Toll-controlled Superhighway connecting into Shahrah-e-Pakistan from the northeast,
- National Highway connecting into Shara-e-Faisal from the east,
- RCD Hughway from Baluchistan connecting into Hub Chowki Road and SITE Town from the north, and
- Bund Murad Khan Road also connecting from the north into Orangi Town, SITE and Shershah Road, Golimar and Garden Road.

The Southern Bypass, starting from Karachi Port carries truck traffic through Corridor #9: Moulvi Tamizuddin Khan Road è Mai Kolachi (Southern Bypass) Intersection è Teen Talwar è Sunset Boulevard èKorangi Industrial Area è Quaidabad on National Highway and thus provides a direct link between the two ports and helps in relieving the congestion owing to freight carriers. The Zero Point of this bypass at Moulvi Tamizuddin Khan Road near the Naval Officer's Residential Estate-1 is connected with Shahrah-e-Roomi in the Clifton Boat Basin through a bridge over the storm water drains. It however, carries sewage from the city and drains it into Chinna Creek.

Karachi Northern Bypass provides an alternate route from the Karachi Port to Super Highway proceeding along the western fringe of the built up area of the city and crossing the northern boundary of Surjani Town. Besides providing an access to the northern areas of the city, it is intended to catalyze the develop¬ment of Halkani, Taisar and Surjani Townships and the north¬ern parts of Gulzar-e-Hijri Scheme 33.

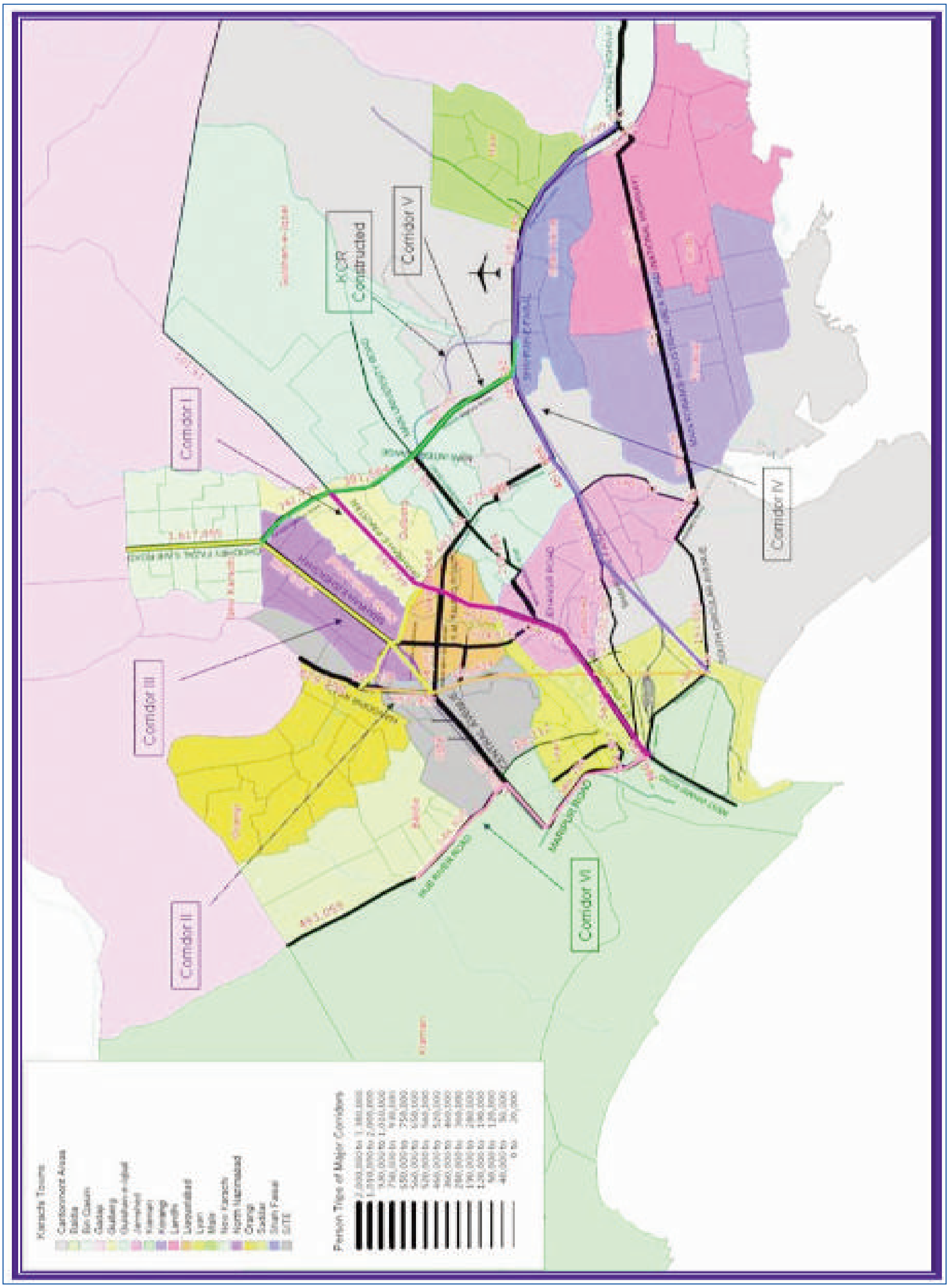
The Northern Bypass takes off from ICI Bridge and while passing through Mauripur Road and SITE it runs parallel to the RCD Highway (Hub River Road) to the 18 Km intersection where it turns northeast to cross Mai Garhie hill range. Subsequently it crosses Madinatul Hikmat Road and after crossing the Manghopir Hills and the Lyari river it terminates at New Sabzimandi Karachi/Al-Habib Restaurant on Super Highway, some 14 km from Sohrab Goth.

The Ship Breaking Industry in Gadani and The Hub Industrial Trading Estate HITE in Baluchistan are among the major users of the Northern Bypass from RCD Highway to Super Highway. The heavy trucks and trailers hauling the raw materials including the ship breakage, and the products to and from upcountry destinations are at present using this section of the Bypass.

Highways in close proximity to the city with a 4 lane divided cross-section are comparatively well maintained. The City Roads have been in dilapidated condition for a long time. However, some of them have recently been rehabilitated. The streets are used by several bus systems, a variety of private vehicles, para-transit and goods vehicles. Institutionally, these systems are loosely managed with little planning, few controls, and inadequate enforcement of traffic rules.

### 5.4.3. Traffic Engineering Profile

Three important features of BRT Corridor are


Corridor I
Corridor II
Corridor III
Corridor IV
Corridor V
Corridor VI
KCR Constructed

discussed in this section i.e. i) Existing Intersections and their treatments, ii) Proposed Station type, size, locations and iii) Existing U – Turns and their proposed treatments. As per the BRT Planning Guide a complete BRT Corridor is defined as, the corridor having a) fully segregated bus bays for BRT, b) closed, high quality stations, c) pre-board fare collection and d) frequent and rapid service.

In order to construct a complete BRT Corridor, incorporating the above mentioned features, various treatments at the intersections, station locations and U- turns are of prime importance. Therefore the following sub-sections describe in some detail the suggested improvements and treatments of BRT Corridor.

### 5.4.3.1. Major Intersection along BRT Corridors & Proposed Improvements

Intersections represent a very critical point along BRT corridor. A poorly treated intersection substantially reduces the system capacity and reliability of the BRT. Generally treatment of intersection for BRT aims to Minimize Delay for BRT System and also to Minimize Delay for Mix Traffic. As per the BRT Planning Guide two types of treatments are proposed for intersections along BRT Corridor. 1) Signal Priority for BRT (for low volume intersections), 2) Grade Separations (for high volume intersections).

Since most of the intersections (as per the traffic survey results 2011) are operating at more than 200,000 vehicles per day with an operational level of service of E which further reduces to F during peak 15 minutes period. Therefore option 2 from the above mentioned alternatives has been selected at most of the intersections.

There are twelve major intersections along BRT Green Line Corridor. Most of them are highly congested and high intersection traffic delays have been calculated during peak hours. The results reveal incrementally high value of travel time delays for these intersections. The traffic volume sheet is attached along with this document showing all the available traffic volumes along this corridor.

The BRT system performance indicators and the success factors mainly are 1) Travel Time Saving, 2) Reliability, 3) Identity and Image, 4) Safety and security and 5) Capacity. The first two are prime most important factors that are highly dependent on the treatments proposed for BRT Corridor at the intersections. These features attract the passengers and if these operational parameters are not well managed, the BRT continues to lose its advantage and the travel demand reduces considerably resulting in loss of revenue and efficacy. The decisions regarding the treatment of intersections are greatly influenced by these factors, therefore in the process of finalizing the BRT corridor alignment and profile, these factors were given the utmost careful consideration.

### 5.4.3.2. Green Line Intersection Details

Intersection Level of Service Analysis

At most of the intersections BRT is proposed to be either elevated or depressed to eliminate bottle necks along BRT Corridor. After the study of available traffic survey data, existing level of service was calculated. It was found out that almost all of the intersections are operating at level of service E and at level of service reaches F during Peak 15 minutes period during the Peak Hour. This level of service analysis was performed using the methodologies mentioned in Highway Capacity Manual 2010. Levels of service analysis actually show the existing conditions of the BRT corridor. However, considering the prevailing lack of discipline a Pakistani characteristics the in traffic movement and poor enforcement, lack of realization of Civic sense prevalent in present traffic in general and motorcycles/Auto Rickshaws in particular suggests that to the extent possible engineering design should provide solutions to eliminate possibilities of accidents casualties albeit at higher cost solutions. Traffic details are follows:

*Traffic count data of KESC Power House was not available therefore peak hour intersection counts have been made for this intersection during a typical week day.*

Using this information a level of service analysis was undertaken. Using the results of this analysis, treatments for each intersection were proposed. Following is the list of major intersections, their Level of Service and the proposed treatments within the BRT Corridor along these intersections.

A = free flow, B = reasonably free flow, C = stable flow

D: approaching unstable flow. Speeds decrease as traffic volume increases. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease. Minor incidents are expected to create delays. It is a considered tolerable goal for urban streets during peak hours.

E: unstable flow, the roadway capacity is fully used. Flow becomes irregular and speed reduces rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affect traffic upstream. Any incident will create serious delays. Drivers' level of comfort and extremely become poor restricted.

F: forced or breakdown flow. Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS, because LOS is an average or typical service rather than a constant state.

**Mid - Block Capacity Analysis**

Another analysis conducted for BRT Corridor was at locations that are mid – blocks between major intersections. In this analysis a volume over capacity (V/C) ratio is calculated in order to estimate the effects of utilization of lanes by BRT on the Corridor. This allows an assessment of the effects of taking away a lane from the existing carriageway for use by BRT running way. However, as a matter of policy it had been decided that wherever a lane is taken up for BRT, it is replaced with addition of a lane on the outer edge of the carriageway. Following are the results.

| Intersection ID | Name of Intersection | Type of Intersection | Traffic volume/day | Peak Hour | PHV | PCU |
|---|---|---|---|---|---|---|
| 1 | Gurumander | 3-legged intersection | 278625 | 07:00-08:00pm | 22688 | 12713 |
| 2 | Lasbela Chowk | 4-legged intersection | 147771 | 07:00-08:00pm | 13892 | 8550 |
| 3 | Nazimabad 1st Chowrangi | 4-legged intersection | 239945 | 06:00-07:00pm | 22238 | 12395 |
| 4 | Board office Chowrangi | 4-legged intersection | 244799 | 06:00-07:00pm | 19327 | 11232 |
| 5 | KDA Chowrangi | 4-legged intersection | 368849 | 08:00-09:00am | 26215 | 7979 |
| 6 | 5 star Chowrangi | 4-legged intersection | 278006 | 06:00-07:00pm | 21704 | 13135 |
| 7 | Sakhi Hassan Chowrangi | 4-legged intersection | 378846 | 05:00-06:00pm | 28176 | 8895 |
| 8 | Power House | 4-legged intersection | 101506 | 09:00-10:00pm | 8487 | 4906 |
| 9 | Surjani | 4-legged intersection | 142914 | 07:00-08:00pm | 11186 | 3465 |
| 10 | Kesc Power House* | 4-legged intersection | - | 07:00-08:00pm | 10091 | 3112 |

## 5.5. Karachi Transportation System

| Intersection ID | Major Intersection | Intersection Geometry | Existing Intersection Control | Existing Level of Service | Proposed Treatment for BRT | Resulting Improvements in LOS |
|---|---|---|---|---|---|---|
| 1 | Gurumander | 3-legged intersection | Yield Control/ Signalized | E-F | Elevated | Yes |
| 2 | Lasbela Chowk | 4-leggedintersection | Signalized | E-F | Elevated | Yes |
| 3 | Nazimabad 1st Chowrangi | 4-legged intersection | Signalized | E-F | Elevated | Yes |
| 4 | Board office Chowrangi | 4-legged intersection | Signalized | E-F | Elevated | Yes |
| 5 | KDA Chowrangi | 4-legged intersection | Roundabout | E-F | Elevated | Yes |
| 6 | 5 star Chowrangi | 4-legged intersection | Signalized | E-F | Elevated | Yes |
| 7 | Sakhi Hassan Chowrangi | 4-legged intersection | Roundabout | E-F | Elevated | Yes |
| 8 | KDA Chowrangi | 4-legged ntersection | Roundabout | D | Elevated | Yes |
| 9 | 5 star Chowrangi | 4-legged intersection | Roundabout | D | Under Ground | Yes |
| 10 | Sakhi Hassan Chowrangi | 4-legged intersection | Yield Control/ Signalized | D | At Grade | Yes |

The intra-city road network has a radial pattern, consisting of a series of arterials, a few circumferential roads with inconsistent links and a disproportionately large number of local and collector roads. In terms of connectivity, the network is deficient in secondary roads that provide feeder service to major thoroughfares. The weakness has basically arisen from the piece-meal development focused on residential schemes in the past. Although the maintenance of Karachi's roads has been poor and problematic, in recent years substantial improvements have been effected through construction of flyovers, underpasses, remodeling of intersections and road rehabilitation. To cater for the heavy traffic to and

**From Tower To Surjani**

| Sr.No. | Segment | Cars | Risckshaw/Bikes | Buses | Trucks | Volume in PCU | v/c ratio | v/c with one lane utilized by BRT |
|---|---|---|---|---|---|---|---|---|
| 1 | G-1 | 29686 | 4296 | 4296 | 226 | 95914 | * | |
| 2 | G-2 | 16678 | 3380 | 3380 | 151 | 72589 | * | |
| 3 | G-3 | 12583 | 2568 | 2568 | 195 | 65409 | * | |
| 4 | G-4 | 15343 | 1042 | 1042 | 191 | 67914 | | |
| 5 | G-5 | 23428 | 1521 | 1527 | 160 | 90535 | | |
| 6 | G-6 | 24516 | 1472 | 1472 | 431 | 93502 | | |
| 7 | G-7 | 28497 | 1817 | 1817 | 1216 | 131177 | | |
| 8 | G-8 | 55468 | 5392 | 5392 | 1416 | 213075 | | |
| 9 | G-9 | 35242 | 2548 | 2548 | 1223 | 121328 | | |
| 10 | G-10 | 59268 | 91714 | 4956 | 1764 | 199758 | | |
| 11 | G-11 | 9214 | 23678 | 1540 | 421 | 45608 | | |
| 12 | G-12 | 12542 | 41369 | 3114 | 1454 | 76516 | | |

**From Tower To Surjani**

| Sr.No. | Segment | Cars | Risckshaw/Bikes | Buses | Trucks | Volume in PCU | v/c ratio | v/c with one lane utilized by BRT |
|---|---|---|---|---|---|---|---|---|
| 1 | G-1 | 24533 | 61860 | 2089 | 158 | 118907 | | |
| 2 | G-2 | 15807 | 47533 | 2794 | 125 | 88565 | | |
| 3 | G-3 | 12886 | 42088 | 1057 | 254 | 76610 | | |
| 4 | G-4 | 15430 | 31972 | 1438 | 1241 | 64417 | | |
| 5 | G-5 | 26609 | 70327 | 1494 | 258 | 132936 | | |
| 6 | G-6 | 27895 | 70644 | 2063 | 1079 | 135162 | | |
| 7 | G-7 | 27842 | 78240 | 3298 | 381 | 146946 | | |
| 8 | G-8 | 60322 | 86216 | 4592 | 560 | 192082 | | |
| 9 | G-9 | 32690 | 73021 | 2225 | 534 | 143468 | | |
| 10 | G-10 | 38252 | 112098 | 4358 | 2016 | 209082 | | |
| 11 | G-11 | 10439 | 26605 | 1978 | 476 | 51455 | | |
| 12 | G-12 | 9468 | 45620 | 2740 | 534 | 79400 | | |

from the Karachi port, two logistic bypasses have been completed, and for the same purpose the Lyari expressway is being constructed. These would well serve an integrated logistic system.

Of 24.2 million trips taken every day in Karachi, the public transport (buses) is deemed to provide 50-60 percent of all trips, para-transit (taxis and rickshaws) and private cars account for about 20 percent of the trips. Pedestrian trips represent about 20 percent of all the trips.

## 5.5.1. Road Network

Three highways link Karachi to other parts of Pakistan. These are the Super Highway (M-9), National Highway (N-5) and RCD Highway (N-25). The Super Highway extends to Hyderabad while the National Highway extends to Hyderabad-Lahore-Peshawar - Torkham. The RCD Highway links Karachi to Chaman via Quetta.

Karachi has six trunk roads which extend radially from the central area. These are Korangi Road extending south eastwards, Shahrah-e-Faisal Road extending eastwards and connecting with the National Highway, University Road extending north eastwards, M.A. Jinnah Road that connects Shahrah-e-Pakistan Road extending north eastwards and connecting with the Super Highway, Chaudry Fazal Ellahi Road that connects with Nawab Siddiq Ali Khan Road via Nazimabad extending northwards and the RCD Highway extending north westwards via Maripur Road.

Meanwhile, the Lyari Expressway runs along Lyari River from the river mouth at Maripur Road to Shahrah-e-Pakistan. The section on the left bank has been completed, but the section on the right bank is currently only partially completed.

## 5.5.2. Road Length

According to the KSDP-2020, the total length of roads in Karachi City is approximately 10,000 km. By type of road, local roads account for 93%. The combined length of expressways, principal arterial roads and minor arterial roads is less than 5% of the total.

The arterial road network including expressways and highways in Karachi City is shown in table xx. Total length of the arterial road network is 884 kms.

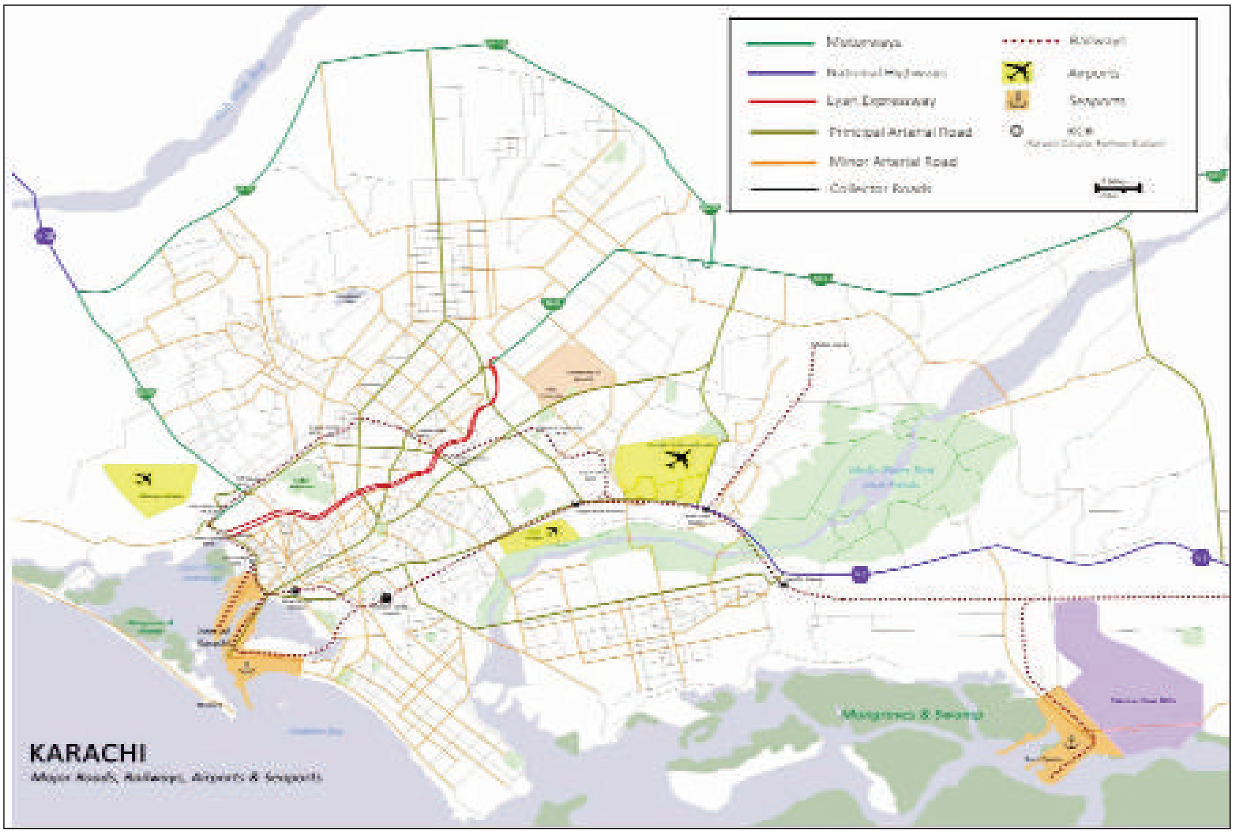



**Fig 5.16:** Karachi Existing Transport Network

## 5.5.3. Number of Privately owned Automobiles

The registered vehicles in Karachi can be observed from the following table. The vehicles are registered under the Excise & Taxation rules, Government of Pakistan. As a Part from this, a good number of vehicles playing in Karachi are registered in other cities. Numbers of unregistered vehicles are also observed in the city.

There is no road-capacity related vehicle policy. Vehicles are being added at a rate of 413 units per day on Karachi roads whose capacity had been exceeded by a factor of 3 in the 1960s. This has resulted in inefficiency in the sector and higher costs to the user. There is lack of clarity regarding the participation of the private sector in the Transport Sector. The government has been unable to forge a clear set of policies that would help to forge an effective partnership between the public and private sectors for the development and growth of the Transport Sector in Pakistan.

**Table 5.27: Road Length by Road Category**

| Expressway | Principal | Minor | Collector | Local | Total |
|---|---|---|---|---|---|
| 77.2 km | 265.9 km | 169.1 km | 243.3 km | 9,197.8 km | 9,944.3 km |

*Source: Karachi Master Plan-2020 Transport Sector Report Table 4.6.2*

## 5.5.4. Public Transport

Public transport modes in Karachi can be categorized into three groups:

**Table 5.28: Arterial Road Lengths**

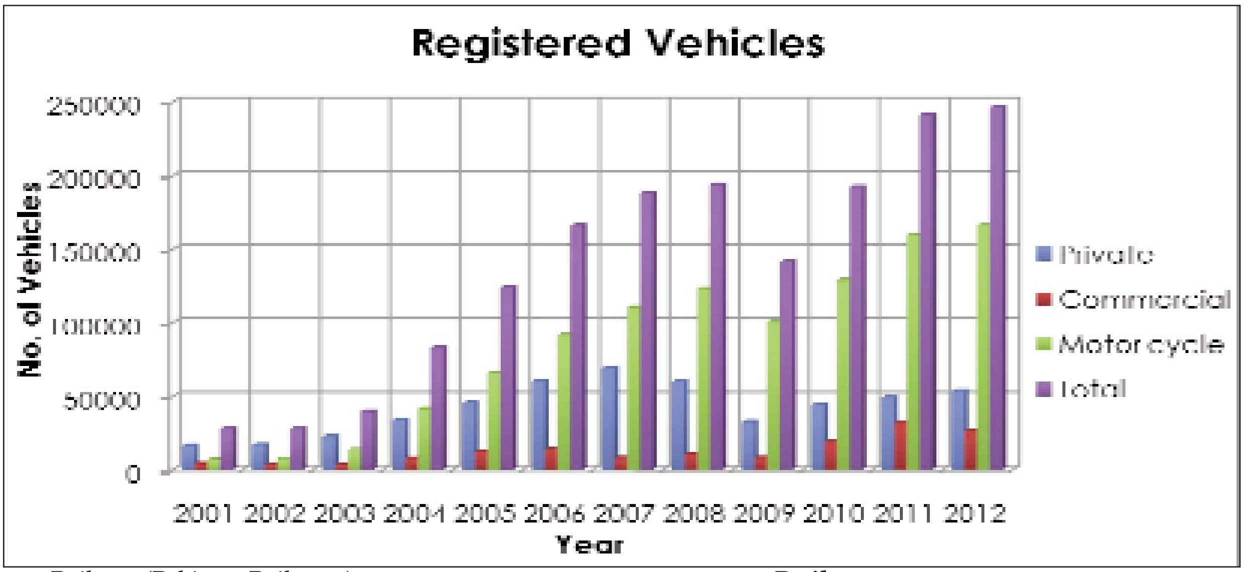
| Expressway | Highway | Highway Principal Arterial | Minor Arterial | Total |
|---|---|---|---|---|
| 25.6 km | 173.2 km | 157.2 km | 527.9 km | 883.9 km |

*Source: KTIP Study (JICA)*

**Table 5.29: Number of Privately owned Automobiles**

| Period | Private | Commercial | Motor cycle | Total |
|---|---|---|---|---|
| July2000- June2001 | 16415 | 4446 | 7137 | 27998 |
| July2001- June2002 | 16868 | 3401 | 7720 | 27989 |
| July2002- June2003 | 22505 | 3629 | 13571 | 39705 |
| July2003- June2004 | 33906 | 7879 | 41374 | 83159 |
| July2004- June2005 | 45523 | 12614 | 65762 | 123899 |
| July2005- June2006 | 60502 | 13907 | 91502 | 165911 |
| July2006- June2007 | 69412 | 8127 | 110487 | 188026 |
| July2007- June2008 | 60017 | 10866 | 122919 | 193802 |
| July2008- June2009 | 32563 | 8169 | 100597 | 141329 |
| July2009- June2010 | 44307 | 19084 | 128856 | 192247 |
| July2010- June2011 | 49062 | 32301 | 159798 | 241161 |
| July2011- June2012 | 53677 | 26492 | 166189 | 246358 |
| Grand Total | 504757 | 150915 | 1015912 | 2571584 |

*Source: Motor Registration Civic Centre Karachi 2009-2012)*




- Railway (Pakistan Railways)
- Public Bus (Minibus, Coach, Large Bus)
- Contract Carriage (Company bus, school bus)
- Para-transit (Rickshaw, Suzuki Carrier, Qimchis)

### 5.5.4.1. Railway

Presently, passenger trains are operated by Pakistan Railways (PR) for inter-city services only. PR is a state-owned railway service company under the Ministry of Railways of the GOP. The track of the inter-city railway runs parallel with the important east-west corridor along Shahrah-e-Faisal Avenue. The route is called as "Main Line". There were 15 trains departing and arriving Karachi Cant Station a day with 17,000 passengers, according to the Cordon Line Survey in KTIP Study.

Karachi Circular Railway (KCR) was introduced in 1969 by PR and has provided the service until 1999. The length of the circular line is approximately 40km. The reason for the closure was that KCR could not attract public passenger demand due to its insufficient and inefficient services.

KCR is expected to formulate a circular and radial structure of mass transit system in Karachi. The scale of KCR is quite similar to that of Yamanote-line in Tokyo, which is very successful circular railway in Japan

JICA has supported a series of studies to reopen KCR and the study in 2008 proposed to upgrade KCR as a modern urban railway system. The revival project of KCR was approved by the GOP on September 3, 2009.

### 5.5.4.2. Bus

The bus is the major transport mode in Karachi. Minibus is the popular bus with a rich decoration and roof seats. The usage of roof seats is prohibited in principal but the seats are commonly used by many passengers because of insufficient bus capacity.

There are approximately 10,000 minibuses in Karachi. It should be noted that thenumber of bus fleet has been decreasing while the population is increasing and the city is apparently expanding.

Buses in Karachi are operated at average speeds of 15-24 km/h. The difference of travel speeds of buses between peak hours and off-peak hours is not large because of frequent stoppage both in peak hours and off-peak hours.

### 5.5.4.3. Para-transit

The Rickshaw (Auto Rickshaw) is a popular transport mode in Karachi, which supplements the insufficient bus network. Rickshaws with two-stroke engine have been blamed for serious environmental damages such as air pollution and noise. The government of Sindh urges conversion of rickshaws from two-stroke engine of gasoline to four-stroke engine of CNG. There are many new rickshaws with CNG four-stroke engine observed on the roads in Karachi, although there still remain a lot of rickshaws with two-stroke engine.

Qingqi Rickshaw is similar to Auto Rickshaw, having three wheels and passenger sheets in the rear. Qingqi Rickshaws are mostly operated in local streets as a feeder service of bus network and operation along main roads are restrained.

**Fig 5.17:** Minibus&Bus

### 5.5.4.4. Inter-modal Transfer Facility

The major inter-modal transfers in Karachi are transfers between inter-city buses and local buses, transfers at the airport, and transfers at PR stations. There are four inter-city terminals in Karachi as follows:

- Karachi Cantt Station (inter-city for National Highway),
- Lee Market Bus Terminal (inter-city for National Highway and Super Highway),
- Daewoo Bus Terminal (inter-city for Super Highway), and
- RCD City Terminal (Karachi – Balochistan)


**Fig 5.18:** CNG Rickshaw Qingqi

Car and taxi are the major modes of the feeder transport from/ to RCD City Terminal because public transport service between RCD City Terminal and the center of the city is poor. Illegal parking of inter-city buses is observed in Saddar Area because there is no inter-city bus terminal in Saddar Area except for Karachi Cantt Station but the passenger demand is high.

### 5.5.4.5. Bus Traffic

Public Transport Survey was conducted in Karachi Transport Improvement Project (KTIP) Study (KUTMP 2030) to investigate bus frequency. Frequency for 12 hours (6:00–18:00) varies from 10 to 495. Route "W-11", which connects Tower and North Nazimabad, is the most frequent route, where a bus runs every 45 seconds in peak time. The 12-hours frequency of "W-11" in front of KMC building (along M. A. Jinnah Road) was as large as 495. There are about 30 routes concentrating on M. A. Jinnah Road, which is the busiest bus transit route. Route "D-7" is the second at 397, which connects Super Highway and Landhi through Rashid Minhas Road. Public Transport Survey recorded 132 routes during the survey in which 70% of bus routes have less than 100 bus trips within 12 hours.

## 5.6. Urban transportation issues/problems (to be addressed) in Karachi

### 5.6.1. Problem Identification of the Transport System in Karachi

**Poor Quality of Service and Inefficient Public Transport**

- The public transport is mostly operated by private operators who compromise on the safety and comfort of the public. The daily commuters face great hardships due to poor quality of service, substandard vehicles and clumsy routes.

- The buses used are more than 20-25 years old usually running on diesel and emitting visible black smoke.

encroached/ill maintained footpaths are some of the main reasons why lower middle and middle income groups do not use NMT.

- Pedestrians, besides being exposed to air and noise pollution, are also the largest group of victims of road crashes as almost 600 people die in

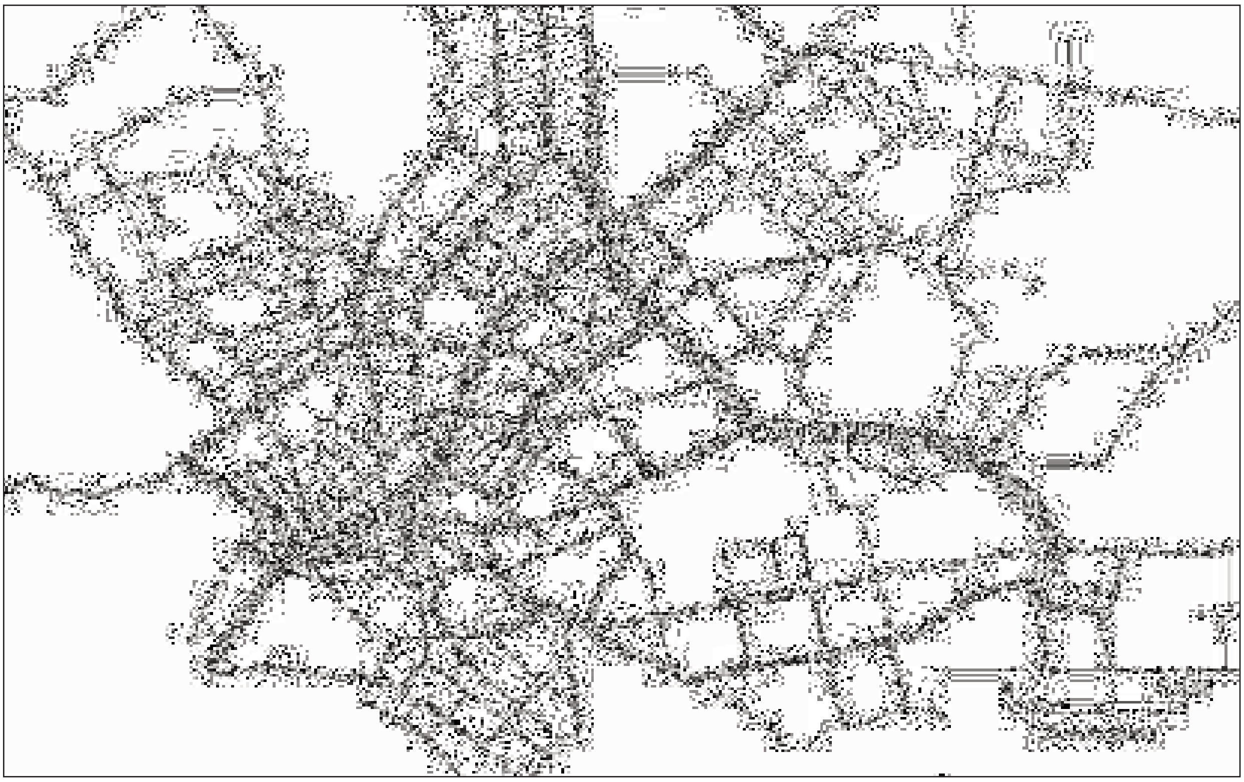


**Fig 5.19:** The width of each road line represents the number of buses operated for both directions per day. (Source: Public Transport Survey in KTIP)

- These buses do not use the designated bus-stops to pick-up and drop-off the commuters, which hinders traffic flow (Intra-city Bus Travel in Karachi, by Saif Asif Khan (15-05-2013)).

- Non-motorized transport (NMT) is one of the most sustainable modes of transport. Unfortunately, it is unpopular in Karachi and only used by the low income group who cannot even afford public transport. The alarming security and safety problems, the absence of policy and planning for pedestrians/cyclists, and the

road crashes every year in Karachi with over 50 per cent being pedestrians (Urban Resource Center, 2003).

- The daily loss in terms of money and time suffered by Karachi's economy owing to the inefficiencies in the system of public transport in the city. Intending passengers claim that they have to wait at least 15-20 minutes daily at the bus stop, which constitutes roughly 6% of peak working time, assuming that the average worker works 8-10 hours a day. Using ballpark estimation, the city suffers a daily loss of at least Rs.50 million due to productive time lost simply waiting at the bus stop.

**Low Capacity of Bus Service**

- The number of bus fleets is decreasing while the traffic demand is increasing with rapid population growth, city expansion, and economic growth. Rapid increase in private cars cannot explain the reason because car is still expensive in Pakistan and there still remain huge population who cannot afford to buy a private car.
- There are several reasons.
- The number of minibuses and coaches are restricted while introduction of standard size buses has failed.
- Bus service might not be a profitable business in Karachi due to the diesel price increase and politically regulated fare.
- It is allegedly said that transport mafia controls the public transport supply to ensure the profit.
- Bus fleets are often burnt by riot due to social unstable conditions.
- The wide gulf between the number of seats available in buses and the demand is further illustrated by the passenger-to-seat ratio of 40:1, which means that passengers often have to risk their lives by travelling on the vehicle's roofs, while there are no speed regulations.
- Estimates of Karachi's population growth rate range between anywhere 3 to 5%. This means that the number of buses should be growing by at least 2-3% each year to cater to this increasing demand for public transport. For instance, in the ten years from 1990 to 2000, there was an 86% increase in the bus fleet of Mumbai, and a 54% increase in that of Chennai. Instead, we observe that the number of buses is actually declining, owing to at least 500 buses.
- In this respect, it might be pertinent to mention here the possibility of implementing a Bus Rapid Transit (BRT) system in Karachi. According to the NY Metropolitan Transit Authority, BRT is a concept of high performance public transport buses which aims to combine bus lanes with top of the notch bus stations, buses, amenities and branding, to achieve comparable performance quality of a metro rail system, with the added flexibility, cost and simplicity of a bus system.

**Improper Bus Route**

- The majority of the bus services concentrate on radial directions except the major circular route such as Rashid Minhas Road.
- Bus routes are designed to provide the service between major origin and destination through high demand routes, and the preferable routes for bus operators are busy while the bus service along non popular routes is poor.
- There is no hierarchy of bus network, or trunk and feeder system. From this, passengers need to transfer their buses to reach their destination.
- Since there is no fare integration, passengers need to pay the fare for every transfer.

**Poor Road Network**

- Road network in Karachi has been significantly improved in recent years by construction of flyovers and underpasses. From this, traffic capacity problem is small at present. However, there are some network problems relating urban structure.
- For example, the access to and from Korangi industrial area is inconvenient because there are

few access routes over Malir River.

- Traffic to and from Clifton area concentrates several intersections on Shahrah-e-Faisal Road, which cause traffic congestion in the center of the city.
- Since the drainage system of road system is poor, even at recently developed underpasses, flood is a big problem in monsoon season.

**Traffic Congestion**

- Traffic congestion is one of the serious problems especially in the center of the city. A lot of traffic signals are installed at intersections in the down town area compared to the suburban area. However, traffic is controlled by traffic police in peak hours because of the problems of the signalized intersections.
- Much of the city's primary highway network has a wide alignment and wide central medians but the road hierarchy is deficient, with a lack of secondary roads, which provide a vital feeder service between the major thoroughfares and residential areas. This results in congestion which is further aggravated by encroachments and on-street parking on the main and collector streets.

**Traffic Accidents**

- Places where frequent traffic accidents occur (black spots) are shown in the following figure. Worst black spot in 2008 was at Korangi Naddi, second worst spots were Beneath KPT Interchange and Jinnah Bridge.
- Many of traffic accidents were occurred on the highway and arterial roads. Particularly noticeable routes of high accidents were Shahrah-e-Faisal – National Highway, Shahrah-e-Pakistan – Super Highway and Estate Avenue.

**Environmental Deterioration**

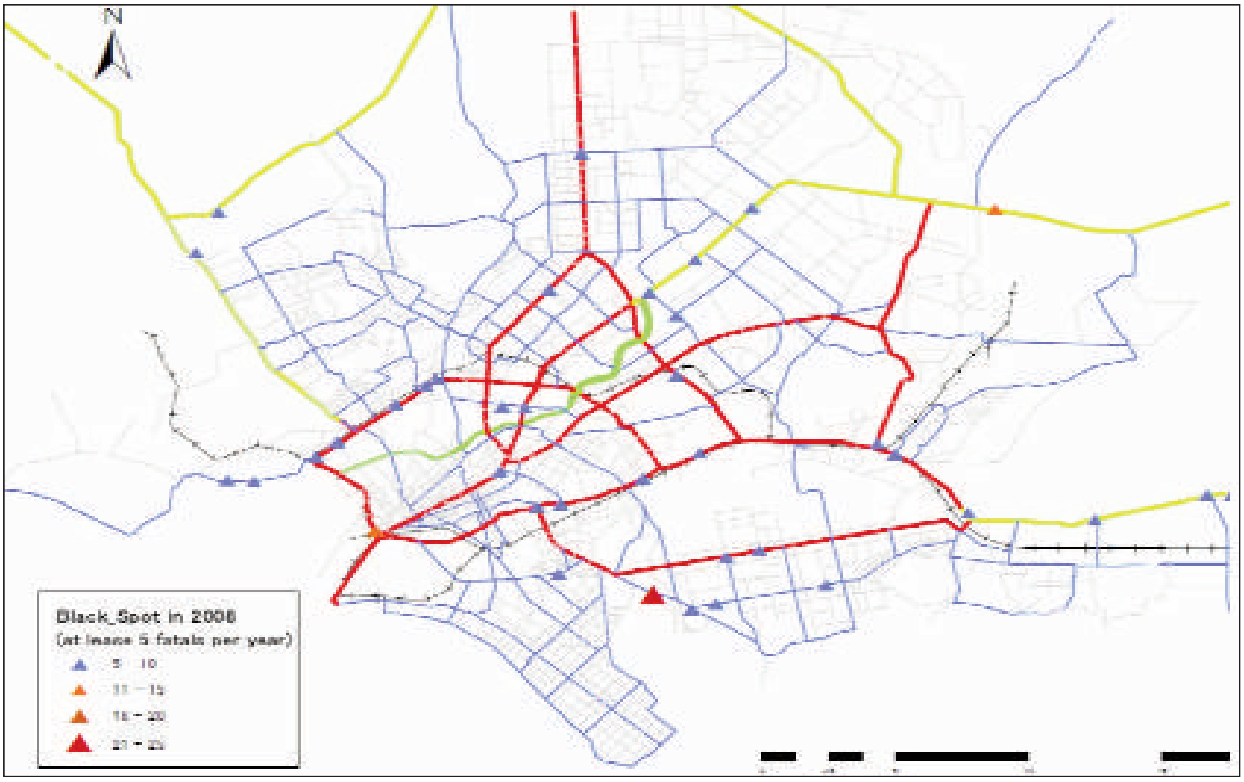
Urbanization and motorization have proceeded with inadequate government and technological support for sustainable development plans. The negative externalities of the transport sector have gradually

harmed the environmental conditions in urban areas and are continuing to exacerbate the quality of life. The unchecked growth in the vehicle fleet combined with an aging and ill maintained vehicle stock has degraded the road environment which has resulted in severe congestion on the roads along with serious levels of air and noise pollution.

Motor vehicle and motorcycle ownership is growing at a rate of approximately 14 per cent per annum (over 500 new vehicles joining the road network each day), is potentially the most significant threat to Karachi's opportunity to improving the quality of life of city residents. This extraordinary rate of growth has major adverse implications for pedestrians, air quality, the public transport system, road safety and the overall liveability and accessibility of the city (ADB, 2007).

Air & noise pollution due to increase vehicular emissions:

Karachi city's air quality is one of the poorest in the world, with levels exceeding WHO guidelines. A major contributor to this pollution and generation of green-house gases (GHG) is the transportation sector, especially from an aging fleet of vehicles in poor mechanical condition and low levels of fuel efficiency.




Highway, Shahrah-e-Pakistan – Super Highway and Estate Avenue.
(Source: KTIP JICA)

The high levels of sulphur in an automotive diesel (0.5% - 1%) is seen as a major contributor to sulphur dioxide (SO2) and particular matter (PM 10) in ambient air.

According to the Pakistan Environmental Protection Agency (PEPA), a major share of the emission load from motor vehicles in urban areas can be attributed to a relatively small number of smoky diesel and 2-stroke (rickshaws) vehicles.

Traffic congestion affects average speed of vehicles and consequently fuel consumption --- and pollution/greenhouse gases.

The health costs associated with air pollution are equivalent to 1% of GDP.

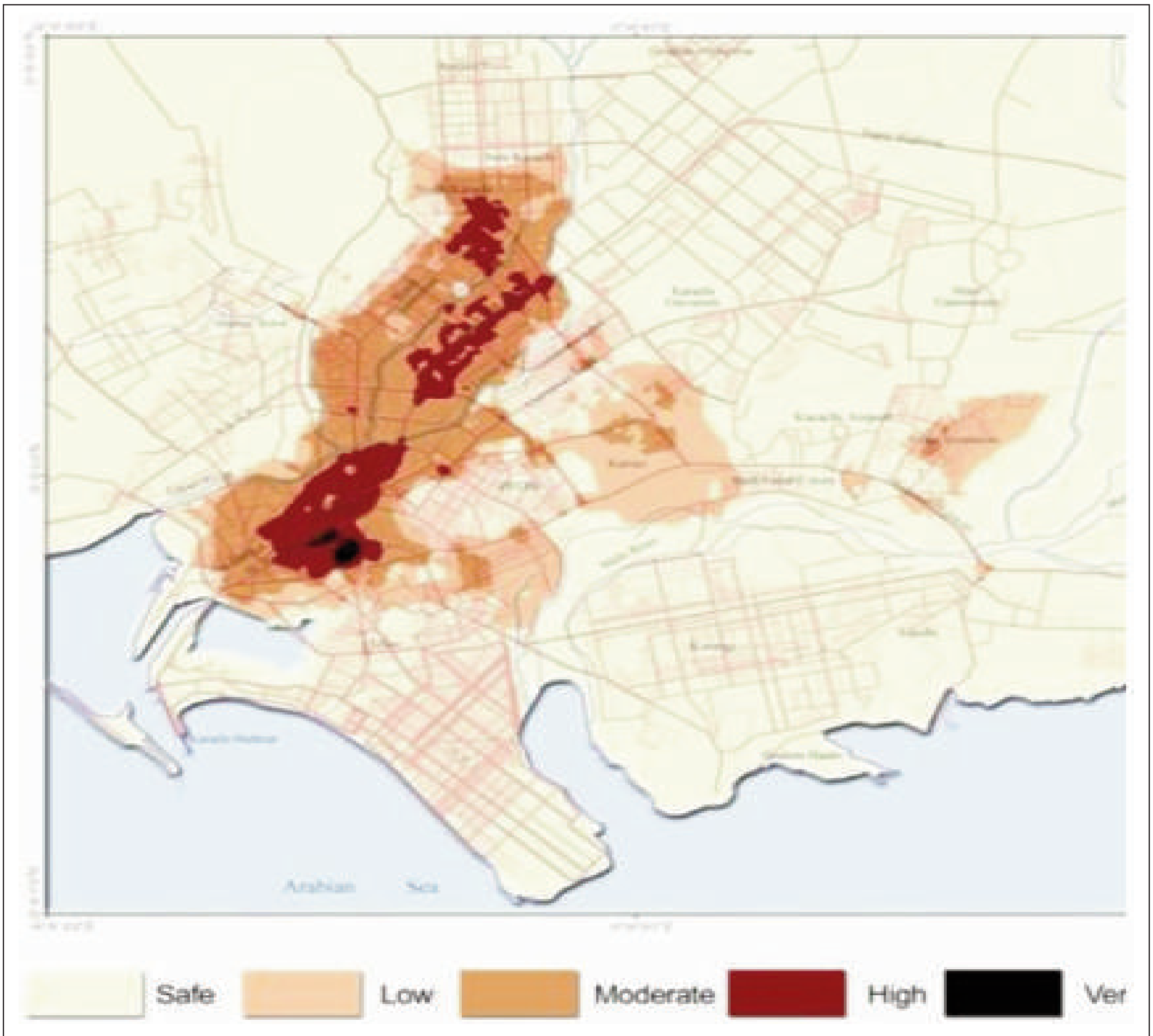
Particularly at health risk are those living within a quarter of a mile of high-volume roads (those carrying 10,000 – 20,000 vehicles per day) and those living near roads with a large amount of truck traffic.

Noise pollution from vehicles, especially in residential areas, is above recommended levels.

Major contributors to the noise pollution are frequent and indiscriminate use of vehicle horns, removal of silencers on rickshaws and other 2-stroke vehicles, high volumes of traffic especially heavy vehicles.

When implementing KCR, the Project can acquire 128,306 tCO2/10 years GHG emission reduction in 10 years (source: SAPROF II). Without the project, equivalent amount of CO2 will be generated due to fossil fuel burnt traffic.

From KCR, the generation of electricity for EMUs is from national grid and the emissions are from point source. But without KCR, the emissions from increase in traffic are non-point sources and spread all over Karachi.




Risk of air pollution to the dwellers of Karachi (Multi-criteria risk assessment)
(Source: Arsalan, 2002)

Ambient air quality monitoring was carried out at 4 different locations along the KCR route. The various sources of air pollution in the project area are industrial emissions, vehicular traffic, and dust arising from field road side and construction activities.

**Ethnicity**

According to the most recent census data available, almost half the residents of Karachi (49%) cite Urdu as their mother tongue, followed by Punjabi (14%) and Pashto (11%).

This is expected to have changed slightly over the past 10 to 15 years, in view of increased migration from Khyber Pakhtunkhwa.

Not too surprisingly, Karachi's two native languages, Sindhi and Balochi, are spoken by no more than 10% of the population.

In this backdrop, experience from Africa has shown that a good system of public transport can play a useful role in mitigating the possibility of ethnic and racial conflict, by building opportunities for interaction between different communities (similar to parks, playgrounds and other public amenities).

| 1- AMBIENT AIR QUALITY RESULTS AT BALDIA NEAR GULBAI | | | | | |
|---|---|---|---|---|---|
| | CO (ppm) | CO2 (ppm) | NOx (ppm) | SO2 (ppb) | PM10 (µg/m3) |
| NEQS | 5 | - | 60 | 120 | 250 |
| Avg. | 3.9 | 353 | 35 | 24 | 181 |
| Max. | 5.3 | 375 | 45 | 34 | 241 |
| Min. | 2.5 | 336 | 21 | 12 | 123 |
| **2- AMBIENT AIR QUALITY RESULTS AT CHANISER HALT** | | | | | |
| | CO (ppm) | CO2 (ppm) | NOx (ppm) | SO2 (ppb) | PM10 (µg/m3) |
| NEQS | 5 | - | 60 | 120 | 250 |
| Avg. | 2.9 | 351 | 36 | 19 | 170 |
| Max. | 4.1 | 372 | 48 | 31 | 230 |
| Min. | 1.3 | 337 | 18 | 6 | 130 |
| **3- AMBIENT AIR QUALITY RESULTS AT DRIGH ROAD** | | | | | |
| | CO (ppm) | CO2 (ppm) | NOx (ppm) | SO2 (ppb) | PM10 (µg/m3) |
| NEQS | 5 | - | 60 | 120 | 250 |
| Avg. | 5.9 | 360 | 38 | 26 | 167 |
| Max. | 7.3 | 379 | 52 | 39 | 240 |
| Min. | 4.5 | 342 | 19 | 12 | 126 |
| **4- AMBIENT AIR QUALITY RESULTS AT NORTH NAZIMABAD** | | | | | |
| | CO (ppm) | CO2 (ppm) | NOx (ppm) | SO2 (ppb) | PM10 (µg/m3) |
| NEQS | 5 | - | 60 | 120 | 250 |
| Avg. | 2.9 | 346 | 34 | 19 | 163 |
| Max. | 4.3 | 365 | 47 | 34 | 236 |
| Min. | 1.5 | 328 | 14 | 7 | 122 |
| **5- AMBIENT AIR QUALITY RESULTS AT WAZIR MANSION** | | | | | |
| | CO (ppm) | CO2 (ppm) | NOx (ppm) | SO2 (ppb) | PM10 (µg/m3) |
| NEQS | 5 | - | 60 | 120 | 250 |
| Avg. | 1.0 | 324.6 | 15.3 | 12.2 | 221 |
| Max. | 6.0 | 349.9 | 39.7 | 27.5 | 287 |
| Min. | 3.0 | 337.9 | 27.0 | 19.6 | 155 |

*Source: KCR EIA Study sec 4.0 2(B) p.6 of 62*

There is also the sense of societal ownership that mass-based projects such as public transport provide to citizens.

## 5.7. Socio-Economic Considerations in Macro Environment

### 5.7.1. Population Density

Karachi is now among the ten top ranking mega cities in the world. Karachi's reported population in 1940 was 387,000, in 1960 it was 1,913,000, in 1981 it was 5,208,000 and in 1998 it was 9,957,726. In 2005, the population of Karachi was estimated at 15.1 million and is estimated at 18 million at present and is expected to reach 27.5 million marks by 2020. The number of households in 2005 was about 2.1 million and by 2020 it is expected to increase to 3.9 million, which suggests an increase of 1.77 million households, at an average size of 7 persons per household. Even at decreasing average annual growth rate (from 4.15 percent in 2005 to 3.5 percent in 2020), the increase in absolute terms is staggering and will put heavy pressure on the physical, infrastructure, financial and institutional systems of the city. The urban population growth rate also increased after 1998 from 3% to 6% till the year 2005.

According to the 1998 population census results, the population of Karachi was 11,335,000. While the population figure actually put forward by the 1998 census are 9,960,000. It is widely known that this figure greatly under-estimated the number of residents of Kachi Abadis and the number of immigrants (especially from Afghanistan and Sri Lanka). The scale of the under-estimation is believed to be 1 - 2 million. In the KSDP-2020, the scale of this under-estimation is estimated to be 1,375,000 and the 1998 Karachi population is accordingly modified to 11,335,000.

The city's population was once predicted to increase to 15.1 billion in 2005 and 27.5 million in 2020. The annual population increase rate has definitely been falling in recent years. While the annual rate of natural increase is believed to be around 3.5%, the conflict in Afghanistan has been driving refugees to Karachi City, resulting in an overall annual population increase rate of approximately 4.2%. Consequently, the size of the city's population in 2005 is inferred to have been around 15.12 million and the annual population increase rate is believed to have been gradually falling thereafter.

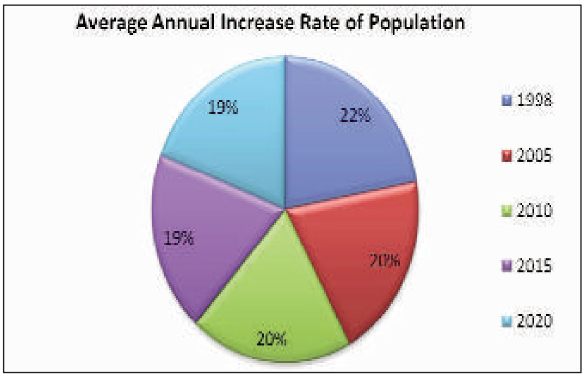
### 5.7.1.1. Population Density at BRT Corridors

The past and projected population growth estimates of the towns of Karachi City which are included on the BRT corridor of Green Line are presented in the following Table 5.30.

## 5.7.2. Settlement Pattern

Karachi expanded from an area of 116 km2 in 1947 to 1800 km2 in 1987 and has remained confined to that area ever since. In population, however, it has expanded from 0.3 million to 5.9 million in 1981 and to 15 million as of now.

Low-income households were initially located in the trans-Lyari sections of Golimar, Liaquatabad,




Nazimabad and were subsequently extended in the early 1950s northward to Nazimabad, Liaquatabad, Federal Area, North Karachi, Baldia, Orangi and Sindh Industrial Estate, and eastward to Drigh Colony, Malir Colony, Landhi Colony and Landhi Industrial Estate, and Korangi Colony and Korangi Industrial Area. These settlements were close to employment opportunities. Economic growth sequential to industrial and commercial activities attracted settlement of low-income households on encroachments on railway property, valuable unoccupied plots as well as amenity plots. Such

**Table 5.30: Population estimates and projection for towns of Karachi City**

| Town No. | Town Name | Population (1,000) | | | |
|---|---|---|---|---|---|
| | | 2005 | 2010 | 2015 | 2020 |
| 1 | Saddar Town | 935.6 | 997.9 | 1,060.3 | 1,122.7 |
| 2 | Jamshed Town | 1,114.2 | 1,262.8 | 1,411.4 | 1,559.9 |
| 3 | Gulshan-e-Iqbal Town | 949.4 | 1,424.0 | 1,898.7 | 2,373.4 |
| 4 | North Nazimabad Town | 753.4 | 828.8 | 904.1 | 979.5 |
| 5 | New Karachi Town | 1,038.9 | 1,108.1 | 1,177.4 | 1,246.6 |
| 6 | Liaquatabad Town | 985.6 | 1,002.0 | 1,018.4 | 1,034.9 |
| 7 | Malir Town | 604.8 | 705.6 | 806.4 | 907.1 |
| 8 | Cantonment Areas | 844.5 | 1,100.7 | 1,356.9 | 1,613.0 |
| | Total | 15,119.8 | 19,263.3 | 23,406.7 | 27,550.1 |
| | Growth Rate | 1.27 | 1.22 | 1.18 | |
| | Yearly Growth Rate (%) | 5.0 | 4.0 | 3.3 | |

*Source: KSDP-2020(August 2007)*

encroachments are interspersed as Katchi Abadis throughout the city.

Old settlement located at the Saddar Town in the Railway Colony on the north of MTK Road. Similar settlements in Jutland Lines Area have been replaced by new apartment buildings. Pakistan Employees Cooperative Housing Society in Jamshed Town was initially meant to provide housing facility to Government Employees. It was among the most important settlements of the time and so were the other housing societies like Sindhi Muslim Cooperative Housing Society, Jinnah Housing Society and Karachi Administration Housing Society. Establishment of these societies was accompanied by encroachment and Katchi Abadis such as Mehmoodabad, Liaquat Ashraf Colony and Umer Colony were interspersed along the railway line and between Chanesar Goth and Baloch settlements further east.

Settlements in Shah Faisal Colony, Malir Colony or Landhi Colony were likewise accompanied by encroachments and subsequent regularization of their status as Katchi Abadis around unoccupied land. Such settlements include those in Natha Khan Goth, Green Town, and Golden Town in Shah Faisal Town; Jafar-e-Tayyar, and land opposite Malir City Railway Station as well as along the railway line in Malir Town, Quaidabad and Laiqabad in Bin Qasim Town and Mansehra Colony, Gulistan Society and Moinabad in Landhi Colony.

## 5.7.3. Social Structure

Social structure of the Karachi, describes the standard of living of the inhabitants; interaction of the residents among each other; infrastructures of the area etc. Generally, Karachi has been broadly grouped into three:

- In the Katchi Abadis, which have been marked for regularization and improvement, Community organizations are developing to protect open spaces and to create sport clubs, lending libraries and cultural organizations. In these settlements services and housing gradually improve over time.
- In Middle Income Settlements, there is a constant struggle with the local authorities to improve services. Citizens' associations lobby with politicians and government agencies to this end. They initiate court proceedings when they do not succeed in getting what they desire and often help in making the issues of their areas into election issues for the national and provincial assembly elections. Ethnic issues dominate the politics of these areas and give rise to a number of social welfare organizations.
- The High Income Settlements, of the city are becoming increasingly isolated from the rest of Karachi. They are developing sports facilities, shopping centers, entertainment activities, libraries and educational institutions in their own areas. Their residents now do not have to go out of their areas except to work. In addition, most houses have armed guards and many are looked after by security companies with computerized security arrangement

### 5.7.3.1. Income Level

**Total Monthly Income of Families**

In Karachi city, 44 percent of families earn between 5,000 to 10,000 rupees per month while 90 percent of families earn less than 20,000 rupees per month. The town of Gulshan-e-Iqbal and North Nazimabad shows high average monthly income. The towns located in outer of Karachi show relatively low average monthly income.

### 5.7.3.2. Distribution of the venerable

The earliest Katchi Abadis in Karachi were established with the refugee migration of 1947. These settlements were established through unorganized invasions of state land within the city and on its then immediate periphery. Residents of settlements bulldozed between1958-68 were also relocated to subserviced plot townships in West Karachi, in locations then far away from the city. Huge Katchi Abadis developed around these settlements and some of them such as Baldia and Orangi, have populations of over one million each. These settlements are now very much a part of the city and have planned areas adjacent to them.

During the period 1958 - 1968 and the decade after,

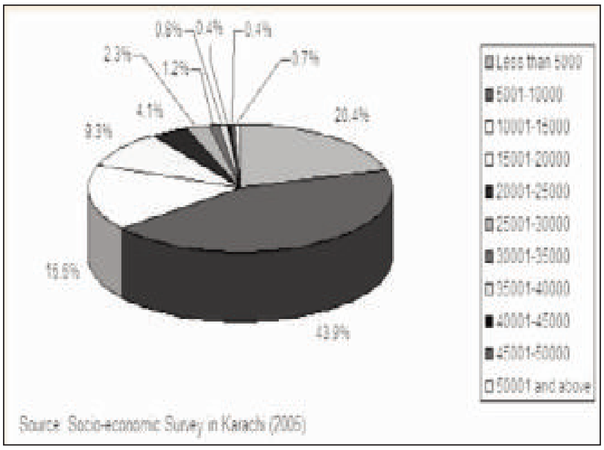



**Fig 5.20:** Total Monthly Income of Family

large scale migrations from the northern rural areas of Pakistan to Karachi continued. This migration was initially housed in Katchi Abadis on natural drainage channels on the roads linking the city to the Dioxides townships of Landhi-Korangi and New Karachi. Subsequently, settlements developed along the railway lines and the natural drainage channels within the city that carry Karachi sewage to the sea. These settlements continued to density. Almost all the larger ISD settlements contain old villages which have now become a part of these Katchi Abadis and on whose community and agricultural lands (usually on a one-year renewable lease from the state) the settlements have been built.

The creation and expansion of Katchi Abadis is now taking place almost exclusively to the west and north of Karachi. The reasons for this are:

1. Government land and road infrastructure is available.
2. These areas are closer and better connected with employment generating areas.
3. They are closer to the larger Katchi Abadis where informal industrial activities and labor populations provide jobs and a demand for services.
4. The other locations land is privately owned or is controlled by cantonments.

The inner city slums are located around high-density wholesale markets, informal transport and cargo handling terminals and or along and in the beds of natural drainage channels and seasonal rivers. Those that are old pre-independence working class settlements have security of tenure.

#### 5.7.3.3. Indigenous and Ethnic people

The ethnic configuration of the metropolis shows that 49% people are Urdu speaking, 14% of Karachiites are Punjabi speaking, 11% speak Pashto, 7% speak Sindhi, 4% speak Balochi and Seraiki is spoken by 2% of the population.

### 5.7.4. Social Infrastructure

#### 5.7.4.1. Water Supply System/Situation

The provision of water for domestic, commercial and industrial use is the primary responsibility of the City District Government of Karachi through the Karachi Water and Sewerage Board (KWSB). KWSB draws most water for the city from two surface water sources – the Indus River, which lies over 100 km from the city, and the Hub dam which lies about 35 km away.

Currently, about 540 million gallons per day (Mgd) is pumped to the city of which about 350 Mgd is partially or completely treated through clarification, filtration and chlorination. The remainder enters the distribution system untreated.

Unaccounted for water (UFW) and system losses are believed to be considerable. In the absence of both

**Table 5.31: Population of Indigenous and Ethnic Groups in Karachi(1998**

| Ethnicity | Percentage |
|---|---|
| Urdu-speaking | 49% |
| Punjabi | 14% |
| Pahsto | 11% |
| Sindhi | 7% |
| Balochi | 4% |
| Seraiki | 2% |
| Others | 13% |

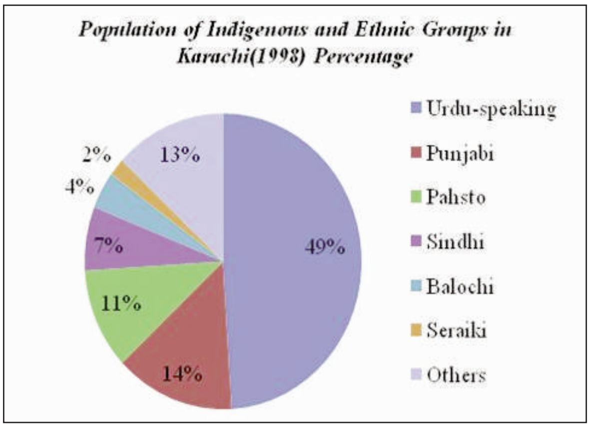



**Table 5.32: Population Proportion of Muslims and other minorities**

| Religion | Male | Female | Both | Percentage |
|---|---|---|---|---|
| Muslims | 5,123,126 | 4,382,909 | 9,506,035 | 96.45% |
| Christians | 113,667 | 124,905 | 238,572 | 2.42% |
| Hindus | 42,384 | 39,214 | 81,598 | 0.83% |
| Ahmadis | 8,945 | 8,044 | 16,989 | 0.17% |
| Scheduled castes | 1,575 | 1,595 | 3,170 | 0.03% |
| Others | 5,170 | 4,784 | 9,954 | 0.1% |
| Total | 5,306,105 | 4,550,213 | 9,856,318 | 100% |

bulk metering on the distribution system and domestic metering, it is simply not possible to arrive at an accurate figure for system losses. However, it has been estimated that between 35 and 50 per cent of the water which is pumped to the network is lost in distribution. With the projected delivery of 635 Mgd from 2006, this represents a loss of between 220 and 320 Mgd. Thus barely 250 Mgd or 20 gal/capita/day (90 lpcpd) is available for use by domestic consumers. Due to the intermittent nature of supply in all areas, and absence of supply in some, this reduces to less than 10 gal/capita/day (45 lpcpd) in many areas – and particularly in the Katchi Abadis - with water only available in the network for a few hours every other day.

The coverage within the urban area of mains water connections to households is reasonably high. The 1998 census results for the city of Karachi indicate 75.8 percent of households have a piped connection within the house and a further 7.2 per cent outside the house – over 8 out of 10 households. The Sindh MICS study which drew information from a 3 percent survey of households throughout the city district recorded 85 percent of households with access to improved sources (77 percent piped and 8 percent other protected sources) and 15 percent unimproved sources (1 percent unprotected wells and 14 percent tanker trucks). With exception of one or two towns, many households (probably well over 10 percent of total Households in Karachi) rely entirely on tankers to supply potable water. It is estimated that some 25,000 tanker loads per day (with around 25 Mgd) of water are supplied at prices ranging from Rs 275 up to Rs 1,000 per 1,000 gallons depending on the quality of water and the ability of the purchaser to pay. This activity is managed by the Pakistan Rangers, who obtain water from KWSB hydrants at no cost.

Water quality in Karachi is poor. Recent surveys have shown that over 75 percent of water samples taken from the system are below WHO standards. Water quality in the network is compromised by

i. The lack of adequate treatment.

ii. Poor functioning (or bypassing) of existing treatment works.

iii. The intermittent flow and variable pressures in the system which allows the ingress into the supply system of faucal contaminated groundwater and surface water.

(Karachi mega cities preparation project 2005)

#### 5.7.4.2. Electricity Distribution System/Situation

Provision and distribution of electricity to the city of Karachi is the responsibility of the Karachi Electric Supply Corporation (KESC). KESC has a generating capacity of 9 percent of the total national power generated (1,756MW), and in Karachi it both generates electricity and transmits and distributes it to domestic, institutional, and industrial users. Current peak demand outstrips supply by an estimated 518 MW or 24% of generation capacity. The impact of this on Karachi is frequent load-shedding during periods of peak demand over the summer months, with the consequent negative economic impact. Recently, the persistent incidents of load shedding in some areas of the city, has led to civil unrest.

In addition to the shortfall in supply, there are serious problems with the distribution network. Many of the feeders are overloaded which adds to transmission losses and outages, others are very long which again contributes to increased transmission losses. While there are 1.4 million paying domestic customers within the service area, and a further 400,000 commercial, institutional and industrial consumers, there are estimated to be a further 350,000 who are illegally connected to the system and thus do not pay for the power that they consume. The combined transmission, distribution and administrative losses are over 37 percent of supply.

(Karachi mega cities preparation project 2005)

### 5.7.5. Historical Places and Monuments along the Corridor

There are no Historical Places and Monuments present on the BRT corridor.

Mausoleum of Quaid-e-Azam is located at a distance along the way of corridor; hence no possible hazard is imposing by the project to this structure.

Close to the project route, most of the old buildings which are notified as heritage sites by the Department of Antiquities, Government of Sindh are located in the old city area, on the M.A. Jinnah road, which is the part of the main project corridor. It is to be mention that all the heritage sites and tombs are located at a reasonable distance from the BRT route R.O.W. which will be located at the median of the road.

### 5.7.6. Sanitation

#### 5.7.6.1. Morbidity of epidemic disease

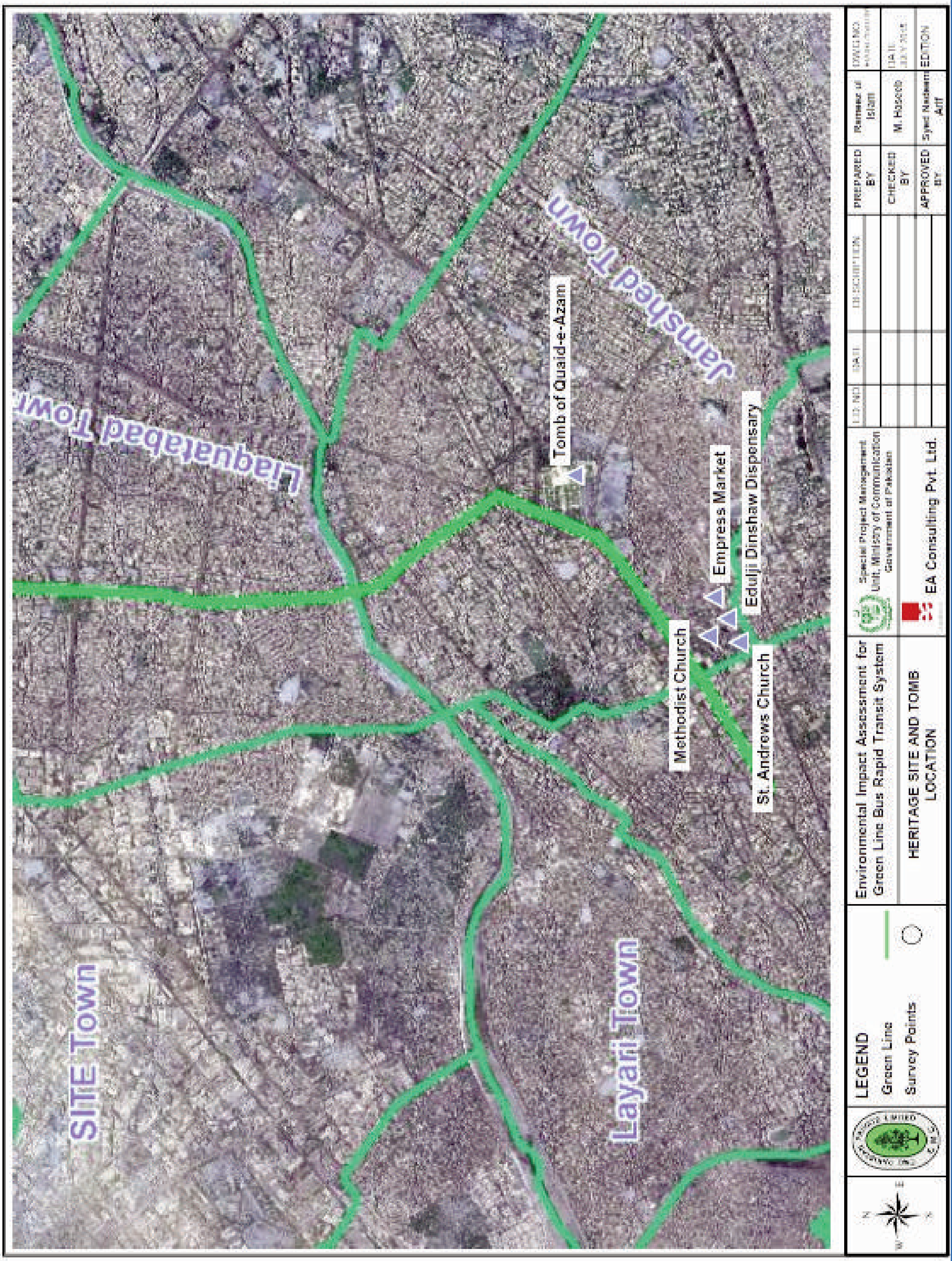
The survey in 2000 revealed the following as very common health issues: cough, flu, fever, high blood pressure, headaches, stomach aches, diabetes. Malaria, diarrhoea, piles, kidney problems, measles, hernia and paralysis were lesser common ailments, some of these being more common in a certain area of the Katchi Abadi.

(Source: Hasan, Arif (2000) Understanding Karachi)

#### 5.7.6.2. Morbidity of infection disease

Most common and lethal diseases in Pakistan include:

- Acute respiratory infection (51%): Among the victims of ARI, most vulnerable are children whose immune systems have been weakened by malnutrition. In 1990, National ARI Control

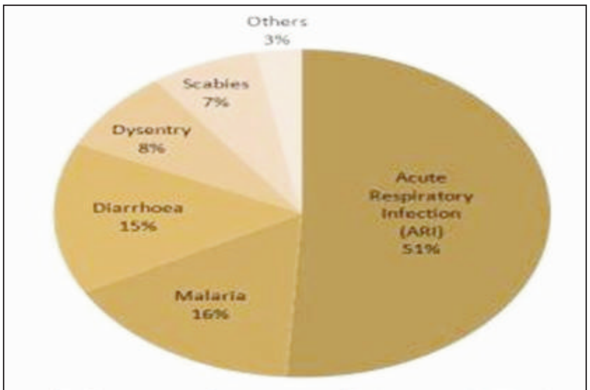

SITE Town
Layari Town
Liaquatabad Tow
Jamshed Town
Tomb of Quaid-e-Azam
Empress Market
Edulji Dinshaw Dispensary
Methodist Church
St. Andrews Church
LEGEND
Green Line
Survey Points
Environmental Impact Assessment for Green Line Bus Rapid Transit System
HERITAGE SITE AND TOMB LOCATION
Special Project Management Unit, Ministry of Communication Government of Pakistan
EA Consulting Pvt. Ltd.
PREPARED BY
CHECKED BY
M. Haseeb
APPROVED BY
Syed Nadeem Arif
EDITION

Programmed was started in order to reduce the mortality concerned with pneumonia and other respiratory diseases.

- Viral Hepatitis (7.5%): Viral Hepatitis, particularly that caused by types B and C are major epidemics in Pakistan with nearly 12 million individuals infected with either of the virus. The main cause remains massive overuse of therapeutic injections and reuse of syringes during these injections in the private sector healthcare.
- Malaria (16%): It is a problem faced by the lower class people in Pakistan. The unsanitary conditions and stagnant water bodies in the rural areas and city slums provide excellent breeding grounds for mosquitoes. Use of nets and mosquito repellents is becoming more common. A programmed initiated by the government aims to bring down malarial incidence below 0.01% by the year 2011. In Pakistan, malarial incidence reaches its peak in September. In 2006, there were around 4,390,000 new reported cases of fever.
- Malaria is one of the common febrile conditions which is often diagnosed on the basis of clinical signs and symptoms. The objective of the study was to determine the prevalence of malaria in Karachi. In this study 463 GP's were interviewed at Karachi. Out of 50 to 70 patients seen by each on a daily basis, 10 – 15 % cases were diagnosed as Malaria. In a follow up study in Karachi and two other areas in Sind, Plasmodium vivid was found to be two times higher than Plasmodium falciparum. Mosquito density in respect of the anopheles corresponds with higher number of cases during July – September.
- Diarrhea (15%): There were around 4,500,000 reported cases in 2006, 14% of which were children under the age of five.
- Dysentery (8%) and Scabies (7%)
- Others: Goiter, Hepatitis and Tuberculosis

### 5.7.6.3. Controllable diseases

- Cholera: As of 2006, there were a total of 4,610 cases of suspected cholera. However, the floods of 2010 suggested that cholera transmission may be more prevalent than previously understood. Furthermore, research from the Aga Khan University suggests that cholera may account for a quarter of all childhood diarrhea in some parts of rural Sindh.
- Dengue fever: An outbreak of dengue fever occurred in October 2006 in Pakistan. Several deaths occurred due to misdiagnosis, late treatment and lack of awareness in the local population. But overall, steps were taken to kill vectors for the fever and the disease was controlled later, with minimal casualties. Since January 1 2009 till the December 19, 1355 people were suspected of being infected with the dengue



Infectious diseases in Pakistan (2006)

virus in Karachi, out of which 830 were confirmed positive whereas 9 people died due to Dengue Shock Syndrome (High fever and bleeding) which created quite a stir.

- Measles: As of 2008, there were a total of 441 reported cases of measles in Pakistan.
- Meningococcal meningitis: As of 2006, there were

a total of 724 suspected cases of Meningococcal meningitis.

- Poliomyelitis: Pakistan is one of the few countries in which polio has not been eradicated. As of 2008, there were a total of 89 reported cases of polio in Pakistan. Polio cases may be on an increase. The year 2010 saw an increase in the number of cases as well identification of polio from new locations. The year also saw a return and increase in polio patients. The disease which was said to be eliminated from the country still poses a threat. "Eighty two children are still infected in our country, among them 11 are from Sind (including 5 from Karachi).
- HIV/AIDS in Pakistan: The AIDS epidemic is well established and may even be expanding Pakistan. Risk factors are high rates of commercial sex and non-marital sex, high levels of therapeutic injections (often with non-sterile equipment), and low use of condoms. The former National AIDS Control Programmed (it was devolved with the Health Ministry) and the UNAIDS state that there are an estimated 97,000 HIV positive individuals in Pakistan. However, these figures are based on dated opinions and inaccurate assumptions; and are inconsistent with available national surveillance data which suggest that the overall number may closer to 40,000.
- The recent devastating floods in Pakistan have further increased the disease burden. United Nations Children's Fund (UNICEF) says as many as three and a half million children in flood-ravaged Pakistan may be at risk of contracting deadly diseases carried through contaminated water and insects. UNICEF says the greatest threats to public health in Pakistan at the current time are certainly from waterborne diseases, which can intensify in precarious hygiene conditions, and when people have limited or poor access to safe water and sanitation services.
- Diseases like cholera or acute watery diarrhea, dysentery or bloody diarrhea, typhoid fever and hepatitis, can all cause excess mortality and morbidity amongst the susceptible populations in the flood hit areas.
- There is also an increased risk of malaria and dengue fever, since the stagnant water may provide an ideal breeding ground for mosquitoes the vector that is responsible for transmission.

(http://tribune.com.pk/story/131565/one-child-dies-every-minute-in-pakistan-report/)

### 5.7.7. Local Economic Activity

Karachi is Pakistan's only port and the country's major industries and businesses are located there. The head offices of all major Pakistani banks are in Karachi and the Karachi Stock Exchange is the country's largest having an annual turnover of Rs 436 million (US$7.2 million). 70 per cent of income tax and 62 per cent of sales tax collected by the Government of Pakistan comes from Sindh province and of this 94 per cent is generated in Karachi. However, Sindh's share in revenue transfers from the federal government in only 23.3 per cent. This is the reason for the Sindh-Centre conflict in which Karachi is the main Sindh player. Karachi has 4,500 industrial units in the formal sector. The major industries are textile, leather, paper, marble, ceramics, rubber, plastic, glass, iron, electronics, pharmaceuticals, food products, agricultural and dairy products and stationery. Many of these industries are export oriented. There are no estimates available for the informal sector. However, 75 per cent of the working population is employed in the informal sector (MPD-KDA, 1989) Karachi Development Plan 2000, KDA) which works out of low income settlements mainly in the garment, leather, textile, carpet and light engineering sectors. In recent years, a link between formal and informal sectors has been established with the formal sector sub-contracting work to informal establishments.

Karachi dominates Sindh's economy. This is evident from the fact that the large-scale industrial sector employs 71.6 per cent of the total employed labor force in Sindh, with a value of fixed assets that is 71.4 per cent of the total. Of the total number of large scale units in Sindh, 72.7 per cent are located in Karachi where 74.8 per cent of the total large scale output produced in Sindh is produced in Karachi (Source: Khuhro, Hamida & Mooraj, Anwer (1997) Karachi, Mega City of Our Times, OUP, Karachi). The growing importance of the city in the national economy is reflected by the increase of cargo handled by the Karachi Port which was 2.8 million tons in 1951 and 29 million tons in 2001.

(Source: Hasan, Arif (2000) Understanding Karachi)

## 5.7.8. Socio-Economic Conditions on Green Line

### 5.7.8.1. General

New Karachi Town is a supplier as well as recipient of work force from and to adjacent UC's/Towns and hence its transportation demand is related to travel to work in the adjacent industrial areas in North Karachi Industrial Area.

Nazimabad Towns is well planned and compact in respect of infrastructure facilities. Nazimabad Town is a supplier of high level as well as middle level manpower and hence its trip generation activities are related to travel concerning value addition. It, however, also has some UC's that is suppliers of manpower and hence is trip generators for workers who have to go to work in the adjacent industrial areas in North Karachi Industrial Area.

The social and economic condition of the area enclosed between the two sides of the corridor at green line, is much better, as determined by quality of life of the residents of households, the shop owners and other users of the structures, materials and utilities. The following description of different aspects of the conditions gives an overview of the type of activities that the people are engaged in or various businesses for their living. Such description is intended to show how much and to what extent the project activities during setting up of stations, construction at site, and operation of vehicular traffic will affect the residents, nonresidents, commuters and other road users in continuing with their activities.

The Social survey along the green line corridor has been conducted by EMC, provided with the information of Green line. The following social findings lay as under:

Following are the affected/beneficiary areas/towns, as shown in Table.5.33.

Among the respondents engaged in commercial activities, 82% are retail shop owners, managers, helpers; service providers (telecommunication, internet, TV cable), 13% respondents were providing recreational services while the rest were engaged in academic institutions, health service institutions and similar activities in the commercial sector.

Among the resident responders 24% Respondents live in apartments and in multi-storey houses, while 19 respondents live in flats and single storey houses. In green line, most of the resident respondents live in multi-storey houses and apartments.

5.7.8.2. Social Structure of Some Particular Areas of Green Line:

- Power house to before 4 K Chowrangi: This area would grow at a pretty rapid rate as a lot of

**Table 5.33: Economic Status of the Population**

| S# | Name of Town | Income Group |
|---|---|---|
| 1. | Jamshed | High to Upper Middle |
| | | Middle to Lower Middle |
| 2. | Nazimabad | Lower Middle |
| | | Upper Middle to Middle |
| | | Middle to Lower Middle |
| 3. | New Karachi | Lower Middle to Low Income Areas |
| 4. | Liaquatabad | Middle to Lower Middle |

**Table 5.34: Structure-wise Distribution of Respondents**

| Type of Structure | No. | Percentage |
|---|---|---|
| Residential | 58.0 | 16.5% |
| Commercial | 284.0 | 80.9% |
| Residential Cum Commercial | 3.0 | 0.3% |
| Others | 6.0 | 1.7% |
| No Response | 2 | 0.5% |
| Total | 351 | 100% |

**Table 5.35: Activity Wise Distribution of Commercial Respondents**

| Type of Structure | No. | Percentage |
|---|---|---|
| Retailer/Service Provider | 235 | 81.7% |
| Eateries/Recreational | 36 | 12.7% |
| Others (Medical Facilities/ Academic Institutions etc) | 16 | 5.6% |
| Total | 287 | 100% |

development is taking place in this area. It has apartment buildings and hence a lot of public transport users.

- Area between UP Morr to Powerhouse: This area has a jungle of flats on both sides of the corridor and has a huge public transport captivity which is a healthy sign as far as Corridor's financial viability is concerned.

- Nagan Chowrangi: This Area lies at Shahra-e-Usman which is again a well-planned road and

**Table 5.36: Distribution of Residential Respondents by Type of Structure**

| Type of Structure | No. | Percentage |
|---|---|---|
| Single storey house | 11 | 18.97% |
| Multi-storey house | 15 | 24.14% |
| Flat | 20 | 32.76% |
| Apartment | 15 | 24.14% |
| Total | 61 | 100% |

has sample space both at the median and at the edges. It is a densely populated area of middle and lower middle class and has good public transport occupancy.

- Sakhi Hassan to Nagan Chowrangi: The corridor shifts towards the left just before Nagan Chowrangi which has a 2 level interchange. Nagan Chowrangi is also an important transfer point for many passengers.

- Five Star Chowrangi to Sakhi Hassan Chowrangi: It is a purely residential area. This area has a lot of apartment buildings which have many middle income families living in them and people from this area travels to the CBD quiet frequently especially for job purposes.

- KDA Chowrangi to Five Star Chowrangi: This is again Shahra-e-Sheer Shah Soori, which is a very well designed Right of Way (ROW) as it has a wide median and service roads on both sides. Public Transport ridership in this area is very good. One of the most important trip originator and distributor in this area is Hyderi Market which is the third biggest market of the city after Saddar & Tariq Road. People from all parts of the city come to this market for shopping purposes. As the shopping centre caters all classes of people i.e. from higher income group to lower income group, so a lot of people could use the station at Hyderi Market.

- Nazimabad No. 7 junction to passes through

North Nazimabad via Shahra-e-Sher Shah Soori: This is generally a middle and upper middle income group area where the car ownership ratio is high but still this entire area has a very good Public Transport occupancy. The positive point about this area is that, for a good transport service people would be willing to pay even a bit higher.

- Nazimabad Interchange: This place serves as a major transfer point. People coming from North of the city who wants to go to Sindh Industrial & Trading Estate (SITE) which is a major employment hub of the city, changes their mode from here. This segment is again a densely populated area and middle income group resides on both sides of the corridor with low car ownership ratio. A part from this, just at the end of this area there are a few commercial pockets where there is a Hospital just near Nazimabad No. 7 junction and shopping centers inside the Nazimabad area where a lot of people travel by bus.
- Golimar: This area is mainly residential area with medium income profile and the car ownership level is not very high, so they are heavily dependent upon Public Transport. This is the reason why a lot of bus routes are passing from this road connecting to different parts of the city. This segment ends just before Nazimabad Interchange where the traffic is being grade separated at 3 levels. i.e. underpass, at grade & flyover.
- Lasbela Intersection to Lyari Expressway: There are various markets pertaining to construction material in the vicinity and hence there is considerable boarding & alighting of passengers in this area. As it is a trip attractor both for employees and customers during morning peak and will act as a trip distributor during evening peak. Also, since the markets are open till a bit late at night (Around 10:00 p.m.) so it would require better frequency operations till that time. One of the issues in this area is of on street parking due to which traffic congestion is a normal routine in this area. Due to on street parking, the capacity of this road reduces to almost 60% for most part of the day.
- Guru Mandir: There are a few encroachments near Patel Para, since this is a mix land use area as some part of it residential and some part of it is commercial. The population on this segment is not high but in the future the city is expected to grow in this direction rapidly. While, it is expected that the occupants of this area would mostly be middle and lower middle income group people who would heavily be dependent upon Public Transport.

### 5.7.8.3. Social Infrastructure

**Water Supply System**

As regard utilities, 72.9% respondents are using the municipal water supply; 12.5% are buying water from the water vendors and the rest are using water from natural sources such as borehole, dug well or a combination of sources.

**Electricity Distribution System/Situation at Green Line**

84.3 percent respondents in corridor 01 reported using electric power supplied by KESC, 9.7% have their own power generators, and 1.1% shares a generator, while almost 3% have their own UPS, which they use in case of load shedding.

Medical Facilities on Green Line

The medical facilities identified during the field survey on Green Line are listed below:

**Table 5.37: Access to Portable Water**

| Source of Potable Water | No. | Percentage |
|---|---|---|
| Municipal water supply | 256 | 72.9% |
| Dig Well (private) | 5 | 1.4% |
| Pump Well (private) | 2 | 0.6% |
| Pump Well (common) | 1 | 0.3% |
| Bought from water vendors (e.g. Nestle) | 44 | 12.5% |
| Other natural water sources | 15 | 4.3% |
| Municipal water supply & Dig Well (private) | 4 | 1.1% |
| Municipal water supply & Bought from water vendors | 17 | 4.8% |
| No Response | 7 | 2.0% |
| Total | 351 | 100.0% |

### Educational Facilities on Green Line

The educational facilities identified during the field survey on Green Line are listed below:

**Table 5.38: : Access to Electricity**

| Source of Potable Water | No. | Percentage |
|---|---|---|
| Power Line (Legal/Illegal) | 296 | 84.3% |
| UPS | 1 | 0.3% |
| Power Line & Generator (private) | 34 | 9.7% |
| Power Line & Generator (common) | 4 | 1.1% |
| Power Line & UPS | 9 | 2.6% |
| Power Line, Generator (private) & UPS | 2 | 0.6% |
| No Response | 5 | 1.4% |
| Total | 351 | 100% |

**Table 5.39: List of Medical Facilities on Green Line**

| Sr. No. | Medical Facilities |
|---|---|
| 1 | North Care Hospital |
| 2 | Noorunisa Eye Hospital |
| 3 | Lions Eye Hospital |
| 4 | Umer Khan Dispensary |
| 5 | Dr. Ausaf Clinic |
| 6 | Kashif General & Children Hospital |
| 7 | Asian Lab Diagnostic Centre |
| 8 | North Mehran Diagnostic Center |
| 9 | Agha Khan Laboratory |
| 10 | Al-Khidmat Medical Center |
| 11 | Hamdard Matab |
| 12 | Agha Khan Laboratory |
| 13 | Remedial Center Hospital |
| 14 | Hussaini Blood Bank |
| 15 | Imam Clinic |
| 16 | Health Care Hospital |
| 17 | Lab Test |
| 18 | Dr. Mehdi A. Manji |
| 19 | Dr. Hamid General Homeo |
| 20 | Karachi Psychiatric Hospital |
| 21 | Baqai University Hospital |
| 22 | M.S Hospital |
| 23 | Fatima Bai Hospital |
| 24 | A.O.Clinic |
| 25 | Hanif Hospital |
| 26 | Lifeline Medical Centre |
| 27 | Saifee Hospital Trust |
| 28 | Halim Hospital |
| 29 | Dr. Muhammad Sultan Malik Family Homoeo Clinic |
| 30 | Dr. Shakeela Diagnostic Center & Clinic |
| 31 | Kanwal Ultrasound |
| 32 | Kashaish Homoeopathy Clinic |
| 33 | Child Care Medical Center |
| 34 | Sanober Consultant |
| 35 | S & Z Heart Care Clinic |
| 36 | Saleem Specialist Clinic Bone & Skin |

Table 5.39: List of Medical Facilities on Green Line

| Sr. No. | Medical Facilities |
|---|---|
| 37 | Nadeem Clinic & Skin Center |
| 38 | Tariq Physiotherapy & Medical Center Bone & Joint Clinic |
| 39 | Liaquat National Hospital Laboratory Collection Point |
| 40 | Asad Clinic |
| 41 | Dr. Mehdi A. Manji |
| 42 | Dr. Waseem Farouqi Welfare Eye Hospital |
| 43 | Dr. Abdul Razzaq Gho Ghari Eye Hospital |
| 44 | Al-Shifa Dental Clinic |
| 45 | Aga Khan Laboratory Collection Unit |
| 46 | Saleem Hospital |
| 47 | Asia Lab Diagnostic Center |
| 48 | Citi Lab |
| 49 | Mumtaz Eye Hospital |
| 50 | Zahabiya Medical & Diabetic Center |
| 51 | Hamdard University Dental Hospital |

Table 5.40: List of Educational Facilities on Green Line

| Sr. No. | Educational Facilities |
|---|---|
| 1 | Vocational Training Center |
| 2 | Mehmooda Computer Institute |
| 3 | Imam Abbu Hanifa Islamic University |
| 4 | County Cambridge School |
| 5 | Askari Grammar School |
| 6 | Usman Public School |
| 7 | Standard High School |
| 8 | Little Flower Secondary School |
| 9 | Ghazi Public School |
| 10 | Woodland Secondary School |
| 11 | L'ycos Grammar School |
| 12 | Al-Hidayah Academy |
| 13 | Mideast Secondary School |
| 14 | Arena Multimedia |
| 15 | Sir Adamjee Grammar School |
| 16 | National Cambridge School |
| 17 | S.M.B Academy |

Table 5.40: List of Educational Facilities on Green Line

| Sr. No. | Educational Facilities |
|---|---|
| 18 | Domino English Language Center |
| 19 | Itec Computer Center |
| 20 | Adamjee Coaching Center |
| 21 | Akbar Public School |
| 22 | Penta Model School |
| 23 | Pak College Of Computer & Business Education |
| 24 | Apex House Educational System |
| 25 | White House Grammar School |
| 26 | Dadabhoy Institute Of Higher Education |
| 27 | Virtual University Of Pakistan |
| 28 | S.M Public School |
| 29 | Sir Syed Children Academy |
| 30 | Student's Inn |
| 31 | Govt Degree College For Women Nazimabad |
| 32 | Gulshan-e-Fatima School |
| 33 | Newday Secondary School |
| 34 | Paradise Collegiate |
| 35 | Eureka English Learning Centre |
| 36 | The Paradise School |
| 37 | Azeem School |
| 38 | Taimoriya Library |
| 39 | Darul Itfaal Orphan House |
| 40 | Iqra Rozat Ul Itfaal |
| 41 | Ghazi Public Secondary School |
| 42 | Ghazi Foundation School |
| 43 | A.B.C. School |
| 44 | Nasra Public School |

# 06 PUBLIC/STAKEHOLDERS CONSULTATION

The process of stakeholder engagement process is designed to seek the views, concerns and needs of Stakeholders and to engage with them in a constructive two way dialogue throughout the project.

It is important to identify early in the process that the key stake holders are in the project. Their needs must be recognized, understood and incorporated at the very beginning of the project. Consultation will enable the client body to understand the stakeholders requirements and ambitions and as well as for the stakeholders to develop an understanding of the project.

A stakeholder is a person or group of people who can affect or might be affected by a given project. Stakeholders can be individuals working on a project, groups of people or organizations, or even segments of a population. A stakeholder may be actively involved in a project's work, affected by the project's outcome, or in a position to affect the project's success. Stakeholders can be an internal part of a project's organization, or external, such as customers, creditors, unions, or members of a community.

There are a number of key stakeholders who should be engaged. It is one of the very important elements of project leadership and management to get the right level of engagement with, and to manage the aspirations of stakeholders.

Each project will be different; each college will have its own unique requirements for stakeholder engagement. The following list should be considered as a guide. Users of the building, governors, managers, teaching staff, students, maintenance and support staff all have an interest and a contribution to make.

The all possible funding agencies Local Authorities, Statutory Bodies, General Public and local community groups, good and well managed communication of information is vital in ensuring positive and constructive consultation. The stakeholder consultation was conducted with respect to the Green Line BRTS project.

## 6.1 Public Consultation & Participation

Generally public consultation and public participation are two effective tools of social interactions. Public Consultation is a significant tool to upsurge confidence between the stakeholders and the project formulators to reduce the risk of delay of project implementation. Participation of public, on the other hand, facilitates implementation of project 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 reduce the negative impacts of the project, and that adequate remedial measures would be taken to recompense the loss of the affected persons, if any.

## 6.2. Public Consultation Guidelines

According to the Pakistan EPA guiding principles for effective public involvement:

Planning by the proponent for a public consultation program needs to begin very early in the study, preferably before any other work is carried out. Otherwise, once work commences on the technical aspects of the proposal, it can be difficult for the study team to rid themselves of preconceptions, and to be responsive to local information and values. From the perspective of those affected, any delay in consulting with them will be read as evidence that the proponent has already made up his mind, and that their input will not be valued, nor effective in shaping the proposal.

The Terms of Reference for the study should include an outline of the proposed public consultation program, detailing the scope, timing, techniques and resources for interaction. The plan for public consultation will typically detail means of informing the public, at an early stage, about the study process, objectives and proposals; ways in which the public will be informed about progress with the study and feedback on community concerns; and ways in which the public will be encouraged to become involved in sharing their knowledge, values and concerns. It will also detail the resources (people and money) available to support the plan. In this respect, some money may be allocated specifically to assist the community to contribute to the study (e.g. to defray travelling costs, to recompense community representatives for the time spent on their involvement, and to allow representatives to report back to their constituents). Money should also be provided to hold public meetings within the local community.

If there are issues which are simply not open to discussion, these should be clearly set out with reasons. For example, if the decision to carry out a project has already been made, this should be clearly stated at the beginning of the process. It must be stressed that in such circumstances, the potential for the process to effectively address issues of concern will be much reduced, and the willingness of the public to be involved is also likely to be diminished.

The development of a public involvement program would typically involve consideration of the following issues:

- The objectives of the proposal, and the study;
- Identification of interested and affected parties (stakeholders);
- Budgetary and time constraints and opportunities;
- Identification of appropriate techniques to involve or consult with the stakeholders;
- Traditional authority structures and decision-making processes;
- Identification of approaches to ensure feedback to the involved stakeholders; and
- Identification of mechanisms to ensure consideration of stakeholders' knowledge, opinions and suggestions.

## 6.3. Consultation Events

Consultation events can take a number of forms depending on the outcomes required and the people to be engaged. The project teams should be involved as participation in these events is essential as a key part of developing the project in brief. Stakeholder conference and consultation are an introductory conference outlining the vision and key objectives of the project, Stakeholder workshops and meetings for understanding the opportunities and constraints of the project contributing ideas and priorities, Questionnaires, Newsletters and Exhibitions.

The project manager, sponsor, and team, the customer (individual or organization)suppliers of material or other resources Creditors, Employees, Unions, City, community, or other geographic region professional organizations, any individual or group impacted by the project any individual or group in a position to support or prevent project success.

## 6.4. Identification of Stakeholders

The stakeholders are those who are directly impacted by the project and those who may be indirectly affected. Examples of directly impacted stakeholders are the project team members or a customer for whom the project is being done for. Those indirectly affected may include an adjacent organization or members of the local community. Directly affected stakeholders will usually have greater influence and impact of a project than those indirectly affected. While these details are developed and analyzed further in the stakeholder analysis process, it is important to begin thinking about them now and helps to provide a systematic way to identify stakeholders.

**Primary Stakeholders:** People, groups or institutions affected positively (beneficiaries) or negatively by the project.

**Secondary Stakeholders:** 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.


**Fig 6.10:** Primary and secondary stakeholders

For the purpose of this project, the primary stakeholders are the local communities living around green line. However, it is pertinent to mention the living population and community settlements problems .Primary Stakeholders are people, groups or institutions affected positively beneficiaries or negatively.

## 6.5. Consultation Process

The importance of stakeholder consultation and effective engagement has never been so apparent. Good news is not always possible when putting together a review or consultation, but with a lot of careful planning and strategic engagement with relevant stakeholders, it is possible to give everyone a chance to contribute and develop some insightful and well-rounded policy ideas. At the very least, it is possible to establish the business-case for cuts, in this instance, away from the prying eyes of the world's media. The Consultation process is a vital tool in the course of engaging with stakeholders and here at Verdant we have often seen situations where better engagement would have resulted in better results. Because we feel so strongly about the need for effective consultation, we have put together this short guide which we hope will alert people to the potential pitfalls and help set out some practices which we have tried and tested.

## 6.6. Consultation at EIA Preparation Stage

### 6.6.1. Scoping

An EIA scoping meeting was organized by EA Consulting Private Limited (the lead consultant of the consortium comprising EMC Pakistan Private limited, Geo Technical Services Limited, National Management Consultants, and Data Communication and Control Private Limited as the associate consultants)on May 22, 2015at Hotel Embassy Innwith the objective to provide a joint platform to the project relevant stakeholders to discuss and highlight, in a candid environment, the important issues, and aspects pertaining to the project which need to be considered during the ongoing EIA study for Green Line BRTS. Scoping at the outset of the EIA study enables the experts of the EIA study team to identify and earmark the important aspects/ issues to be subsequently covered in the EIA.

All the relevant stakeholders as identified by SPMU-MoC, SEPA&EA recommendations and Public Consultation Guidelines by Pakistan Environmental Protection Agency (1997) were invited to attend the Scoping Meeting. The meeting was attended by many important stakeholders representing proponent, governmental and non-governmental organizations, academic, industrial and special interest groups.

Following are the details of the stakeholders and their representatives present at the meeting:

The meeting started at 1600Hrs with opening remarks from Mr. Syed Nadeem Airf (Director, EMC Pakistan Private Limited) who welcomed the participants to the meeting. The meeting proceeded with a presentation by Mr. Tahir Soomro (Team Leader for the Consortium, EA Consulting Private Limited) on the proposed BRT Green Line project. He briefly yet comprehensively illustrated the different project components, route alignments along the entire project length, strategies that will be adopted at sensitive location, alternatives considered for different sections of the alignment and other relevant aspects.

His presentation was later continued by Mr. Syed Nadeem Arif who briefed the participants on the EIA; scope and objectives and proposed methodology that will be adopted to conduct the EIA.

At the end of the presentation from Mr. Syed Nadeem Arif, the participants were invited for questions/suggestions etc.

Below is a brief summary of the proceedings during the Question and Answer Session:

Comments:

1. The site will be surveyed by the officials of the Antiquities Department to identify any significant site in the project area. Our verdict will be later communicated to the project management. Mr. Abdul Karim Solangi (Department of Antiquities, Government of Sindh):

2. Data Collection should be in-depth with particular focus on the sensitive areas. (Dr. Yasmin Nargis, Bahria University)

3. The natural gas lines running below proposed alignment will need to be shifted particularly at places where elevated route is planned. For this purpose SSGC has meetings in the past with the authorities. (Mr. Azhar Kamal, Planning and Development Department, SSGC)

4. It is suggested that continuous air quality monitoring be carried out in oder to effectively determine the air quality at various intervals

(during peak hours, off peak hours, night time etc.) (Dr. Yasmin Nargis, Bahria University)

5. Institutional setup constitutes the key factor that can help the project owners implement long term effective project operations without any hindrance. Lessons can be learned from BRT that's operating in Lahore where they've diligently considered and streamlined every component of the project from sanitation to continuous monitoring.

The project would add value to the environment and social infrastructure in terms of improved air quality and social uplift. (Ijaz Hussain Khilji, Independent Consultant).

| S. No. | Name and Organization | Query | Answer |
|---|---|---|---|
| 1 | **Mr. Fayyaz Ahmed**<br>**Divisional Forest Officer, Sindh Forest Department** | Our roads are already too congested and the project appears to add more to the situation. | The corridor from Surjani Town to N. Nazimabad is not congested. From there onwards there is some congestion problem.<br>Additionally, for most part of the alignment, there is enough space available for the project.<br>The project will add beauty to the landscape once it's completed and starts operating.<br>(Mr. Tayab from EA Consulting Private Limited). |
| 2 | **Mr. Rasheed Ahmed**<br>**Sindh Wildlife Department** | How much area will you cover in the EIA? | Starting from Surjani Town, we'll cover all areas of the alignment. 15 meters from each side of the road will be covered in the EIA.<br>(Mr. Syed Nadeem Arif, EMC Pakistan Private Limited) |
| 3 | **Mr. Imran Aziz**<br>**Karachi Chamber of Commerce** | How do you plan to resolve the space issue at places where there is not much space available for the project? | Route is elevated at Gurumandir. The business recorder road is already congested but operating. We have planned elevated routes/sections at places where space is not available or there are other issues. This is how we plan to sort out space issues.<br>Another option that we are considering is to create an open underpass for BRT and cars (express lanes) up to Prede Street. |
| | | How would you prevent the unauthorized use of BRT route (use by motorbikes etc.)<br><br>Education of drivers is important, how do you intend to plan on this? | In Lahore, they have hired educated drivers and engaged them in intensive training of 3 months so that they could understand the operating needs particularly the Intelligent Transport System so that proper signals are generated and communicated.<br>Role of Sindh Government is important and recently it has announced a bill for Sindh Mass Transit Authority that will be the focal body to control and regulate this type of system in an integrated way. (Mr. Tahir Soomro, EA) |
| | | With the passage of time, projects here (Pakistan) start operating poorly, how do you plan to ensure long term effective operations of this project? | Role of Sindh Government is important and recently it has announced a bill for Sindh Mass Transit Authority that will be the focal body to control and regulate this type of system in an integrated way. (Mr. Tahir Soomro, EA) |

| S. No. | Name and Organization | Query | Answer |
|---|---|---|---|
| 4 | **Dr. Nuzhat from National Institute of Oceanography (NIO), Dr. Yasmin from Bahria University, and Dr. Tabrez, NIO** | Measures are needed for sustainable implementation of such projects. So much of time, energy, and finance are put into planning of such huge projects but the output does not come as planned. How do you plan to ensure that project operates smoothly in the long run? | Answering to the queries of participants on the sustainable operations of the project, Mr. Tahir discussed in detail the underlying limitations in the government system, national attitude towards such type of developments and other hindrances that impede the progress of projects like the one under discussion. |
| 5 | **Mr. Ali, SSGC** | How long will it take you to complete the design? | Approximately four months. (Mr. Tahir Soomro, EA Consulting Private Limited) |
| 6 | **Dr. Tabrez, NIO** | How will you control the air pollution from the project? | The buses that we propose to use in the system comply with EURO IV standards and are therefore environmentally sound. |

**Questions/Answers:**

The meeting ended with concluding remarks from Mr. Syed Nadeem.

**List of Invitees for the Scoping Meeting:**

| | | | |
|---|---|---|---|
| 1. | Director General | 2. | Secretary |
| | Sindh Environmental Protection Agency | | Department of Antiquities |
| 3. | Mr. Irshad Hussain Bukhari | 4. | Director General |
| | President, Karachi Transport Itehad | | Parks & Horticulture Department |
| 5. | Director General | 6. | Managing Director |
| | Public Private Partnership Unit | | Karachi Urban Transport Corporation (KUTC) |
| 7. | Managing Director | 8. | Managing Director |
| | Karachi Water & Sewerage Board | | Southern Sui Gas Company Ltd |
| 9. | General Manager | 10. | Deputy Manager, Business Development |
| | National Highway Authority | | K-Electric Limited |
| 11. | Environmental Engineering Department | 12. | President, |
| | NED University of Engineering & Technology | | Karachi Chamber of Commerce & Industry |
| 13. | Chairman | 14. | Section Officer Admin |
| | National Institute of Oceanography (NIO) | | Sindh Board of Investment Government of Sindh |
| 15. | Director General | 16. | Project Coordinator |
| | Karachi Mass Transit Cell | | Karachi Urban Transport Corporation (KUTC) |
| 17. | Senior Director | 18. | Executive Member |
| | Transportation & Communication | | Shehri-CBE |
| | Karachi Metropolitan Corporation | | |
| 19. | Incharge Environmental Research Centre | 20. | Country Representative |
| | Bahria University Karachi Campus | | IUCN Pakistan Country Office |

| | | | |
|---|---|---|---|
| 21. | Director | 22. | Chief Conservator |
| | WWF Pakistan | | Sindh Wildlife Department |
| 23. | Chief Conservator | 24. | General Secretary |
| | Sindh Forest Department | | Shehri – CBE |
| 25. | DIG, Traffic Police | 26. | SUPARCO |
| 27. | Institute of Business Management | 28. | Mr. Ijaz Hussain Khilji, Independent Consultant |

**Overview of the meeting**

### 6.6.1.1. Conclusion

The scoping meeting was attended by a good number of stakeholders including representatives from government bodies, academia, and experts from various sectors, industrial units along the project road, utilities departments and other organizations. The participants highlighted some very important points during the discussion. A summary of the suggestions/comments from the stakeholders is given below.

### 6.6.1.2. Key Points highlighted by Stakeholders

1. The natural gas lines running below proposed alignment will need to be shifted particularly at places where elevated route is planned.

**List of Participants**

STAKEHOLDER CONSULTATION MEETING
FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR GREEN LINE BUS RAPID TRANSIT SYSTEM
(22 MAY, 2015) – EMBASSY INN

| S.NO. | NAME | DESIGNATION | ORGANIZATION | CONTACT NO. | SIGNATURE |
|---|---|---|---|---|---|
| 1. | Syed Nadeem Arif | Director - | EMC | 0300-8230542 | |
| 2. | SAQUIB EJAZ HUSSAIN | MANAGER | EMC | 0300-0320332 | |
| 3. | Shazeb Saleem | I.T Manager | EMC | 0345-2295518 | |
| 4. | Farhat Shaheen | Env Specialist | EMC | 0304-2182452 | |
| 5. | Jalal Abbas | Environmentalist | EMC | 0331-2577617 | |
| 6. | Dr. A. R. Tabraz | Advisor / Consultant | EMC | 0300-2447762 | |
| 7. | Faiyaz Ahmed | Divisional Forest Officer Kh. | SFD | 03410026100 | |
| 8. | M. Azhar Kamal | DGM (P&D) | SSGC | 03222225034 | |
| 9. | Mustafa Ahmed | Director | NMC | 03333257470 | |
| 10. | Dr. M. Tahir Soomro | Team Leader EA | FA | 03008243210 | |

## List of Participants

**STAKEHOLDER CONSULTATION MEETING**
**FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR GREEN LINE BUS RAPID TRANSIT SYSTEM**
**(22 MAY, 2015) – EMBASSY INN**

| S.NO. | NAME | DESIGNATION | ORGANIZATION | CONTACT NO. | SIGNATURE |
|---|---|---|---|---|---|
| 11. | S.M. Tayyab | Chief Engineer | EA Consulting Pvt. Ltd. | 03009249832 | |
| 12. | M. Bux Qureshi | SO (Admin) | SPMU, Green Line | 0300-9327754 | |
| 13. | Chiaki Yamada | JICA N5 project Ingerosec | Environmental consultant | | |
| 14. | Sultan Mahmood | Co-ordinator | GTS | 0300-2730734 | |
| 15. | Ali Ahmed | DGM-HSE | SSGC | 03222215352 | |
| 16. | Ali Nawaz | Executive-HSE | SSGC | 0321-2234162 | |
| 17. | Imran Aziz | Chairman Comunication | KCCI. | 0321 8207185 | |
| 18. | Rasheed Ahmed | Game officer | S.W.D | 03003379064 | |
| 19. | Dr. Babar Ghauri | Head/ Dept 1ST/ SUPARCO | 1st SUPARCO | 0300-2731902 | |
| 20. | Dr. Yasmin Nergis | Bahria/ R.O | Bahria University | 0345-2424832 | |

**List of Participants**

STAKEHOLDER CONSULTATION MEETING
FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR GREEN LINE BUS RAPID TRANSIT SYSTEM
(22 MAY, 2015) – EMBASSY INN

| S.NO. | NAME | DESIGNATION | ORGANIZATION | CONTACT NO. | SIGNATURE |
|---|---|---|---|---|---|
| 21. | Imran Sabir | Deputy Director | SEPA | 0345-3019757 | |
| 22. | Abdul Kareem Solangi | Spl. Secretary (Antiq) | Antiquities | 03313165362 | |
| 23. | Dr. Nuzhat Khan | PSD | NIO | 0333-2247187 | |
| 24. | Ajaz Hussain Khilji | Consultant | – | 0300-8228751 | |
| 25. | SYED HYDER ALI | DIRECTOR | TCD, KMC | 99231169 | |
| 26. | | | | | |
| 27. | | | | | |
| 28. | | | | | |
| 29. | | | | | |
| 30. | | | | | |

2. Unauthorized use of BRT route (use by motorbikes etc.) should be avoided.

3. Education of BRT Bus drivers is important and will be done for 3 months

4. Measures needed for sustainable implementation and operation of such mega projects.

5. To control the air pollution, buses that will be proposed to use in the system comply with EURO IV standards and are therefore environmentally sound.

## 6.6.2. Consultation with Institutions through Questionnaire Feedback Form (Stage 3)

### 6.6.2.1. Consultation with Mr. Irshad Bukhari, President Karachi Transport Ittehad

*Comments*

- We appreciate and welcome the efforts of the government to introduce the Green Line BRT. However, this will only cover selected parts of Karachi, efforts should be made to introduce the other lines as well.
- All government-run bus schemes have failed in the past and therefore, the Green Line BRT should be handed over to private parties or a public-private partnership
- Having several decades of experience of living and managing transport issues in Karachi, I recommend that Green Line BRT project should be executed and managed by those who are familiar with the realities of life and transport issues of Karachi. Many projects have failed in Karachi as they are not given under the ownership/management of companies/individuals who have experience of working in Karachi
- There has been a consistent lack of motivation for managing issues of Karachi honestly and earnestly with full ownership and accountability. These facts have ruined the life of ordinary citizens. Compared to other big cities in the country, Karachi offers the cheapest transport fares, but these positive aspects have not led to improved social and economic conditions of the citizens.
- Unfortunately, random acts of violence and terrorism have become common in Karachi, the project should take in to account these realities
- We are willing to sacrifice for an improved public transport system in Karachi, other stakeholders and citizens should also have the same spirit
- We are not fearful that the coming of the Green Line BRT will affect our existing business. The city needs at least 10,000 buses and another 10,000 other public transport modes; the Green Line BRT will probably not add a fleet of more than a 100.
- We have no problem with the Green Line BRT project; we are willing to share our experience and expertise with respect to routes, fares, etc. during project execution.

Consultation with Mr. Mr. Arif Hasan, Urban Planner & Architect

*Comments*

- Planning and development of all the BRT Lines should be done in an integrated holistic manner; such an isolated approach can lead to engineering failures and cost over-runs in the near future.
- Similarly, EIA needs to look at all the lines together; separate EIAs for each line does not make technical sense. All these BRT Lines are for

one city-Karachi and several of these BRT lines overlap in important junctions such as Gurumandir; therefore assessment of impacts based on one line in isolation will not provide a realistic view. Cumulative impacts will not be captured. Moreover, important services such as development of stations, signage and ticketing will all need to be coordinated; quality and service needs to be consistent and this can only happen if all the BRT Lines planned and developed together.

- Similarly, the concept of BRT has changed. Most recent BRT projects are not focused only on transport from point A to point B, but have been designed to complement existing transport options in the city. Modern BRT systems focus on connecting with existing public transport services at important junctions providing easy and swift transfers for commuters between modes of public transport. Therefore, the EIA should take in account issues of connectivity and transfer points for the proposed lines; each BRT Line should fit into the existing travel routes of consumers. The assimilative capacity of a BRT system has become an important indicator of its success.

- Recent studies conducted by us on motorbike use in Karachi has revealed that ‘flexibility’ is an important demand for commuters and therefore, the sale of motorbikes has increased rapidly and many public transport users have expressed that if affordable, they would prefer using a motorbike. Therefore, a successful BRT will ensure that the proposed system gives commuters flexibility, which can only be ensured if a comprehensive analysis of the existing transport services and connectivity with the new system is carried out. It should be part of the EIA.

- The Green Line BRT should be kept at-grade as much as possible; if BRT overpass and underpass are unnecessary, only flyovers may be considered. The concept of developing BRT overpass and underpass is now old and highly costly, it should be avoided. Our context and our affordability demands for simpler, less costly BRT design as is currently working successfully in Istanbul.

- Moreover, if BRT is kept at-grade, land values of adjoining land is bound to increase, this will open up avenues for development and the government can use land development fees and charges to subsidize the BRT system. However, with overpass and underpass, land values will not increase.

- Existing BRT systems and their critique need to be looked at more critically, especially existing systems at Rio, Jakarta.

- The most important feature of a successful BRT is a strong institutional and regulatory framework; both of which are present in Delhi and Bangkok. Effective government control and regulation is of utmost importance to successful implementation of a BRT system. In Karachi’s context, this is the weakest point and unless these aspects are looked at seriously; even if we develop BRT lines, they may not be sustainable.

# 07 POTENTIAL ENVIRONMENTAL IMPACTS OF PROPOSED DEVELOPMENT AND RECOMMENDED MITIGATION MEASURES

This section identifies the potential impacts of the proposed project during preconstruction, construction and operation stages on the physical environment including air quality, water quality, noise and vibration; ecology including flora and fauna, and socio-economic environment of the macro environment of Green Line BRTS Project area i.e. the Union Councils of the Towns on which the BRT corridor has been laid and the microenvironment i.e. its immediate surroundings.

## 7.1. Screening of Potential Environmental Impacts

Screening of potential environmental impacts due to siting of the Green Line BRTS project on the existing road network and construction as well operation of the BRT system has been carried out by the checklist method and described in Table 7.1.

## 7.2. Identification of Pollution Sources

Pollutants generated in the proposed development of BRT during the construction and operation phases are solid, liquid and gaseous in nature. Also the generation of pollution could be continuous, periodic or accidental. Sources of pollutants and their characteristics during the construction and operation phase are given below in Table 6.2.

## 7.3. Identification of Impacts during Pre-Construction Phase

The pre-construction stage would commence after approval of this EIA study. Changes that may occur in the mean time in the microenvironment would be recorded and the consequential impact would be

**Table 7.1: Screening of Potential Environmental Impacts**

| Screening Questions | Yes | No | Remarks |
|---|---|---|---|
| **A. Project Siting** | | | |
| Is the project area adjacent to or within any of the following environmentally sensitive areas? | | | |
| Densely Populated? | X | | |
| Heavy with Development Activities? | X | | |
| Adjacent to or within any Environmentally Sensitive Areas? | | X | |
| Cultural heritage site | X | | There are no gazette archaeological sites located within the close vicinity of proposed Green Line Corridor. |
| Protected Area | | X | No protected area found within RoW or immediate environs of RoW. |
| Wetland | | X | There are no significant wetlands in the vicinity of Project area. |
| Mangrove | | X | No Mangrove area is found within or in immediate environs of RoW. |
| Estuarine | | X | No Estuarine area is found within or in immediate environs of RoW. |
| Buffer zone of protected area | | X | No buffer zone of the protected area lies within ROW. |
| Special area for protecting biodiversity | | X | No special area for protecting biodiversity found within or in immediate environs of ROW. |

**Table 7.1: Screening of Potential Environmental Impacts**

| Screening Questions | Yes | No | Remarks |
|---|---|---|---|
| **Potential Environmental Impacts** | | | |
| • disfiguration of landscape by project embankments, cuts, fills, and quarries? | | X | No disfiguration of landscape occurs because the road is already existed on the proposed alignment of BRT Corridor. |
| • encroachment on precious ecology (e.g. sensitive or protected areas)? | | X | No such area is found within the RoW. However, there are atleast 16,637 trees inside the ROW of project corridor. If these trees will be cut down, compensatory plantation will done along the alignment. |
| • alteration of surface water hydrology of waterways crossed by project, resulting in increased sediment in streams affected by increased soil erosion at construction site? | X | | There are few nalas and small streams passing through project corridor that carry sewage or storm water. They will choke of clogged during construction phase. |
| • deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction? | X | | Mitigation measures have been proposed in EMP. |
| • dislocation or involuntary resettlement of people? | | X | There are project affected persons along the green line corridor. |
| • disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups? | | X | The people living around project area belong to different races and different cast patterns but no such community has been identified which has closed culture, close economy and closed community. Therefore there is no danger of elimination or damage of any indigenous community. |
| • hazardous driving conditions where construction interferes with pre-existing roads? | X | | These conditions exist at the intersections of project corridor and local roads during construction. Mitigation measures have been proposed in EMP. |
| • poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations? | X | | Mitigation measures have been proposed in EMP. Camp site should be developed in the remote location from the settlements and waste management measures should be taken. |
| • creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents? | | X | Mitigation measures have been proposed in EMP. Camp site should be developed in the remote location from the settlements and wastewater treatment at campsite should be taken. Drainage system is proposed to overcome the accumulation of storm water during operation phase. |
| • accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials? | | X | Due to the construction of BRT, the oad traffic will be decreased. On the other hand, BRT will use its own dedicated corridor, therefore there will be no impact of traffic. |
| • increased noise and air pollution resulting from traffic volume? | | X | The existing BRT Corridor is already deteriorated due to air and noise pollution from traffic ad congestion. After BRT development, traffic will move more easily without jams. Therefore, air pollution will decrease subsequently. But mitigation measures have been proposed in EMP. |
| • increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road? | | X | There are no surface water present along the project corridor except Lyari River which is already contaminated with wastewater. Secondly, traffic volume after development of BRT will be reduce, so there will be no impact. |
| • social conflicts if workers from other regions or countries are hired? | | X | Local people will be hired for the project and also included in consultation process. |
| • large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? | | X | Karachi is a mega city and all the resources are available in the city including human resources. It is not envisaged that human resource will be hired from outside. |

**Table 7.1: Screening of Potential Environmental Impacts**

| Screening Questions | Yes | No | Remarks |
|---|---|---|---|
| **Potential Environmental Impacts** | | | |
| • community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning. | X | | Project components including BRT Buses, Stations, pedestrian, bridge and underpass are accessible to the public. Proper safety measure and emergency protocols will be embedded in the design of BRTS. |
| • Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes. | | X | Not envisaged. During heavy rain, mitigation measures will be taken for drainage of storm water. |
| • Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., increased erosion or landslides could increase maintenance costs, permafrost melting or increased soil moisture content could affect sub-grade). | X | | Changes in precipitation patterns could result in partial inundation in the project area which increase soil moisture content and increase erosion and that will affect the sustainability of the project. |
| • Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g., high incidence of marginalized populations, rural-urban migrants, ethnic minorities, women or children)? | | X | No community of vulnerable or migrants present in the project area. |
| • Could the Project potentially increase the climate or disaster vulnerability of the surrounding area? | | X | Not envisaged. |
| **Total Rating** | **9** | **20** | |

**Table 7.2: Pollutant Sources & Characteristics**

| S.No. | Activity Area | Pollutant | Pollutant Characteristics | Frequency |
|---|---|---|---|---|
| **Construction Phase** | | | | |
| 1 | Site Preparation | Air emissions – SPM, PM10, CO, NOx, SO2 | Dust from construction activities and excavation. Particulates, NOx and CO from vehicle exhaust | Temporary during construction phase only-bulk of the emissions are from ground working and leveling expected activities |
| | | Solid Waste | Solid waste from construction activity and excavation. | Periodic. |
| | | Noise | Noise generated from construction equipment and machinery | Temporary during initial construction phase. |
| 2 | Labour Camps | Sewage | Sewage generated from temporary labour camps on site | Temporary – during the initial construction phase |
| | | Solid waste | Solid waste generated from temporary labour camps on site | Temporary – during the initial construction phase |
| **Operation Phase** | | | | |
| 1 | Vehicular movement | Air emissions<br>Noise | Vehicle exhaust emissions<br>Vehicular Movement | Continuous / Periodic<br>Continuous/ Periodic |

**Table 7.1: Screening of Potential Environmental Impacts**

| S.No. | Activity Area | Pollutant | Pollutant Characteristics | Frequency |
|---|---|---|---|---|
| | | Water | Presence of Oil & Grease, Suspended Solid during rainy seasonOil Spillage | Periodic |

reviewed and updated to introduce appropriate mitigation measures and reflect the same in the detailed design.

## 7.3.1. Physical Impacts

The detail design will be implemented during pre-construction stage. There is no physical impact at detailed design stage. During this period, the ambient physical environment will be changed due to industrial development or population increase or other urban development.

## 7.3.2. Sensitive Receivers, Heritage and Religious Sites and Schools

The location of the residences, mosques, schools, hospitals and civic cultural and other heritage sites has been reviewed in Section 5. Some of the structures are close but on a safe distance to BRT corridors that there will be potential impacts in the construction stage from disturbance, noise and dust.

Mitigation Measures

Before the commencement of construction activities/during design stage, detailed design consultants will include following in detailed design to ensure that provisions are made to preserve the operation of an existing local infrastructure and that utilities are protected.

1. Overpasses and underpasses to avoid pedestrian severance.
2. Existing drainage and other utilities have been identified and avoided / re-provisioned.
3. The impacts related to the aesthetic value religious context of the local environment have been considered.

## 7.3.3. Issue related to Electric Pylons from Nagan Chowrangi to Statrt point of Power House

From Nagan Chowrangi to the end of Route Alignment i.e. KESC Power House Chowrangi, huge Electricity pylons of 25 nos. run along the alignment covering the entire median. Therefore, an inner lane in each direction will be acquired from the main carriageway to run as BRT Lane along both sides of Pylons. To maintain uniform cross-section of the main carriageway one outside lane will have to be constructed.

**Impacts related to this issue**

1. Pedestrian bridges constructed to access the bridges will be elevated. Therefore it is a chance that they may contact with HTLs.
2. Grade separations needs to be provided due to existing U-turns and Chowrangi.
3. From 4K to Nagan Chowragi, Water transmission travelling under the median and needs to relocated.
4. Huge cost is involved for the relocation of these Pylons and HTLs

According to the earlier correspondence with K-Electric-Engg. & Construction department and EHT Department, safety distances are required for Electric pylons and HTLs as mentioned below (KE Letter is also attached below):

1. BRT must be kept away from HTLs of each side atleast 10 feet horizontally for human safety in case of conductor fall.

2. The standard minimum vertical ground clearance from the point of maximum sag is 9.5 meters.

3. In case of pedestrian crossing bridges, keeping a clearance of 4.5 m, an insulation barrier for 145 kv must be provided for Health and Safety of

K-ELECTRIC
Energy That Moves Life

**Mr. Bilal Ahmed Memon**
Director, (SPMU-Green Line BRTS),
Transport & communication Deptt.
8th floor, EOBI House, 190/B/1,
Block-2, PECHS,
Karachi.

Your Res: SPMU(GLBRT)/DIR/15/11 Dt: 06th Feb-2015. Our Ref.: DD/E&C/15/F-Govt./ 23 Dated: 11-06-15

Subject: Payment of estimated cost amounting to Rs. 91.731306 Million for shifting / relocation of K-Electric system required for Karachi BRT Green Line Project.

Annx. "A"

Following concerns of Transmission main't are to be considered first;
Construction aspect;

1. Complete BRT (G) corridor falls under hazardous parallel zone(maiden) to under EHT lines both side which means out of allowable limits (EHT line from Nagan Chorangi to Surjani).
2. According to the consultant, only ½' ft distance from tower leg would be left and barricaded. This will be unsafe for EHT tower, atleast 3' ft secure distance must be maintained from tower foundation and then barricaded.
3. The BRT must be kept away from B-phases of EHT line of each side atleast 10'ft horizontally for human safety in case of conductor fall.
4. According to the new design Green BRT will move adjacent to the Green belt, taking up 4.5 meters on both sides, and not on the Green belt.
5. According to the new design the Green Belt including the bus lanes will be barricaded and will be off limits to the general public, which means that this Dept. won't have free access to the EHT towers that befall within the vicinity of Green BRT Route.
6. The standard minimum vertical ground clearance from the point of maximum sag is 9.5 meters . According to the design there will be bus stations raised above ground level which definitely create a Safety Hazard for which K-Electric will not be held accountable in any way. Moreover, apart from vertical clearances, horizontal clearances must also be met keeping in consideration the Electro Magnetic Fields/Radiations created all around the Conductors.
7. As far as BRT crossing bridges are concerned, although I was informed by consultant that it would be constructed near to tower which means max clearance they will have. Though, keeping clearance of 4.5 m , an insulation barrier for 145 kv must be provided for health/life safety of human.

Maintenance aspect;

1. After construction of BRT-G, no access will be available for crush/corrective/scheduled/preventive or even breakdown of the EHT failure which results system jolting, load management and Mhr / revenue losses in result of time expansion and possibilities of way-out.
2. No traffic shutdown is formulated as how to enter into BRT when EHT need to be addressed.
3. Traffic diversion at both ends of maiden of BRT is required/designed at every 500 meters interval of BRT.
4. All activity depends upon type of crush faults and main't schedule.
5. Although the design incorporates measures such as providing doors at regular intervals (beside each Pylon/Tower on both sides) and assures that we will have access to our towers but it will not fulfil our maintenance requirement in presence of team members as will need to occupy the lanes designated for BRT with crane/logistic. Hence, Green BRT lane will be disturbed for the flow of normal traffic.
6. In such scenario if fault arises which demands rapid & instantaneous response from transmission dep't, it will pose as a hindrance to the work and cause of load shedding.
7. Since nature of faults depending upon crane / logistic mobility, hence it will not only effect on rectification of line/fault but on the other way it will also be a constant threat of safety which may cause electrical or mechanical hazards to Green BRT.

Human.

**Mitigation Measures**

- From this point all the way to the end of alignment grade separations are proposed consisting mostly of depressed grade separations because of existing Pylon restrictions which necessitate grade separation below rather than overhead.
- Another alternative is to shift the BRT line from center to left side of the road and being elevated as there is ample space available for elevated BRT development with negligible disturbance of social settings. For this development, Consultation and correspondence with KE is underway related to horizontal clearance for elevated bridge of BRT and No objection in this regard.

## 7.4. Identification of Impacts During Construction Phase

Since Green Line BRTS is a development project in transport sector, its impacts on the environment are anticipated to be significant. However due to the extraordinary nature of the project i.e. its physical existence in the urban transportation system, the operation in existing road network and infrastructure, such factors have considerably reduced the severity of most of the significant impacts. The physical impacts that are critical in construction phase are being considered with an emphasis to take necessary mitigation measures. Summary of potential impacts and propose mitigation measures is given in table 7.3.

**Table 7.3: Summary of Impact Identification- Construction Phase**

| S. No | Environmental Attributes | Aspect | Potential of Impact | Mitigation Measures |
|---|---|---|---|---|
| 1. | Ambient Air Quality | Dust emissions from site preparation, excavation, material handling & other construction activities at site. | Minor negative impact within site premises. No negative impact outside site premises. Short term | Regular water sprinkling on the exposed surfaces to reduce dust emission and proper maintenance of all equipment at regular intervals |
| 2. | Noise & Vibration | Noise & Vibration generated from construction activities, operation of construction machinery, equipment and their movement | Minor negative impact near noise Generation sources within site. No significant impact on ambient noise levels outside site. Short term | The advance BRT construction techniques provide adequate measures to control noise and vibration limiting its nuisance effects |
| 3. | Water Quality | Surface runoff from project site Oil/fuel & waste spills Improper debris disposal Discharge of sewage from labour camp. | No significant negative impact. Short term | Construction methods and techniques and disposal of used water need to be designed for proper drainage and control of discharge |
| 4. | Solid waste | Disposal of excavated soil, construction debris and other waste including domestic waste which can cause soil contamination and other health & safety issues | Minor negative impact | Proper solid waste management programme to be designed and executed for the construction operation phases of the project as integrated in the EMP. |
| 5. | Land use | Demolition/excavation on BRT route requires rehabilitation | Minor negative impact | |
| 6. | Topography & Geology | Site development | No significant impacts | |
| 7. | Soils | Construction and excavation activity leading to topsoil removal & erosion. | Minor negative impacts | |
| 8. | Ecology Flora & Fauna | Habitat disturbance during construction activity. | Minor negative impacts Short term | It is required to adopt appropriate techniques while undertaking construction activities to minimize ecological disturbances |

| Table 7.3: Summary of Impact Identification- Construction Phase | | | | |
|---|---|---|---|---|
| S. No | Environmental Attributes | Aspect | Potential of Impact | Mitigation Measures |
| 8. | Socio-economy | Increased job opportunity for locals. Economy related to material supply etc. expected to boom.<br>The infrastructure of the project will increase the urban aesthetic and landscape profile of the city.<br>Communicable diseases such as HIV may be introduced due to the immigration of workers associated with project. | Overall positive impact | Regular and proper maintenance of the infrastructure is required throughout the project life.<br>Communicable diseases prevention program will be prepared for construction workers or resident near the construction site. |
| 9. | Traffic Pattern | Vehicle movement and possibility of traffic congestions on the road. | Minor negative impact | Prepare traffic management plan one month before the commencement of construction work |

## 7.4.1. Air Quality

The prevalent ambient air quality along the Green Line BRTS proposed corridor as observed at selected field survey point is within allowable limits in accordance to the prescribed NEQS limits. Any Additional emissions expected to arise during construction phase due to activity of construction equipment would be insignificant. Additional dust sources from construction of the BRT and from general materials handling are therefore likely to create significant additional impacts, especially where the works are close to the residential sensitive receivers, schools and hospitals that are near to the majority of the proposed corridors. The worst effects are likely to be in the most constricted areas where there is most construction take place such as the elevated sections and around the station locations.

Vehicles carrying construction material are expected to result in increased SPM levels near the haul roads. This can be of potential importance if the vehicles pass through the residential areas. At the construction yard, the dust levels are also expected to increase due to unloading of construction materials. It is also assumed that most of the excavated material will be used within the project, with minimal cut and fill material to come from outside the site.

The pavement works will also generate gas and odor from the asphalt works and vibration from the compaction of the new BRT road pavement. Emissions from powered mechanical equipment will be superimposed on already high traffic pollution but ought to rapidly disperse.

Also, there will be slight increase in concentration of NOx and CO due to increased vehicular traffic. Regular maintenance of vehicles will be done to minimize automobile exhaust.

The impact of such activities would be temporary and restricted to the construction phase only. The impact will be confined within the project boundary and is expected to be negligible outside the project boundaries.

### 7.4.1.1. Fugitive Dust Control

Source wise Fugitive dust control measures are tabulated below:

**Table 7.4: Source wise Fugitive dust control measures**

| Source | Control Measures |
|---|---|
| Earth moving | For any earth moving which are more than 30m from site boundary, conduct watering as necessary to prevent visible dust emissions. |
| Disturbed Surface Areas | Apply dust suppression measures frequently to maintain a stabilized surface;<br>Areas, which cannot be stabilized, as evidenced by wind driven dust, must have an application of water at least twice per day. |
| Inactive Disturbed Surface Areas | Apply dust suppressants in sufficient quantity and frequency to maintain a stabilized surface. |
| Unpaved Roads | Water all roads used for any vehicular traffic at least twice per day of active operations; OR Water all roads used for any vehicular traffic once daily and restrict vehicle speed to 20 kmph, which will reduce dust emission. |
| Open Storage Piles | Apply water to at least 80 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust; OR Install an enclosure all along the storage piles. |
| Track-out Control | Downwash of construction vehicles (especially tires) prior to departure from site. |

**Mitigation Measures**

The most cost-effective dust suppressant is water. Water can be sprinkled by the handheld sprays or with the help of automatic sprinkler systems as the situation would demand. The incoming loads of dusty materials could be covered to avoid spreading of dust. Besides; loss of material in transport, especially if material is transported off-site, will be minimized.

Water is available in the study area although surplus water may not always be available to suppress dust at some locations as piped supplies are not reliable and already in short supply. Therefore it is recommended that if works are within 10 m of any sensitive receivers, the contractor should install segregation between the works at the edge of the median at the road edge nearest the center to provide a barrier to protect the sensitive receivers and passing traffic. The segregation should be easily erectable 2.5 m high hoarding/ Fiber boards and /or steel sheets to make protection fences around the construction site (at every station location and depot site during the construction) within which all construction works can take place. They can be moved on from worksite to worksite along the BRT Route as the work proceeds and removed when the works are completed to trigger a milestone payment.

The need for large stockpiles should be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and should be covered with tarpaulins when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m3) of crushed materials are necessary they should be enclosed with side barriers and also covered when not in use.

Construction materials (sand, gravel, and rocks) and spoil materials will be transported trucks covered with tarpaulins and all vehicles (e.g., trucks, equipment, and other vehicles that support construction works) will comply with the NEQS (as amended) for carbon emissions and noise.

### 7.4.1.2. Vehicular Emissions

- Periodically check and maintenance of the construction machinery and haul vehicles.
- Regular change of engine oil and use of new engines / machinery / equipment having good efficiency and fuel burning characteristics.
- Use of catalytic converters and low Sulphur fuels.
- Training of the technicians and the operators of the construction machinery and drivers of the

vehicles.

- Air quality monitoring in the project site during construction phase.

#### 7.4.1.3. Procedural Changes to Construction Activities

- **Material Production:**

The transport of materials such as concrete, asphalt, etc. to construction sites generate significant amounts of road dust, especially for sites that are relatively far off from the material manufacturers. Setting up the temporary portable concrete plants and/or asphalt plants at construction sites can eliminate haulage of these materials.

- **Emission from construction machinery**

The emissions from construction machinery would contain particulates, SOx, NOX, CO. However, the quantity of these pollutants is expected to be extremely low due to low fuel requirement and use of cleaner fuel like diesel. It is expected that the machinery will consume merely 20 to 30 L of diesel. The resultant emissions, therefore, are not expected to affect ambient air quality.

- **Idling Time Reduction**

Construction equipment is generally left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Existing idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention of the operators.

- **Improved Maintenance**

Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors could be asked to provide maintenance records for their fleet at regular intervals as a part of the contract awarded to them. A monetary incentive/disincentive provision could be made to encourage contractors to comply with the regular maintenance requirements.

### 7.4.2. Noise and Vibration

The assessment of the impacts of noise on the surrounding community depends upon:

1. Characteristics of noise source (instantaneous, intermittent, or continuous in nature),
2. Time of day at which noise occurs; and
3. Location of noise source.

Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project corridor.

The construction activities will include the excavation for foundations and grading of the site and the construction of structures and facilities. Powered mechanical equipment such as generators, excavators, bulldozers, piling rigs, stabilizers, drills, stone crushers, graders, vibratory rollers, concrete-mixing plants, and screening plants can generate significant noise and vibration. Whereas various modern machines are acoustically designed to generate low noise levels there may not be much acohese increased noise levels will prevail only for a short duration during the preconstruction and construction stage.

The noise and vibration produced by construction equipment is presented in table 7.5 as reference.

The cumulative impact of the noise caused by construction equipment will be estimated based on the following formula;

**Table 7.5: Noise and Vibration produced by construction equipment**

| Operation | Equipment | Noise (dB) | Vibration (dB) |
|---|---|---|---|
| **Excavation and backfill** | | | |
| Road surface breaker | Road surface breaker | 105 | 73 |
| | Truck | 105 | 68 |
| Soil stability (Pile driving, retaining wall) | Derrick | 101 | 33 |
| | Mortar injector | 97 | 50 |
| | Pile driving | 101 | 63 |
| Excavation | Excavator | 101 | 72 |
| | Bulldozer | 98 | 64 |
| | Crane | 101 | 40 |
| | Truck | 105 | 68 |
| | Concrete pumping | 104 | 50 |
| | Batching plant | 98 | 50 |
| | Bull dozer | 98 | 64 |
| | Rammer | 106 | 57 |
| | Truck | 105 | 68 |
| Concrete placing | Concrete pumping | 104 | 65 |
| | Batching plant | 98 | 50 |
| Soil backfill | Bulldozer | 98 | 64 |
| | Rammer | 106 | 57 |
| | Truck | 105 | 68 |
| | Roller | 98 | 65 |
| **Construction of viaduct** | | | |
| Foundation excavation | Boring machine | 100 | 50 |
| | Derrick | 102 | 35 |
| | Excavator | 101 | 72 |
| | Generator | 98 | 68 |
| | Truck | 105 | 68 |
| Foundation concreting | Concrete pumping | 104 | 50 |
| | Mixing plant | 95 | 50 |
| Soil stability( Sheet piling) | Sheet piling | 98 | 63 |

**(Source: Construction Ministry of Japan, 1983:Japan Public Works Institute, 1979, Japan Mechanism Construction(Association ,1987)**

LAp = 10lg (10LA1/10 + 10LA2/10 + 10LA3/10+ …… + 10LAn/10)

Where: LAp: cumulative noise caused by construction equipment (dB),

LAi: noise level at forecast point caused by each construction equipment (dB)

LAi = L AW - 20lgr - 8

LAw: noise caused by construction equipment

r: distance from construction equipment to forecast point

Though the construction method has not been determined yet, however it is believed that the adopted method of construction shall produce less noise and vibration if the suggested mitigation measures are adopted.

**Mitigation Measures**

In order to mitigate the impact of noise from construction equipment, the contractors should be required by the SPMU-MoC to:

- Provide evidence that all equipment to be used for construction is fitted with the necessary air pollution and noise dampening devices to meet any statutory requirements that may apply from the NEQS;
- Locate and operate equipment to minimize nuisances; and
- Install acoustic insulation or use portable noise barriers or install a hoarding where practicable to limit noise to protect sensitive areas such as schools, hospitals, relics, residential areas, etc.
- Plants and machinery with high intensity of noise and vibration such as drilling machines, rollers, excavators, etc. will be allowed to operate during specified / designated timings in day hours only (no operation timings from 0:00 to 5:00 am shall be observed). In case it is necessary to take construction activities in night time to catch up with the required schedule, permissions from local authorities shall be obtained.
- Background noise levels are likely to be high during night time (10 pm to 7 am). Therefore the performance criteria shall be as follows. During night time (10 pm to 7 am) the measured impact noise at the residential or hospital sensitive receiver shall not be more than 3dB above background noise levels measured at the nearest sensitive receiver (Leq15minutes) two weeks prior to the commencement of works.
- Where noise is a major consideration (say outside schools or hospitals) construction should be avoided at sensitive times. As a fall back option to control noise, the mass of the hoarding barriers can be increased using heavy thick ply-board or corrugated metal sheet to supplement the tarpaulins to achieve a mass of greater than 10kg/m2. In addition to the physical effect of mitigating dust and noise the installation of such measures should be discussed with the local population and serve as a means for further public consultation during implementation and assist in public relations. The design of the hoardings and works layout must also allow for pedestrians to cross the roads and avoid community severance.
- Noise monitoring at construction site will be done on regular basis.
- Unnecessary use of horn and hooter by the vehicle operators should be restricted.
- Use of ear muffs and protective gears by the workers on the construction site would be mandatory.
- Vibration due to operation of heavy construction equipment in the sensitive areas may be controlled by imposing time restrictions.

## 7.5. Impacts on Land Environment

### 7.5.1. Land Use & Aesthetics

The proposed project will built on existing road and comes under KMC limit. Land required for proposed project is in possession with KMC. There is minor change in land use pattern of the area.

Aesthetic and visual impacts during the construction phase are limited to the sections which are passing through the residential areas however the construction of station will have a positive impact on the urban aesthetics and architectural beauty that they will bring to the city real estate line. Construction of viaducts, underpasses and flyovers would be added features of project adding structural beauty and value of the project however erection of barrier walls and electrification poles along the track will have some displeasing effect on the overall aesthetics which is perhaps unavoidable due to safety and technological requirements.

### 7.5.2. Solid waste and Land Contamination

Solid waste mainly generated is from the construction debris and the packaging material as well as some from human activity i.e. workers at construction site. The mean (average) rates of waste for some specific materials are timber 13% which is the highest percentage of waste among all materials with sand 9% while other materials such as reinforcing steel 5%, cement 5%, and concrete 4%. Tiles and Masonry wastes varies according to their types.

Among non-construction waste i.e. generated from human / worker activity are; food waste, paper, plastic, rubber, metals, glass, textile and other waste materials. It is estimated that the non-construction waste is not likely to exceed 0.5kg/worker/day. The entire solid waste generated at the construction site is recyclable except for the food waste which is perhaps considered to be a major issue in regard to contamination from non-construction waste however is negligible in comparison to the total solid waste generated during construction phase.

The component of construction waste likely to cause contamination of soil and other ecological resources are oil, paints and allied chemicals which require specific containment, proper handling and storage.

**Mitigation Measures**

- A proper solid management programme describing safe disposal mainly through recycling process would provide a viable solution against land contamination impact likely to cause by solid waste generation during the construction phase.
- Excavated soil shall be checked for any harmful materials / contents before disposal.
- Contracts for services of waste collection / transport / dumping / recycling / treatment and reuse shall be formulated and assigned to reliable companies.
- Monitoring of all the waste management activities should be carried out by IMC.

### 7.5.3. Topography & Geology

During the construction phase the chances of severe impacts are less because the existing site is fairly leveled. Considering the region is flat with no deposits of minerals on site leading to loss of revenue. The development is planned according to the international standards for earthquake protection. Hence the impacts will be minor and not noteworthy.

### 7.5.4. Soil Erosion and Sedimentation

Since the construction involves earth moving activity and lot of earth is disturbed and exposed therefore the impact of construction on erosion is significant. Sediments dispersion and associated deposition in and around the project area will be of little concern as much is carried out through the aerial rather than hydrological regime.

Construction activities for the proposed development can have minor impact on hydrology and ground water quality of the area in case the construction chemicals leach into ground.

The majority of the road works proposed are designed to be within the existing median of major roads on paved surfaces and therefore soil erosion and sedimentation should not be a significant impact. The green corridor will cross the Lyari River but the crossing structures will have been provided for both corridors in the detailed design. Any drainage structures, cross road tunnels, culverts or pipes crossing the BRT corridor may need to be modified or protected and the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the constructions works.

Potential impacts on the hydrology and ground water quality have been discussed with respect to the following:

- Soil runoff from the site leading to off-site contamination (particularly during the rainy season).
- Improper disposal of construction debris leading to off-site contamination of water resources.
- Unaccounted disposal of domestic wastewater from temporary labor camps.
- Spillage of oil and grease from the vehicles and wastewater stream generated from on- site activities such as vehicles washing, workshop etc.

**Construction & Development of site**

Development of the proposed site could lead to stockpiling and excavation activity on site, thereby causing erosion of base soil. The run off from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season.

The impact also envisaged from the construction practices and the type of material used. Construction waste is likely to create significant impact. This type of waste would be stock piled and disposed of properly. Water logging at certain stretches along the road can be caused due to various borrowing operations. During rains, these borrow areas get filled up and remains water logged due to in adequate local drainage.

**Site Workshop**

The repair and maintenance of equipment / vehicles on site would generate waste containing oil and grease. The wastewater stream would also be generated from vehicle washing. The impact can be mitigated to a great extent by installing oil and grease traps.

**Mitigation Measures:**

In order to prevent degradation and maintain the quality of the water, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water into any nearby water body like small pond, stream, etc. Following management measures are suggested to protect the water quality during this phase.

- The drainage designs for BRT should be cleared with the local drainage and irrigation authorities before works commence. Crossing structures should be prefabricated off site to prevent impacts to sensitive receptors near the river crossings (if any).

- Avoid excavation during monsoon season.
- Care should be taken to avoid soil erosion.
- Pit latrines and community toilets with temporary soak pits and septic tanks should be constructed on the site during construction phase to prevent the wastewater from entering into the water bodies.
- To prevent surface and ground water contamination on account of oil/grease, etc. leak proof containers should be used for storage and transportation of oil/grease. The floors of oil/grease handling area should be kept effectively

impervious. Any wash off from the oil/grease handling area or workshop should be drained through impervious drains and effluent should be treated appropriately before releasing it.

Construction activities generate disturbed soil, concrete fines, oils and other wastes. On-site collection and settling of storm water, prohibition of equipment wash downs, toxic releases from the construction site, etc. are some of the essential measures which prove helpful in minimizing water pollution.

## 7.6. Biological Environment

The following aspects are of typical consideration while evaluating ecological impacts of Green Line BRTS project:

### 7.6.1. Flora

There are several locations where there are trees present in the median of the BRT corridor. As many as 72 species of plants were recorded during roadside trees measurement e. The total of tree count on the median of Green Line corridor is found to be 16,637. The dominant plant species are obviously Conocarpus, Eucalyptus and Lignum species.

During construction the vegetation present on the median lane will be removed on the points where the bus station and depot will be constructed. Trees will be retained and maintained wherever possible on the rest of the corridors. The removal of trees at the bus stations will result in the local ecosystem changed.

**Mitigating Measures**

Where trees have to be felled, mitigation will be required in the form of reinstatement and compensatory planting. Soft landscaping should be installed in the median under the elevated sections to improve the appearance of the completed works. Other opportunity spaces should be sought by SPMU-MoC to plant trees as near the locations of the felled tree as possible. The contracts drawn up by SPMU-MoC for the BRT should require that wherever possible the trees are transplanted for use elsewhere in the project (e.g. amenity areas at intersections). After removing the existing trees and top soil (down to 0.5 m) the topsoil shall be retained for elsewhere in the project. The cut wood shall not be burned on site. All stumps and surplus vegetation shall be disposed of at landfill via routes or other destinations as designated and instructed by SPMU-MoC.

Recent international practice suggests that replacement at a minimum rate of 3:1 for trees would be appropriate given possible difficulties with establishing trees and low survival rate of young trees. This would probably be affordable. Therefore it is important to recognize that some significant part of the replacement ratio should allow for a high mortality rate among the newly planted trees based on observation, international expectations, and advice from the KMC parks authority.

### 7.6.2. Fauna

No significant impact is likely to register as there is no considerable fauna in the project area particularly along the green line.

#### 7.6.2.1. Migratory Birds

The project area does not have wetlands also the sections passing across rivers and water bodies are not directly affecting the associated ecosystems particularly the movement and feeding / breeding grounds of migratory birds.

## 7.7. Impacts on Socioeconomic of the Area

### 7.7.1. Job Opportunity

The local people would get the job opportunities closer to their places of stay. Expenditure incurred by those employed at the project will boost local economy. Jobs would be created for unskilled, semiskilled as well as skilled labor category, for which local population would be given preference. Thus, the project is expected to contribute to the overall development of the area.


**Fig 7.1:** Typical Cross Sections Showing Tree Counting Areas

Construction activity may lead to influx of construction labors. Though majority of work force would be recruited locally, labors with specific skills, may be from outside. However, such labors would be limited in number. The camp shall be provided with all basic amenities like water supply, public toilet etc. Therefore no significant pressure on local infrastructure is envisaged.

### 7.7.2. Archaeological and Heritage Sites

There are no significant sites of archaeological and heritage value however during the construction phase there is some exposure to be experienced with cultural or religious sites which needs attention and should be carefully handled to minimize the physical impacts. The socioeconomic and cultural considerations of these sites are to be given due regards under respective domains.

### 7.7.3. Communicable Diseases

Communicable diseases such as HIV may be introduced due to the immigration of workers associated with project. Communicable diseases prevention program will be prepared for construction workers or resident near the construction site.

## 7.8. Impact on Traffic

The proposed BRT corridors will be constructed on existing traffic routes. Construction activities along these routes are likely to cause hindrance in traffic flow if not mitigated properly. A temporary traffic management plan will be developed and submitted by the contractor at least one month before commencement of construction. The main objectives of the plan shall be to maximize the safety of the workforce and the travelling public. The main secondary objective will be to keep traffic flowing as freely as possible.

Mitigation Measures

The Temporary Transport Management Plan will include consideration of the following:

- Lane availability and minimization of traffic flows past the works site.
- Establishment of acceptable working hours and constraints.
- Agreement on the time scale for the works and establishment of traffic flow/delay requirements.
- Programming issues including the time of year and available resources.
- Acceptability of diversion routes where necessary.
- Need for road closures and the necessary Orders.
- Co-ordination with other planned road and street works.

- Discussion of the SPMU-MOC inspection/monitoring role.
- Establishment of incident management system for duration of the works.

The plan will be reviewed by SPMU-MoC and approved, if found appropriate. Resources from contractor, SPMU-MoC, and the traffic police will be provided as per the plan before construction commences.

Traffic signs and warning instructions are displayed at sites and along the proposed routes being used by the construction traffic for the information of other road traffic as well. Period of construction and area / location of construction site shall be informed to public in general and specifically to local residents. Any closure of the roads and deviations / diversions proposed should be informed to the riders through standard signs and displays.

## 7.9. Natural and Manmade Hazards

These natural disasters include wind storms, floods, earthquakes which may be experienced during the construction phase however the likelihood is quite low and the effect of the project in case of occurrence of natural calamity on the health and safety of the workers and affected population can be minimized by adopting appropriate and adequate mitigation measures.

Fire accidents and terrorist / sabotage activities are something which cannot be predicted or foreseen but can be prepared for it by taking precautionary measures such as training of staff and acquiring extra safety and security measures.

## 7.10. Identification of Impacts During Operation Phase

The introduction of modern BRT buses with low emissions coupled with the removal of older buses from the traffic fleet is expected to deliver some reductions in ambient levels of noise and air pollution. However these improvements will also depend greatly on other changes that are implemented in the management of the vehicle fleets in Karachi.

The implementation of BRT will be within a wide median reserve within the RoW keeping the BRT vehicles away from sensitive receivers, but residences and commercial premises and schools will still be fairly close to the BRT and much of the existing traffic except busses will remain on the rest of the road lanes during the operation of BRT.

The impacts in the operation phase are critically important as most of the impacts are 'long term' and need sustained mitigation measures as long the project is in operation or sometimes may continue beyond the service life of the project. Impacts for operation phase and mitigation measures are summarized in Table 7.6.

**Table 7.6: Summary Matrix of Predicted Impacts Due to Proposed Project (Operation Phase)**

| S.No | Components | Activities | Predicted impacts | Mitigation Measures |
|---|---|---|---|---|
| 1 | Ambient Air Quality | -Particulate and gaseous emissions from vehicle | Minor negative impact inside premises with no movement impact outside. Limited alongside the routes | Vehicle Emission Control and Greenbelt Development |
| 2 | Noise | Noise from vehicle movement | No significant impact at sensitive receptors. New generation vehicles will be plying on the roads, which generate less noise. | No negative impacts |

**Table 7.6: Summary Matrix of Predicted Impacts Due to Proposed Project (Operation Phase)**

| S.No | Components | Activities | Predicted impacts | Mitigation Measures |
|---|---|---|---|---|
| 3 | Water quality | Oil/fuel and waste spills. Discharge of sewage. Discharge of contaminated storm water | No significant adverse Impact. No wastewater discharge outside the premises to the nearby water source. | Wastewater treatment at depots will be installed to mitigate the impact. |
| 4 | Land contamination | Accidental Fuel and material spills | No negative impact | Proper waste management plan and spill response plan to be implemented |
| 5 | Ecology, flora & fauna | Land use change | No negative impact | - |
| 6 | Socio-economy | Increased job opportunity Improvement of Infrastructure Facilities Wider Economic Growth Reduced Health Risk and Accidental Hazards | Overall positive impact. Socio-economic status of the region will be improved | Regular and proper maintenance of infrastructure throughout the project life cycle. |
| 7 | Traffic pattern | Improved roads without any obstruction | Positive Impact | |

## 7.10.1. Air Quality

The change in air quality is subjected to the mode of transportation being used and its design frequency in the project. The transportation mode will suggest the type of technology and fuel consumed and in addition to that the equivalence of Passenger Car Units (PCU) factor of that mode of transport will identify its economical and modal efficiency.

In the Case of Green Line BRTS the buses will be operated through fuel (diesel, CNG etc.), which suggest that major pollutants from the vehicular movement are carbon monoxide and oxides of Nitrogen and SPM. The concentration of various pollutants in the engine exhaust varies with the type of engine namely, spark ignition (petrol engine) or compression ignition (diesel engine) two stroke or four stroke engines; and also mode of engine operation.

On the macro-environment the impact would be reduction in the air emissions due to expected switch over to a more environment friendly mode of transport which would curtail unnecessary delays in traffic that results in excessive vehicular emissions in the events of road jams particularly during peak hours.

**Mitigation Measures**

Following mitigating measures are needed to be suggested:

**Vehicle Emission Control**

Regular maintenance of the vehicle should be mandatory. Restriction of speed is also helpful in the reducing the emission rate. Instead of petrol, the fuels like CNG/LPG could be encouraged.

**Greenbelt Development**

Increasing vegetation in the form of greenbelt is one of the preferred methods to mitigate air pollution. Plants generate oxygen, serve as a sink for pollutants, reduce the flow of dust and reduce the noise pollution too alongside the BRT routes

## 7.10.2. Noise and Vibration

Noise is generally accepted from local traffic in the towns as a consequence of urban life but concerns have been expressed during the consultation, particularly about the elevated sections increasing noise and some residences, temples and schools will be quite close to the elevated sections.

Depending on the eventual traffic flows most road sections near the BRT are expected to carry less but still substantial traffic. This is based on the assumption that the BRT will remove the major portion of existing busses on the BRT routes and transfer the passengers to the BRT.

The traffic noise will be from new generation passenger cars, and buses, which generate very little noise. Hence the impact during the operation phase is not expected to be felt outside the project boundaries. There would be smooth traffic flow hence no congestion and hence less noise at junctions and intersections.

## 7.10.3. Impacts on Water Resources

### 7.10.3.1. Wastewater Generation and Discharge

The operation of the BRT does not directly involve any discharge of effluents into the surrounding environment except for the certain locations identified in the project where physical activities involving excessive or commercial use of water is involved which may therefore require proper treatment prior to disposal.

The main sources of wastewater regarding the BRT operation include each station and depot. The runoff from alignment including corridor and depot may affect the water quality of the surface and ground water, if the drainage and collection system is not properly designed and fail to functions.

The water consumption is not estimated yet however the quality of water projected is likely to be contaminated mostly with oil and grease with paints (to some extent) therefore it is proposed that a proper wastewater collection and treatment facility would be set up at the depot.

### 7.10.3.2. Accidental Spill

Contamination of surface & ground water may be possible due to accidental spillage of oil, grease and diesel from the vehicles during operation phase of project. Better storm-water drainage network alongside of the route will minimize the waterlogging.

**Mitigating Measures:**

Following remedial measures will be helpful in minimizing the impacts.

**Wastewater collection and Monitoring**

Wastewater collection, conveyance and disposal system shall be installed at depot and treatment will be carried out prior to disposal. Monitoring shall be carried out at specified locations for any possible incident of contamination and non-compliance to NEQS.

**Storm Water Management**

Most of the storm water produced along the BRT routes will be channeled to the well laid out storm water network devised alongside of both the corridors and it will recharge in ground water recharge pit through sand filter.

**Rainwater Harvesting**

Rainwater harvesting can serve as a solution to the water problem in the water crises area by capturing the runoff. Rainwater harvesting helps in utilizing the primary source of water and prevent the runoff from going into sewer, thereby serving dual purpose: Making water available for future use and reducing the load on treatment plants. Recharging the water aquifers help in improving the quality of existing groundwater through dilution.

### 7.10.4. Health Impacts

Along the route BRT from Power House chowrangi to Nagan Chowrangi, Elevated High Tension (EHT) lines of Electricity and Pylons are located and can pose an inherent risk to workers that will expose for a longer period of time.

**Human Exposure to Electromagnetic Fields (EMF)**

During the operation phase, the HTLs will remain energized and there will be an increase in the level of electromagnetic fields (EMFs) in the RoW vicinity.

In epidemiological studies, researchers try to establish whether there is a statistical association between selected groups of people with certain types of exposures of EMF and diseases. Some epidemiological studies have suggested a possible link between exposure to magnetic fields and childhood leukemia. It is unclear however, whether exposure to magnetic fields actually caused the disease. Some studies do not include magnetic field measurements when trying to determine an association and no epidemiological study has drawn direct conclusions about a link between cancer and EMF.

Experimental studies involve exposing cells, tissues and/or animals to magnetic fields under controlled conditions. These studies allow researchers to closely control magnetic field exposure and provide information about any small scale biological changes that magnetic fields may cause. Experimental studies have not found that magnetic fields are the cause of any disease.

Many reputable health authorities such as the World Health Organization (WHO) and Health Canada have conducted thorough reviews of all the different types of studies and research on EMF and health. These health authorities have examined the scientific weight-of-evidence and have determined that when all of the epidemiological and experimental studies are considered together, the consensus is that there is no cause-effect relationship between exposure to magnetic fields and human health. The WHO concludes:

From the current scientific literature there is no convincing evidence that exposure to radiation field shortens the life span of humans or induces or promotes cancer (WHO, 2006).

Similarly, the World Bank Electric Power Transmission and Distribution EHS Guidelines state:

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only high voltage power lines and substations, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment. However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern (World Bank, 2007).

The World Bank Electric Power Transmission and Distribution EHS Guidelines recommend evaluating potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation (ICNIRP); average and peak exposure levels should remain below the ICNIRP recommendation for general public exposure. The WHO reviews also conclude that exposures below the limits recommended by the ICNIRP international guidelines do not appear to have any known consequence on health.

To minimize potential EMF impacts from the Project the following mitigation measures have been adopted:

- During design the RoW alignment was selected so as to avoid settlements and sensitive receptors.

- Operation phase EMF monitoring will be undertaken. Average and peak exposure levels should remain below the ICNIRP recommendation for general public exposure.

The typical value of EMF below the 500kV overhead HTLs is predicted to be 40 microtelsa (μT), which is in our case i.e. below the 145kV HTLs the value is well below the ICNIRP guideline of 100 μT. Overall no significant adverse EMF impacts are predicted during Project operation.

**Electrocution and Induced Currents**

Electrocution can occur as a result of direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity. Power line fields can also induce voltages and currents on conductive objects such as metal roofs or building, fences, and vehicles. When a person or animal comes in contact with a conductive object a perceptible current or small secondary shock may occur.

To mitigate these impacts:

- Warning signs will be posted at installations near HTLs.
- Conducting objects (e.g. fences or other metallic structures) installed near power lines will be grounded to prevent shock.
- In case of pedestrian crossing bridges, keeping a clearance of 4.5 m, an insulation barrier for 145 kV must be provided for Health and Safety of Human.

## 7.10.5. Impacts on land Environment

During the operation phase the routine impacts to soils would be limited largely to soil erosion impacts caused by vehicular traffic. Any excavations required for maintenance would cause impacts similar to those from construction phase, but at a lesser spatial and temporal extent. The accidental spill of product such as accidental fuel and material spills would likely cause soil contamination. Except in the case of a large spill, soil contamination would be localized and limited in extent and magnitude.

In the operational phase, the domestic garbage from stations and passenger buses, and wastes from regular working and living in the depots includes dinner boxes, aluminum cans, plastic bottles, tissue paper / paper / newspaper, nutshells, and fruit peels, food waste.

**Mitigating Measures**

To minimize the disruption of top soil following remedial measures should be taken.

- The top soil that will be excavated from the area will be preserved and reused for the horticulture purpose.
- Proper solid waste management program is prepared and executed to ensure and Land waste containment, collection, transfer and disposal.
- Monitoring is carried out at specific locations for strict compliance to the developed EMMP in implementing measures to solid waste management.

## 7.10.6. Biological Environment

During the operation phase there is fewer chance of habitat disturbance. Hence no major impacts are envisaged. Following remedial measures should be taken to reduce the impact.

**Mitigation Measures**

Extensive plantation and landscaping is proposed to mitigate any impacts during this phase.

Selection of the plant species to be done on the basis of their adaptability to the existing geographical conditions and the vegetation composition of the region. During the development of the green belt within the project area, emphasis shall be given on selection of plant species like nitrogen fixing species, species of ornamental values, species of very fast growth with good canopy cover etc.

## 7.10.7. Hazardous Driving Conditions

Overall the condition of the road facilities in the vicinity of BRT will be enhanced with the implementation of BRT; driving conditions should improve. The BRT will retain or introduce fully separated two way traffic. Routine safety measures, signage and road markings should be introduced to reduce driving risk further in accident prone areas and provide enhancements to driving conditions near the junctions. The Urban Traffic Control system should also contribute in this regard.

However the road traffic carriageways will be narrower due to the space required for BRT and at the bridges, rivers and streams passing these areas there could be a risk since the bridges as currently designed have no dedicated drains. Therefore the only option in the event of chemical spillage is a rapid clean up and therefore an accidental spillage action plan should be prepared with the local emergency services to protect water bodies in the event of an accidental spillage of toxic or hazardous chemicals.

Provisions will need to be made to consider in the detailed designs for road conditions at the major intersections and other local intersections. The overall visibility at the intersections will need to meet the local design standards and will need to be acceptable under all the foreseeable conditions. Improvements to sighting angles and improved junction warning signage and road markings may require inclusion at the detailed design stages. Fluorescent junction countdown markers should be considered for the major junctions.

## 7.10.8. Socioeconomic

Activities during the operations would contribute to local economy by providing job opportunity. These benefits will definitely increase the socioeconomic status of the region. Hence the overall impact will bring the positive change.

### 7.10.8.1. Improvement of Infrastructure Facilities

The development of project will also create or improve the amenities / services like power, road, communication, health, education, etc. thereby improving the life of local populace.

### 7.10.8.2. Wider Economic Growth

The proposed project will increase the economic activities around the area, creating avenues for direct/indirect employment in the post project period. There would be a wider economic impact in terms of generating opportunities for other business like transportation, marketing, repair and maintenance tasks, etc.

### 7.10.8.3. Better Road Transportation

During the operation phase the road will likely to be improved without any obstruction. As more commuters are diverted to BRT the traffic conditions will improve due to reduction in traffic flow which further suggests improved air quality and general environmental conditions associated with vehicular traffic along road side. Hence the project will bring the positive change.

#### 7.10.8.4. Reduced Health Risk and Accidental Hazards

The same applies while ensuring maximum operational safety it suggests that accidental hazards are minimized. As well as construction of separate BRT lane will greatly reduce the accidents associated with movements across the roads. Health risks due to vehicular/exhaust emissions experienced in congested traffic conditions is likely to be avoided by the commuters travelling on BRT thereby giving them a free or no exposure environment.

# 08 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The scope of the present EIA study includes delineation of Environmental Management and Monitoring Plan (EMMP). The aim of an environmental management and monitoring plan is to provides an approach for managing and monitoring environment related issues and describes the institutional framework for environmental management and resource allocations to be carried out by the SPMU-MoC for mitigating the negative impacts during various project execution and operation phases of Green Line BRTS Project.

EMMP is a dynamic and a live document that is under constant review having periodic revisions and may be updated as required. Any amendments in the procedures, information are notified to the concerned personnel after the approval from the competent authority for subsequent implementation.

## 8.1 Introduction

The EMMP will serve as a principal execution module of the project that would not only mitigate adverse environmental impacts during the construction and the operation phase of the project but also ensures that environmental standards and good in housekeeping are maintained. Continuous environmental monitoring is exercised to ensure that preventive measures are in place and effective to sustain environmental integrity. Some of the key objectives of EMMP are to:

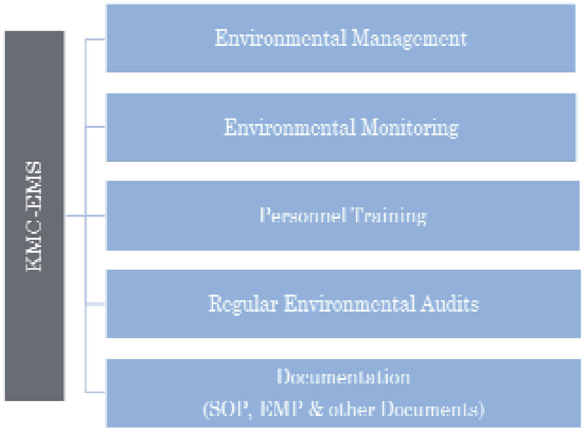
- To outline functions and responsibilities of responsible persons.
- To state and implement standards and guidelines which are required under environmental legislations particular in context to the project.
- Facilitates the implementation of the mitigation measures by providing the technical details of each project impact, and proposing implementation schedule of the proposed mitigation measures.
- Define a monitoring mechanism and identify monitoring parameters to ensure that all proposed mitigation measures are completely and effectively implemented.
- Identify training requirements at various levels and provide a plan for the implementation of training sessions.
- Identify the resources required to implement the EMMP and outline corresponding financing arrangements; and
- Providing a cost estimate for all proposed EMMP actions.

## 8.2. Environmental Management System

SPMU-MoC will establish an Environmental Management System (EMS) called as Green-EMS to provide continuous support and commitment to implementation of the Environmental Management and Monitoring Plan along the RoW of Green Line. The Green-EMS should include the following:

- Environmental Management.
- Environmental Monitoring.
- Personnel Training.

- Regular Environmental Audits & Corrective Action.
- Documentation – Standard operating procedures, Environmental Management Plans & other records.




## 8.3. Functions of EMS

Environmental Management Cell within SPMU will take the overall responsibility for co-ordination of the actions required for environmental management and mitigation, and for monitoring the progress of the proposed management plans and actions to be taken for the project. The Cell will be headed by a qualified environmental engineer and the other members of the cell that will include an environmental field officers, scientist, chemists and operators. Following responsibilities will be headed by Green-EMS:

- Overseeing the environmental performance at its different Facilities, Installations, Construction sites, Activity Centers and Institutions along the BRT corridor, at regular interval to demonstrate compliance with existing National Environmental Quality Standards and guidelines.
- Oversee the environmental performance in a manner that their operation as well as maintenance will neither degrade the environment of the BRT corridor nor its macro environment and will provide continuous support and commitment to implementation of its Environmental Management and Monitoring Plan.
- Avail facilities at a designated Laboratory certified with EPA for all environmental sampling and will also arrange for specialist qualified personnel to perform the work within parameters specified by NEQS, or as advised by EPA Sindh. EMS will thus satisfy the national as well as international requirements.
- Establish and maintain procedures to identify the environmental issues pertaining to its own activities, and services that it can control and over which it can be expected to have an influence, in order to determine those issues which have or can have significant impacts on the environment. Green-EMS will ensure that the characteristics related to significant impacts are considered in setting its environmental objectives, and will keep this information up-to-date.
- Establish and maintain procedures to identify and have access to legal and other requirements to which it subscribes, that are applicable to the environmental quality of its own activities, and services.
- Establish and maintain documented environmental objectives and targets, at each relevant function and level within its organizational set up.
- Consider, while establishing and reviewing its objectives, the legal and other requirements, its significant environmental features, technological options and its financial, operational and business requirements, in addition to obtaining the views of stakeholders. The objectives and targets set by Green-EMS will be consistent with environmental regulations, including the commitment to prevention and control of pollution.
- Maintain a database and its own archives to keep abreast of modern environmental legislation, emission norms that are now technology-specific,

and have their own limits and standards. National legislation or guidelines on specific emission limits have not been set in many cases in Pakistan, World Bank Guidelines are widely used as the minimum norm if the host country does not have its own specific legislation. EMS will follow the World Bank Guidelines till such time that Technology-specific limits, closely corresponding to National as well as actual conditions are not available. As will be seen in the later sections, the limits of most important specific emissions that Green-EMS will look for are CO, NOx, SO2 and Particulate Matter for the air, besides Dissolved Oxygen (DO), NO3, BOD5, COD, and trace elements for the effluent.

- Comply with all existing environment related laws and other requirements, including safety regulations, applicable to different systems and products.

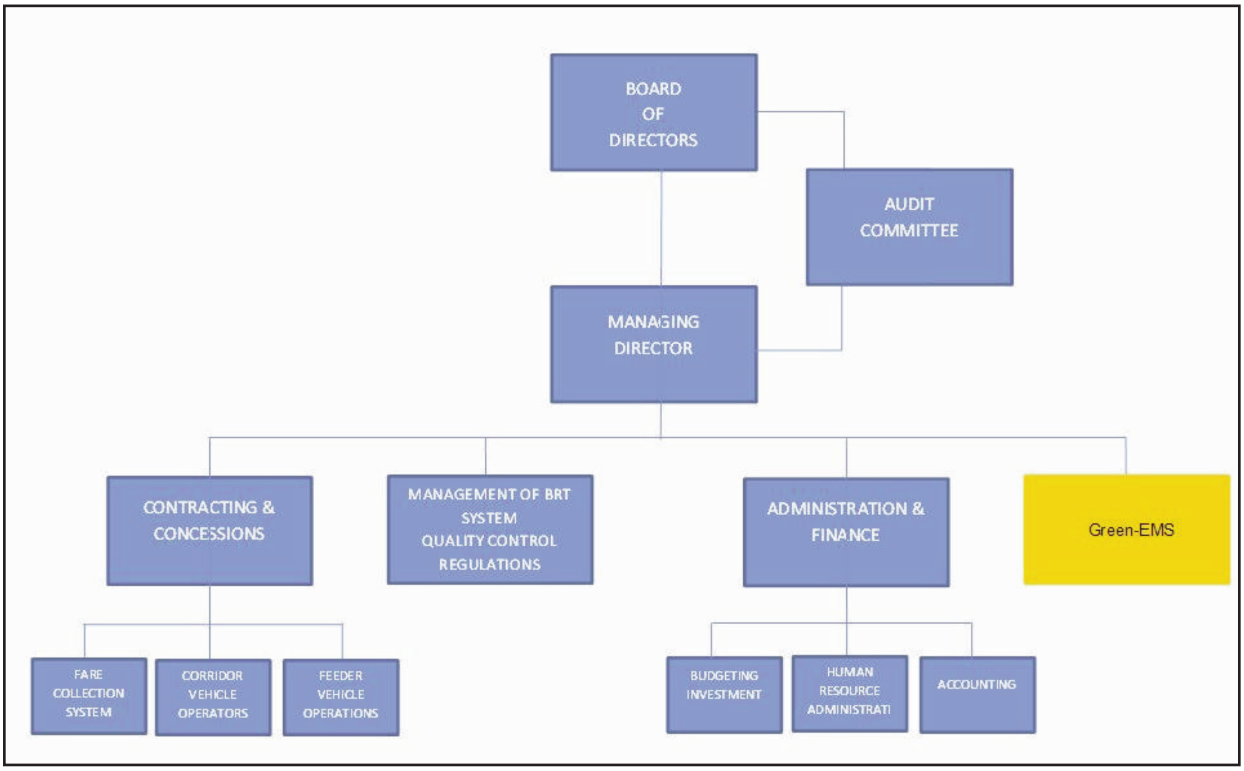
## 8.4. Organization Structure

The organogram shown below gives an idea of the organizational set-up of Green-EMS in SPMU-MoC.

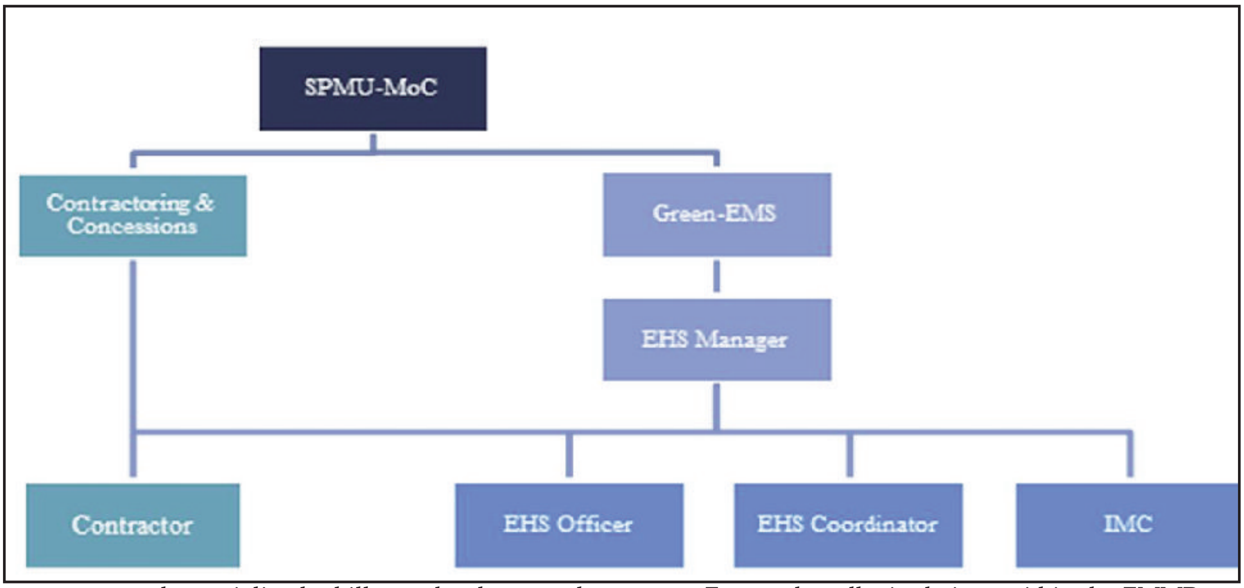
## 8.5. Functions and Responsibilities

Roles, responsibilities and authorities will be defined for different levels of hierarchy, documented and communicated in order to facilitate effective implementation and operation of the EMMP along the BRT corridors.

Green-EMS will have the Institutional Capacity and resources essential to the implementation and control of EMMP, including its Safety, Security, and Contingency Plan issue. Resources include human




The proposed organization Set-Up for Green-EMS is given below




resources and specialized skills, technology and budgetary allocations.

SPMU-MoC top hierarchy will appoint specific Management Representatives for Green-EMS who, irrespective of other responsibilities, will have defined roles, responsibilities and authority for

Ensuring that EMMP, including its Safety, Security, and Contingency Plan requirements are established, implemented and maintained in accordance with International Standards e.g. ISO 14,000 certification. Reporting on the performance of EMMP, including its Safety, Security, and Contingency Plan issues to top hierarchy for review and as a basis for improvement of the EMMP.

Specific responsibilities of the EHS Manager, EHS Officer, EHS Coordinator and Independent Monitoring Consultant (IMC) are detailed below.

### 8.5.1. The EHS Manager

- Ensure that the contractor is aware of all specifications, legal constraints, standards and procedures pertaining to the project specifically with regards to environment.
- Ensure that all stipulations within the EMMP are communicated and adhered to by contractor(s).
- Monitor the implementation of the EMMP throughout the project by means of sit inspections and meetings. This will be documented as part of the minutes of the site meeting documents.
- Be fully conversant with the Environmental Impact Assessment of the project, the conditions of the approval of EIA (once issued), and all relevant environmental legislations.
- Conduct audits to ensure compliance to the EMMP.
- Liaise with the top officials of SPMU-MoC and delegate the EHS Officer, EHS Coordinator and relevant discipline Engineer on matters concerning the environment.
- Prevent actions that will harm or may cause harm to the environment, and take steps to prevent pollution on the site.
- Confirm activities to the demarcated construction site.

### 8.5.2. The EHS Officer

- Be fully conversant with the Environmental Impact Assessment and conditions of its approval.
- Be fully conversant with the Environmental Management Plan.
- Be fully conversant with all relevant environmental legislation, policies and procedures, and ensure compliance with these.
- Undertake regular and comprehensive inspection of the site and surrounding areas in order to monitor compliance with the EMMP.
- Take appropriate action if the specifications contained in the EMMP are not followed.
- Monitor and verify that environmental impacts are kept to a minimum, as far as possible.
- Review and approve construction methods, with input from the Site Manager, where necessary.
- Ensure that activities on site comply with all relevant environmental legislation.
- Order the removal of person(s) and/or equipment in contravention of the specifications of the EMMP.
- Compile progress reports on regular basis, with input from the Site Manager, for submission to the EHS Manager, including a final post construction audit.

### 8.5.3. The EHS Coordinator

- Be fully conversant with the Environmental Impact Assessment and conditions of its approval.
- Be fully conversant with the Environmental Management Plan.
- Be fully conversant with all relevant environmental legislation, policies and procedures, and ensure compliance with these.
- Convey the contents of this document to the contractor site staff and discuss the contents in detail with the EHS Manager and Contractor.
- Liaise with the Site Manager regarding the monitoring of the site.
- Report all environmental problems arising on the construction area to the EHS officer and reports on such problems will be submitted to the EHS Manager.

### 8.5.4. Contractors and Service Providers

- Environmental management is part of on-site quality management. Under the environmental management plan, the contractor
- Shall propose measures to minimize environmental impacts during construction process, and submit them to the EHS Coordinator. In case of having impacts on the environment, the contractor will inform them to the EHS Coordinator in time to get instructions and then take next step.
- Comply with the environmental management specifications;
- Submitting an obligatory Methods Statement for approval by the EHS Officer before any work is undertaken;
- Adhering to any instructions issued by the Engineer/Project Manager on the advice of the EHS Coordinator;
- Submitting a report at each site meeting which will document all incidents that have occurred during the period before the site meeting.
- Displaying the list of transgressions issued by the EHS Officer in the site office.

- Maintaining a public complaints register. Arrange that all his employees and those of his subcontractors receive training before the commencement of construction.

### 8.5.5. Independent Monitoring Consultant

Independent Monitoring Consultant appointed will be headed by EHS Manager. He along with his team will supervise the Project Contractors to ensure quality of work and fulfillment of contractual obligations. The Independent Monitoring Consultant (IMC) will:

- Ensure that all environmental and social parameters / provisions comply with the applicable standards;
- Ensure that day-to-day construction activities are carried out in an environmentally sound and sustainable manner. Organize periodic environmental training programmmes and workshops for the Contactor's staff and Site staff in consultation with the administration; and
- Develop "good practice" construction guidelines to assist the Contractors and Administrative staff in implementing the EMMP.

## 8.6. Environmental Management Programme

Green-EMS will establish and maintain programmes for achieving the environmental objectives and targets. These programmes will include:

- Designation of responsibility for achieving environmental objectives and targets at each relevant function and level, and
- The means and timeframe by which they are to be achieved.
- If and when a project related to new developments and new or modified system of transportation or material usage is introduced, that may likely alter the quality of the environment, the EMMP will be suitably amended to ensure that the System applies to such development or modification as the case may be.

## 8.7. Training, Awareness and Competence

Green-EMS will identify its own training needs. It will ensure that all personnel, whose work may create a significant impact on the environment, e.g. those who have to handle safety, security, and emergencies arising out of spill of hazardous materials or have to work in hazardous situations, receive appropriate training.

Green-EMS will establish and maintain procedures to make its employees or members at each relevant function and level aware of:

- Importance of conformance with the environmental policy and procedures and with the requirements of EMMP
- Significant environmental impacts, actual or potential, of their work activities and the environmental benefits of improved personal performance
- Their roles and responsibilities in achieving conformance with environmental commitment and procedures and with the requirements of the EMMP, including emergency preparedness and response requirements
- Potential consequences of departure from specified operating procedures
- Comprehension that competence of personnel performing the tasks that can cause significant environmental impacts, depends on appropriate education, training and/or experience.

## 8.8. Communication

With regard to its environmental considerations and EMMP, Green-EMS will establish and maintain procedures for:

- Internal communication between its various levels and functions
- Receiving, documenting and responding to relevant communication from external interested parties.
- Green-EMS will consider processes for external communication on its significant environmental aspects and record its decision.

## 8.9. EMMP Documentation

Green-EMS will establish and maintain information, in paper or electronic form to:

- Describe the core elements of EMMP and their interaction
- Provide direction to related documentation
- Help its facilities in establishment of their own Information Documentation Centers.

### 8.9.1. Document Control

Green-EMS will establish and maintain procedures for controlling all documents required to ensure that:

- They can be located
- Current versions of relevant documents are available at all locations where operations essential to the effective functioning of EMMP are performed
- Obsolete documents are promptly removed from all points of issue and points of use, or otherwise assured against unintended use
- Any obsolete document retained for legal and/or knowledge preservation purposes are suitably identified.
- They are periodically reviewed, revised as necessary and approved for adequacy by authorized personnel

Green-EMS will ensure that its documentations are legible, dated (with dates of revision) and readily identifiable, maintained in an orderly manner and retained for a specified period. Procedures and responsibilities will be established and maintained concerning the creation and modification of the various types of documents. Typical record keeping requirements are given below:

## 8.10. Operational Control

Green-EMS will identify those operations and activities on the corridors that are associated with

**Table 8.1: Record Keeping Requirement**

| Parameter | Particulars |
|---|---|
| Solid Waste Handling & Disposal | Daily quantity of waste received<br>Daily quantity of waste recycled<br>Daily quantity sold |
| Regulatory Licenses (Environmental) | Environmental Permits |
| Monitoring & Survey | Records of all monitoring carried out as per the finalized Monitoring protocol. |
| Other | Log book of compliance<br>Employee environmental, health and safety records<br>Equipment inspection & calibration records, where applicable<br>Vehicle maintenance and inspection records |

significant environmental impacts as well as Health Consequences in line with its commitments, objectives and targets.

The significant impacts on the environment from BRT activities and operations include emission of CO, SO2, NOx, particulate matter and noise of medium to high intensity from the vehicular traffic.

Green-EMS will ensure that baseline for different environmental parameters, health, safety and security issues, and MSDS for chemicals, pharmaceuticals and auxiliaries, relevant to the project are generated and recorded, and the database is regularly updated.

Green-EMS will ensure that it is actively involved in getting

- EIA or IEE carried out for its improvement and rehabilitation projects,
- Necessary mitigation measures identified in the EIA, IEE and Environmental Audit by concerned Agency,
- Due approval obtained from Responsible Authority at the EPA before launching on the project.

Green-EMS will further ensure Performance monitoring of this project, at its construction sites and activity centers to verify the situation in the air shed and watershed of the projects and to require the SPMU-MoC or the concerned Agency to adopt remedial measures to reduce the residual impact.

## 8.11. Environmental Management Procedures

### 8.11.1. Measures to Improve Environmental Awareness

To improve the awareness of the environment of site workers and people living around the Project area, the contractor will take following actions:

- Frequently train the Site staff about the meaning and the importance of environmental protection.
- Manage and improve conditions at the construction area to minimize negative impacts.
- Make residents understand the consequences of environmental degradation.

### 8.11.2. Specific process to meet Environmental Requirements

To meet legal requirements, the contractor will take the following steps:

- Comply with the provisions of Sindh Environmental Protection Act 2014 and other legal frameworks.
- Shoulder responsibility for ensuring that no waste materials and rubbish are left on roads as consequences of transport during the construction process.
- Collect and move away all the wastewater generated during the construction process from the construction area using the temporary drainage system designed and arranged at proper locations so as not to cause environmental pollution.
- Timely clean and move away the waste materials and debris generated during the land and mud construction process at the construction area and surrounding areas to revert the environment to the original state.
- Specific measures to control air pollution during the operation of concrete mixing stations include:
- Periodically cleaning and watering the mixing stations and related areas to control the dust

generation.

- Applying pollution control by the EHS Officer whenever mixing stations operate.
- Enclosing with three-sided walls all sand and materials stockpiles within the location of mixing stations with volume of more than 50 m3.
- Dust, exhausted gases-minimizing measures shall be taken as proposed in the Environmental Impact Assessment Report. Periodically watering the construction area shall also be implemented.
- The EHS Officer will monitor activities generating dust on the construction area, and join hands with the Independent Monitoring Consultant in minimizing air pollution.

### 8.11.3. Water Quality Management

The water needs of the project will be assessed and will make its own arrangement for procurement if the same is not available from conventional sources. Quality and quantity of water used will be recorded and its treatment, if required will also be noted. Water and energy balance at the project will be recorded and maintained in the log book to be submitted to the Green-EMS.

- The EHS Officer is in charge of frequently monitoring water sources to prevent them from being polluted. The contractor and the sub-contractor will supervise such activities.
- The EHS Officer is to propose schemes on arranging the construction area to limit water pollution. The contractor and subcontractors are to ensure that the schemes will not cause pollution.

### 8.11.4. Refuse management

The Project owner instructs the contractor to ensure that no soil, stone or brick debris scatter on roads during the construction process. The refuse include wastes falling down during the transport process.

It is necessary to cover and wrap wastes containing chemicals when discharging them to prevent dangerous effects on environment and humans. It is also necessary to strictly conform to relevant criteria when handling chemical wastes.

Classifying refuse and strictly following commitments about the location of dumping sites made with local authorities affected by the project. The contractor will allocate areas for specific kinds of wastes at the construction area. However, wood, steel, iron, plastic materials and raw materials necessary to the construction area and not affected by weather will be placed near the consumption area to prevent storage overload at the site and material squandering.

### 8.11.5. Wastewater Management

Generation of wastewater from various activities and operations will be collected and conveyed to the point of discharge. The requirement of treatment prior to discharge and disposal shall be determined by the quality of effluent meeting the NEQS criteria.

The EHS Manager in liaison with the Project Manager shall be responsible for the preparation of the wastewater management plan which then shall be executed by the contractor responsible for complying to the environmental standards as prescribed and introduced from time to time according to the requirements of the project operations.

Wastewater generated during construction phase will be disposed of in the designated channel after obtaining permission from the KWSB to do so. The quality of this wastewater will also be tested against NEQS requirements.

SPMU-MoC will ensure adequate disposal of storm water from the BRT corridors, roads, and construction sites. It will be ensured that storm water does not accumulate on the roads.

The Independent Monitoring Consultant (IMC) shall ensure that wastewater management plan is prepared before commencement of Project's construction works. IMC will also monitor the implementation of this plan by contractor.

## 8.11.6. Materials Management Plan

The contractor will comply with conditions stated in the approval of EIA and the Environmental Protection Law and other relevant regulations in context to material procurement, handling, storage, consumption / use, transportation and disposal.

The materials management plan shall be developed and formulated by the EHS Manager in consultation with the Project Manager however contractor and personnel who shall be in charge / responsible for the execution of the management plan may also be invited for their technical / supportive input. The contractor shall remain the key functionary of the Material Management during the construction as well as the operation phase of the project.

The Independent Monitoring Consultant (IMC) shall ensure that materials management plan is prepared before commencement of Project's construction works. IMC will also monitor the implementation of this plan by contractor.

### 8.11.6.1. Storage and Preservation

The contractor will ensure that all hazardous materials/wastes are stored and preserved in accordance with chemical properties of each substance such as burning, melting and boiling points. To prevent substances from interacting with one another, each kind of hazardous material/waste should be isolated in separable suitable containers.

Specifically, when storing and preserving inflammable substances and agents prone to explosion, the contractor should install fire and explosion prevention systems at the preservation area using thick concrete blocks, mortar or other fire-proof materials. The contractor is also to supply and install other fire prevention equipment at preservation sites.

Training of personnel and assigning of responsibilities to individuals for managing and control of hazardous materials and waste shall be included in the materials/waste management plan of the facility. The hazardous substance storage and preserving area shall be protected strictly. Strict control of discharge of liquid wastes should be maintained which are used as solvents in the processes of drilling foundations and bridge buttresses (the location for storing these wastes should be pre-approved from the local authorities and mentioned in the plan).

### 8.11.6.2. Materials Inventory

The contractor will make an inventory of all the materials (raw material and waste produced) categorizing them according to the nature of safety requirements, handling, storage, transportation and disposal. In case of changes addition and deletion of materials the inventory will be updated on a periodic basis.

### 8.11.6.3. Handling Procedures

Training is part of the programme provided to the team designated to materials/waste management. Standard procedures are to be developed for specific types of materials and waste for handling and transferring to receptacles for subsequent disposal. Training for the use of safety devices and personal protective gears is to be imparted to the personnel.

### 8.11.6.4. Public Hygiene Management

- **Site inspection**

The contractor will conduct the site inspection to ensure that hygienic conditions are maintained in and around the project area. Cleanliness maintenance according to the environmental and public health standards would be carried out in service areas and general public areas will be maintained accordingly. Solid waste management and wastewater/sewerage system function along with air and noise quality monitoring will be undertaken by the Independent Monitoring Consultant.

- **Liquid and Solid Waste disposal**

All types of wastes arising should be contained and disposed of properly without causing a potential threat to general public and staff.

## 8.11.7. Worker's Health and Safety

During the period of construction at site, EHS Officer will ensure that the contractor bears the responsibility for worker's safety, safe working practices and for providing adequate and appropriate facilities for fire protection, medical aid, potable water supply and sanitation. Emphasis would be on health and safety training of the personnel. Safety instructions, handbooks, charts, diagrams etc. will be printed in English as well as Urdu. The workers would be given appropriate training for handling hazardous materials and goods. World Bank guidelines relating to worker's health and safety would be incorporated into the SPMU's Health and Safety Procedures.

For eye and face protection it will be mandatory on the Construction workers and other personnel in emergency situations to wear safety glasses, for skin protection to wear protective gloves, and for respiratory protection, positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus will be made available for emergency use. For general protection, wearing of overalls, helmets and safety shoes will be made obligatory, and provision will be made for safety shower and eyewash.

Restoration of site: It will be contractor's responsibility to restore the sites of excavation for the supporting structures by removing the debris and construction equipment and materials No attempt will be made to dispose of residual waste or unused materials on the Corridors.

Health, Safety & Security Commitment of the project will have the following components:

- Monitoring implementation of Health and Safety Plan to prevent and reduce accidents and occupational diseases among workers of the project as well as facilities affiliated with operations within its jurisdiction.
- Periodic programme for fire, safety and accident prevention
- Good housekeeping practices
- Regular and periodic course on general safety, health and hygiene.
- Providing appropriate signage throughout the corridors
- Providing a site safety handbook.
- Providing on site publicity on safety instructions through conventional notice boards.

## 8.11.8. Emergency Preparedness and Response

Green-EMS in collaboration with Fire & Safety Department of KMC will establish and maintain procedures to identify potential for and respond to accidents and emergency situations associated with unforeseen events. For preventing and mitigating environmental impacts associated with the risks, a Contingency plan will be in place to deal swiftly and efficiently to prevent the emergency from becoming a disaster.

The objectives of Green-EMS Contingency Plan, Disaster Management Plan and Hazardous Materials & Hazardous Waste Management Plan will be:

- To protect the life and property of people within the Corridor and public places and people in the Corridor of Impact (CoI),
- To limit and control the economic and environmental damage, and
- To fight the results of an incident.

The Contingency Plan would be a management tool to aid site personnel and relevant third parties to tackle an emergency situation. Green-EMS will formulate its Contingency Plan to integrate it with the Karachi City Network of Contingency Plan, aiming at sharing the responsibility to handle all emergencies at the place of emergency. Green-EMS's contingency plan will therefore be a component of emergency response plan of SPMU-MoC for maintaining an efficient and safe facility.

Green-EMS will review and revise, where necessary, its emergency preparedness and response procedures, in particular, after the occurrence of accidents or emergency situations.

Green-EMS will, in collaboration with City Network of Contingency Plan periodically test such procedures where practicable.

## 8.12. Environmental Monitoring Plan

### 8.12.1. Objectives

Environmental Monitoring is carried out to evaluate the effectiveness of the environmental mitigation measures. Environmental monitoring during construction and operation phases of the project assures implementation of Environmental Impact Assessment Report recommendations for a sustainable project. The plan of environmental monitoring has the following objectives:

- To verify the adequacy of the environmental protection measures;
- To conduct colloquia on revising the environmental protection measures, if necessary, in order that these measures accord with goals of the environmental monitoring plan.
- To provide a framework/outline of environmental protection and monitoring plan;
- To determine the scope of the environmental monitoring during construction and operation phase.

A monitoring programme will be in place not only to ensure conformance to the EMMP, but also to monitor any environmental aspects and impacts which have not been addressed or included in the EMMP at the planning stage that are, or could result in significant environmental impacts for which corrective actions are required.

The Green-EMS will ensure that the monitoring is carried out. An Independent Monitoring Consultant (IMC) must be appointed to ensure compliance with the EMMP, and to carry out monitoring activities. The IMC must have the appropriate experience and qualifications to undertake the necessary tasks. The Green-EMS will support IMC in carrying all the compliances to EMMP or otherwise IMC shall be required to report non-conformities to the SPMU-

MOC. Green-EMS will also depute its environmental engineers for regular checking of monitoring programme in accordance with the suggested monitoring programme.

All instruments and devices used for the measurement or monitoring of any aspect of EMMP must be calibrated and appropriately operated and maintained.

### 8.12.2. Monitoring Parameters

Contents of the environmental monitoring during the construction and operation period shall include environmental impacts associated with water, air, noise, land including wastewater, solid waste generation and socioeconomic such as land acquisition, demolition and resettlement, economic development triggered by the BRT, etc.

Contents of monitoring shall include all direct and indirect impacts generated during the construction period and the operation period. These issues may be eased or nipped at root as much as possible through environmental control measures and environmental monitoring process.

The program on observing air, noise and vibration environment is conducted at locations of the stations as specified by the project plan. Following arrangements will also be ensured and monitored by IMC:

**Table 8.2: Monitoring Plan**

| No. | Monitoring Item | Construction Stage | Operation Stage |
|---|---|---|---|
| I | **Noise Monitoring** | | |
| | Monitoring Parameter | Leq (dBA) | |
| | Monitoring Frequency | Measuring 2 times per month, 16 hours / day, | Measuring 1 time per quarter during the first 12 months, 16hours / day, |
| | Monitoring location | Stations/ Residential areas Sensitive areas | Stations/ Residential areas / Sensitive areas |
| | Comparative standard | NEQS | NEQS |
| II | **Vibration Monitoring** | | |
| | Monitoring Parameter | La (dB) | La (dB) |
| | Monitoring Frequency | Measuring 2 time per month, 16 hours / day. | Measuring 1 time per quarter during the first 12 months, 16 hours / day. |
| | Monitoring Location | Stations/ Residential areas Sensitive areas | Stations/ Residential areas Sensitive areas |
| III | **Air Quality Monitoring** | | |
| | Monitoring Parameter | CO, CO2, SO2, NOx, dust and microclimate parameters | CO, CO2, SO2, NOx, dust and microclimate parameters |
| | Monitoring Frequency | Measuring twice a month, 6 samples at one location. | Measuring the first 12 months, 8 samples at ring once a quarter during one location. |
| | Monitoring Location | Stations / Depot / Rail-road intersections | Stations / Depot / Rail-road intersections |
| | Comparative Standard | NEQS | NEQS |
| IV | **Water Quality Monitoring** | | |
| | Monitoring Parameter | TSS, TDS, pH, Temperature, BOD, COD, Metals, Sulphates, Carbonates, Oil and Grease, Anionic Detergents | TSS, TDS, pH, Temperature, Oil & Grease, Anionic Detergents. |
| | Monitoring Frequency | Once fortnightly for surface and groundwater. Grabs Sampling to be done once at each identified location. | Monthly for surface and groundwater. Grab Sampling to be done once at each identified location |

**Table 8.2: Monitoring Plan**

| No. | Monitoring Item | Construction Stage | Operation Stage |
|---|---|---|---|
| | Monitoring Location | Surface water bodies / lagoons / ponds, etc. in proximity to construction sites | Surface water bodies / lagoons / ponds, wells etc. in proximity to stations & depot. |
| | Comparative Standard | NEQS | NEQS |
| V | **Land Contamination Monitoring** | | |
| | Monitoring Parameter | Alkalinity, Salinity, pH, Electrical Conductivity | Alkalinity, Salinity, pH, Electrical Conductivity |
| | Monitoring Frequency | Once fortnightly for surface and sub-surface samples. Sampling to be done grab once at each identified location | One monthly basis and sampling to be done grab at each identified location |
| | Monitoring Location | Exposed surfaces in and around areas in proximity to construction sites particularly at stations & depot. Subsurface sampling in areas around piling, excavation, quarrying and batching plants. | Stations and Depot |
| | Comparative Standard | NEQS | NEQS |
| VI | **Mitigation Measures** | | |
| | Monitoring Parameter | All Treatment Works (Refer Section 6) | N/A |
| | Monitoring Frequency | Continuous | N/A |
| | Monitoring Location | Refer Section 6 Table……. | N/A |
| | Comparative Standard | N/A | N/A |
| VII | **Site Restoration** | | |
| | Monitoring Parameter | Restoring the sites to finished project sites without unnecessary delays. | N/A |
| | Monitoring Frequency | After completion of each section | N/A |
| | Monitoring Location | Construction Sites | N/A |
| | Comparative Standard | N/A | |
| VIII | **Social Aspects** | | |
| | Monitoring Parameter | The new employment opportunity on Green Line operation will be created for them with suitable training. | |
| | | Communicable Diseases Prevention Program will be prepared for construction workers or residents near the construction sites | N/A |
| | | Proper space to prevent sun shading will be prepared. | |
| | | Cultural & Archaeological Sites | |
| | | | Construction of Pedestrian Bridges |
| | Monitoring Frequency | Continuous | Continuous |
| | Monitoring Location | Green Line-RoW | Green Line-RoW |
| | Comparative Standard | N/A | N/A |
| XI | **Occupational Health Monitoring** | | |
| | Monitoring Parameters | Temporary fencing of the construction site for safety of workers and general public also checking unauthorized access. | Safety of workers and general public also checking unauthorized access. |

**Table 8.2: Monitoring Plan**

| No. | Monitoring Item | Construction Stage | Operation Stage |
|---|---|---|---|
| | Monitoring Frequency | Continuous | Half Yearly |
| | Monitoring Location | Green Line-RoW | Green Line-RoW |
| | Comparative Standard | Potential monitoring method could be occupational safety training at the inception of the construction or each time a new worker starts to engage in the job and periodic health checks for all workers. | Potential monitoring method could be occupational safety training at the inception of the operation or each time a new worker starts to engage in the job and periodic health checks for all workers. |

# 09 CONCLUSION AND RECOMMENDATIONS

The Karachi Transport Improvement Project (KTIP) was thereafter started by the Japanese International Co-operation Agency (JICA) in 2009 and a comprehensive planned development for the Karachi Transport System was proposed. This Transport Master Plan outlines policy and projects with the development horizon up to 2030. The Public Transport development component of this plan had identified 9 major Mass Transit Corridors with a total length of 193 Kms and included Bus based and Rail based solutions. The Plan was followed with a feasibility Study for two Corridors; the Green Line and the Red Line to be launched for Immediate Action Program for development as Bus Rapid Transit System.

The Prime Minister of Pakistan announced the GOP financial assistance to be made available under Public Sector development Plan (PSDP) portfolio for the Green Line Project.

The main purpose of this EIA Study is to provide and analyze information on the nature and severity of environmental aspects of the above issues and propose mitigation measures in case of negative impacts arising from the construction and operation of the project and related activities that would take place concurrently or subsequently. The EIA study will in fact respond to the provision of Sindh Environmental Protection Act 2014 and its associated rules and regulations.

Potential impacts of the proposed project during preconstruction, construction and operation stages on the physical environment including air quality, water quality, noise and vibration; ecology including flora and fauna, and socio-economic environment of the macro environment of Green Line BRTS Project area have been assessed. The significant impacts with summarized mitigation measures are as follows.

From Nagan Chowrangi to the end of Route Alignment i.e. KESC Power House Chowrangi, huge Electricity pylons of 25 nos. run along the alignment covering the entire median.

1. Pedestrian bridges constructed to access the bridges will be elevated. Therefore it is a chance that they may contact with HTLs.

2. Grade separations needs to be provided due to existing U-turns and Chowrangi.

3. From 4K to Nagan Chowragi, Water transmission travelling under the median and needs to relocated.

4. Huge cost is involved for the relocation of these Pylons and HTLs

According to the earlier correspondence with K-Electric-Engg. & Construction department and EHT Department, safety distances are required for Electric pylons and HTLs.

- From this point all the way to the end of alignment grade separations are proposed consisting mostly of depressed grade separations because of existing Pylon restrictions which necessitate grade separation below rather than overhead.
- ***Another alternative is to shift the BRT line from center to left side of the road and being elevated as there is ample space available for elevated BRT development with negligible disturbance of social***

*settings. For this development, Consultation and correspondence with KE is underway related to horizontal clearance for elevated bridge of BRT and No objection in this regard.*

There are several locations where there are trees present in the median of the BRT corridor. As many as 72 species of plants were recorded during roadside trees measurement. The dominant plant species are obviously Conocarpus, Eucalyptus and Lignum species.

Where trees have to be felled, mitigation will be required in the form of reinstatement and compensatory planting. Soft landscaping should be installed in the median under the elevated sections to improve the appearance of the completed works. Other opportunity spaces should be sought by SPMU-MOC to plant trees as near the locations of the felled tree as possible. The contracts drawn up by SPMU-MOC for the BRT should require that wherever possible the trees are transplanted for use elsewhere in the project (e.g. amenity areas at intersections).

Recent international practice suggests that replacement at a minimum rate of 3:1 for trees would be appropriate given possible difficulties with establishing trees and low survival rate of young trees.

The essential components of the project include resizing/augmentation of the existing drains based on the hydrologic and hydraulic calculations, proposal of new drains in areas having no existing drainage facilities, and elimination of cross-connections.

Recommendations for Storm Drainage Improvement Authorities concerned include:

i. Provision of new drains

ii. Elimination of cross sewer connections with Drains

iii. Rehabilitation and de-silting of existing drains.

iv. Solid Waste Management.

The proposed BRT corridors will be constructed on existing traffic routes. Construction activities along these routes are likely to cause hindrance in traffic flow if not mitigated properly. A temporary traffic management plan will be developed and submitted by the contractor at least one month before commencement of construction. The main objectives of the plan shall be to maximize the safety of the workforce and the travelling public. The main secondary objective will be to keep traffic flowing as freely as possible.

On the macro-environment the impact would be reduction in the air emissions due to expected switch over to a more environment friendly mode of transport which would curtail unnecessary delays in traffic that results in excessive vehicular emissions in the events of road jams particularly during peak hours.

The traffic noise will be from new generation passenger cars, and buses, which generate very little noise. Hence the impact during the operation phase is not expected to be felt outside the project boundaries. There would be smooth traffic flow hence no congestion and hence less noise at junctions and intersections.

During the operation phase the road will likely to be improved without any obstruction. As more commuters are diverted to BRT the traffic conditions will improve due to reduction in traffic flow which further suggests improved air quality and general environmental conditions associated with vehicular traffic along road side. Hence the project will bring the positive change.

The same applies while ensuring maximum operational safety it suggests that accidental hazards are minimized. As well as construction of separate BRT lane will greatly reduce the accidents associated with movements across the roads. Health risks due to vehicular/exhaust emissions experienced in congested traffic conditions is likely to be avoided by the commuters travelling on BRT thereby giving them a free or no exposure environment.

The proposed Project, when commissioned, would be integrated into the concerned microenvironment and will become a friendly component of its macroenvironment. The nature of Project, its siting; adoption of adequate measures to minimize waste and control pollution during construction as well as operation stages of the project will have residual impact of low significance on the microenvironment and macroenvironment as well as on precious ecology.

Construction of flyover and underpasses at the proposed corridor and operation of vehicular traffic is not expected to have unacceptable/significant impact on the aesthetics of the microenvironment and macroenvironment. The impact, if identified, will be mitigated through careful planning, suitable landscaping and adopting appropriate mitigation measures, besides providing a monitoring and contingency plan.

Mitigation will be assured by a program of environmental monitoring conducted to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the EPA Sindh.

There are two essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. The Implementing Agency (KMC) shall ensure that:

- All mitigation, compensation and enhancement measures proposed in this EIA report are implemented in full, as described in the document;
- The Environmental Management and Monitoring Plan is implemented in letter and spirit.

Screening of potential impact suggests that proposed "Green Line Bus Rapid Transit System" will, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition.

Furthermore the Project will achieve the prime objectives of sustainable development in facilitating dedicated, safe, secure and speedy travel along the Green Line Corridor, besides upgrading and modernizing the infrastructure facilities of the fast growing section by identifying the bottlenecks and removing the constraints to smooth flow of traffic.

# ANNEX I

EXTRAORDINARY                                        Registered No. M324

# The Sindh Government Gazette

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KARACHI THURSDAY MARCH 20, 2014

## PART-IV

PROVINCIAL ASSEMBLY OF SINDH

NOTIFICATION

KARACHI, THE 20TH MARCH, 2014.

No.PAS/Legis-B-06/2014- The Sindh Environmental Protection Bill, 2014 having been passed by the Provincial Assembly of Sindh on 24th February, 2014 and assented to by the Governor of Sindh on 17th March, 2014 is hereby published as an Act of the Legislature of Sindh.

THE SINDH ENVIRONMENTAL PROTECTION ACT, 2014.

SINDH ACT NO. VIII OF 2014.

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; — Preamble.

PART-I

It is hereby enacted as follows:-

1. (1) This Act may be called the Sindh Environmental Protection Act, 2014. — Short title and commencement.

L.No. 382    , Part-IV-33                (97)                Price Rs. [illegible]

# ANNEX I



(2) It extends to the whole of the Province of Sindh.

(3) It shall come into force at once.

Definitions. 2. 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;

(b) pollution; and

(c) any adverse environmental effect as may be specified in the rules or regulations made under this Act;

(ii) "Agency" means the Sindh Environmental Protection Agency established under section 5 of this Act;

(iii) "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 and agricultural runoff;

(iv) "air pollutant" means any substance that causes pollution of air and includes soot, smoke, dust particulate matter, odor, light, electro-magnetic radiation, heat, fumes, combustion exhaust, exhaust gases, noxious gases, hazardous substances and radioactive substances;

(v) "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; this includes diversity within species, between species and of ecosystems;

(vi) "biosafety" means the mechanism developed through policy and procedures to ensure human health, and the environmentally safe application of biotechnology;

(vii) "Council" means the Sindh Environmental Protection Council established under section 3 of this Act;

(viii) "discharge" means spilling, leaking, pumping, depositing, seeping, releasing, flowing out, pouring, emitting, emptying or dumping into the land, water or atmosphere;

(ix) "ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit;

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(x) "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;

(xi) "emission standards" means the permissible standards established by the Agency for emission of air pollutants and noise and for discharge of effluent and waste;

(xii) "environment" means-

(a) air, water, land and natural resources;
(b) all layers of the atmosphere;
(c) all organic and inorganic matters and living organisms;
(d) ecosystems and ecological relationships;
(e) buildings, structures, roads, facilities and works;
(f) all social and economic conditions affecting community life; and
(g) the inter-relationship between any of the factors in sub-clause (a) to (f) made under this Act;

(xiii) "environmental aspect" means an organization's activities or services that can interact with the environment;

(xiv) "environment audit" means a systemic scrutiny of environmental performance of an organization, factory, company or manufacturing and production unit regarding to its operations;

(xv) "environmental impact assessment" means an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, mitigation 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;

(xvi) "Environmental Management Plan" means a site specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with the environmental legislation;

(xvii) "Environmental Protection Order" means an order passed under Section 21 made under this Act.

(xviii) "Environmental Protection Tribunal" means the Environmental Protection Tribunal constituted under section 25 of this Act ;

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(xxix) "Environmental Review" means a quantitative and qualitative assessment of documents submitted by proponent, comments from public and Government agencies or organizations;

(xx) "factory" means any premises in which industrial activity is being undertaken;

(xxi) "genetically modified organism" means any organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology and which does not occur naturally through mating and or recombination and includes both living and non-living modified organisms;

(xxii) "Government" means the Government of Sindh;

(xxiii) "Government Agency" includes:-

(a) A department, attached department or any other office of Government; and

(b) A development authority, local authority, company body corporate established or control by Government;

(xxiv) "Court" means the Court of the Judicial Magistrate First Class;

(xxv) "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, 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;

(xxvi) "hazardous waste" means waste which is or which contains a hazardous substance or which may be prescribed as hazardous waste, hospital waste, nuclear waste, obsolete pesticides and persistent organic pollutants;

(xxvii) "hospital waste" means 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, laboratories and veterinary facilities;

# ANNEX I



(xxviii) "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 purposes;

(xxix) "industrial waste" means waste resulting from an industrial activity;

(xxx) "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;

(xxxi) "local authority" means any agency set up or designated by Government, by notification in the official Gazette, to be a local authority for the purposes of this Act;

(xxxii) "local council" means a local council constituted or established under a law relating to local government;

(xxxiii) "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;

(xxxiv) "municipal waste" includes sewage, refuse, garbage, waste from abattoirs, sludge and human excreta and the like;

(xxxv) "noise" means the intensity, duration and character of sounds from all sources, and includes vibration;

(xxvi) "non degradable plastic products" means a plastic product which are made from the non-biodegradable substances

(xxxvii) "nuclear waste" means waste from any nuclear reactor or nuclear plant or other nuclear energy system, whether or not such waste is radioactive;

# ANNEX I



(xxxviii) "Oxo-biodegradable Plastic Products" means a plastic product made of a polymer by adding a pro-degrading additive containing a transition metal salt, except cobalt, which cause the plastic to degrade and bio-grade from oxidative and cell mediated phenomena either simultaneously or successfully;

(xxxix) "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;

(xl) "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 unfavorably 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;

(xli) "prescribed" means prescribed by rules made under this Act;

(xlii) "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;

# ANNEX I



(xlii) "proponent" means the person who proposes or intends to undertake a project;

(xliii) "regulations" means regulations made under this Act;

(xliv) "rules" means rules made under this Act;

(xlv) "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;

(xlvi) "Schedule Plastic Products" means all types of flexible plastic packaging and disposable plastic products made of Polythene, Polypropylene, Polystyrene and Poly-ethylene Terephthalate (PET), used for food and non-food items, like shopping bags, garbage bags, snacks packs, water and milk packaging, shrink wraps, bubble pellet wraps, films, liners, woven or non-woven bags, mulch films;

(xlvii) "Sindh Environmental Quality Standards" means standards established by the 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 made under this Act;

(xlviii) "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 Sindh Environmental Quality Standards, emission standards and other standards established under this Act and the rules and regulations;

(l) "strategic environmental assessment" means an analysis of a proposed policy, legislation, plan or programme to determine whether the principles of sustainable development have been integrated therein and to identify its likely environmental effects and such components as require an initial environmental examination or environmental impact assessment;

(li) "sustainable development" means development that meets the needs of the present generation without compromising the ability of future generations to meet their needs;

# ANNEX I



(lii) "trans-boundary environmental impacts" means environmental impact arising from beyond the boundaries or limits of Sindh province and causing any adverse environmental impact or pollution in the air, land, water and coastal waters of Sindh province;

(liii) "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.

(liv) "waters (coastal waters, inland waters, territorial waters and historical waters)" means such limits of the waters adjacent to the land territory as may be specified in the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976).

## PART-B
## THE SINDH ENVIRONMENTAL PROTECTION COUNCIL

**Establishment of the Sindh Environmental Protection Council.**

3. (1) The Government of Sindh shall, by notification in the official Gazette, establish a Council to be known as the Sindh Environmental Protection Council consisting of:

| | | |
|---|---|---|
| (i) | Chief Minister or such other person as the Chief Minister may nominate in this behalf. | Chairperson |
| (ii) | Minister-in-charge of the Environment Protection Department. | Vice Chairperson |
| (iii) | Additional Chief Secretary, Planning and Development Department, Government of Sindh. | Ex-officio Member |
| (iv) | Secretaries to the Environment, Finance, Public Health Engineering, Irrigation, Health, Agriculture, Local Government, Industries, Live Stock and Fisheries, Forest and Wildlife, Energy, Education, Departments of Government of Sindh and the Divisional Commissioners of Sindh. | Ex-officio Members |

# ANNEX I



| | | |
|---|---|---|
| (v) | Such other persons not exceeding twenty- five as Government may appoint from representatives of the Chambers of Commerce and Industry and industrial associations, representatives of the Chambers of Agriculture, the medical and legal professions, trade unions, non-governmental organizations concerned with the environment and sustainable development, and scientists, technical experts and educationists. | **Non-official Members** |
| (vi) | Director General, Sindh Environment Protection Agency | **Member / Secretary** |
| **(vii)** | **Two Members of the Provincial Assembly of Sindh amongst the eleven Members of the Standing Committee on Environment nominated by the Speaker** | **Members** |

2) The Members of the Council, other than ex-officio members, shall be appointed in accordance with the prescribed procedure.

(3) A non-official member, unless he sooner resigns or is removed, shall hold office for a term of three years and shall be eligible for re appointment but shall not hold office for more than two terms.

(4)The Council shall frame its own Rules of Procedure.

(5) The Council shall hold meetings, as and when necessary, but not less than two meetings, shall be held in a year.

(6) 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.

(7) 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.

# ANNEX I



**Functions and Powers of the Council.**

4. (1) The Council shall-

(a) co-ordinate and supervise the enforcement of the provisions of this Act and other laws relating to the environment in the Province;

(b) approve comprehensive provincial environmental and sustainable development policies and ensure their implementation within the framework of a conservation strategy and sustainable development plan as may be approved by Government from time to time;

(c) approve the Sindh 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.

(e) coordinate integration of the principles and concerns of sustainable development into socio-economic and development policies, plans and programmes at the provincial, district and local levels;

(f) consider the annual Sindh Environment report and give appropriate directions thereon and cause it to be laid before the Provincial Assembly;

(g) deal with inter-provincial and federal-provincial issues, and liaise and coordinate with other Provinces through appropriate inter-provincial forums regarding formulation and implementation of standards and policies relating to environmental matters with an inter provincial impact;

(h) provide guidelines for biosafety and for the use of genetically modified organisms; and

(i) assist the Federal Government or Federal Agency in implementation and or administration of various provision of United Nation Convention on Laws on Seas, 1980 (UNCLOS) in coastal waters of the province

(2) The Council may, either itself or on the request of any person or organization, direct the 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 specified aspect of environment.

# ANNEX I



## PART-III
## THE SINDH ENVIRONMENTAL PROTECTION AGENCY

**Establishment of the Sindh Environmental Protection Agency.**

5. (1) Government shall, by notification in the Official Gazette, establish the Sindh Environmental Protection Agency, to exercise the powers and perform the functions assigned to it under the provisions of this Act and the rules and regulations made thereunder.

(2) The Agency shall be headed by a Director General who shall be appointed by Government on such terms and conditions as it may determine.

(3) The Agency shall have such administrative, technical and legal staff as Government may specify, to be appointed in accordance with such procedure as may be prescribed.

(4) The powers and functions of the Agency shall be exercised and performed by the Director General.

(5) The Director General may, by general or special order, delegate any of these powers and functions to staff appointed under sub-section (3).

(6) For assisting the Agency in the discharge of its functions 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.

**Functions of the Agency.**

6. (1) The Agency shall –

(a) administer and implement the provisions of this Act and the rules and regulations;

(b) prepare, in co-ordination with the appropriate Government Agency or local council and, in consultation with the concerned Advisory Committees where established, environmental policies for the approval of the Council;

(c) take all necessary measures for the implementation of the environmental policies approved by the Council;

(d) prepare and publish an annual Sindh Environment Report on the state of the environment in the province;

(e) prepare or revise and establish the Sindh Environmental Quality Standards with approval of the Council.

# ANNEX I



Provided that before seeking approval of the Council, the Agency shall publish the proposed Sindh Environmental Quality Standards for public opinion in accordance with the prescribed procedure;

(f) ensure enforcement of the Sindh Environmental Quality Standards;

(g) where the quality of ambient air, water, land or noise so requires, the Agency may, by notification in the Official Gazette establish different standards for discharge or emission from different sources and for different areas and conditions as may be necessary:

Provided that where these standards are less stringent than the Sindh Environmental Quality Standards; prior approval of the Council shall be obtained;

(h) 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;

(i) 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;

(j) issue licences, approval for the consignment, handling, transport, treatment, disposal of, storage, handling or otherwise dealing with hazardous substances;

(k) certify 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;

(m) provide assistance to relevant Federal and Provincial Government Agencies in the management of environment accidents and natural and environmental disasters, including conduct of inquiry thereto;

(n) 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 specified in Part XI (Access to Information);

# ANNEX I



(o) assist Government Agencies, local councils, local authorities and other persons to implement schemes for the proper disposal of wastes so as to ensure compliance with the Sindh Environmental Quality Standards;

(p) provide information and guidance to the public on environmental matters;

(q) recommend environmental courses, topics, literature and books for incorporation in the curricula and syllabi of educational institutions;

(r) promote public education and awareness of environmental issues through mass media and other means including seminars and workshops;

(s) establish and maintain mechanisms, including its own website, to disseminate information, subject to the provisions of this Act, regarding policies, plans and decisions of the Government, the Council and the Agency, relating to the environment;

(t) specify safeguards for the prevention of accidents and disasters which may cause pollution, collaborate with the concerned persons in the preparation of contingency plans for control of such accidents and disasters, and co-ordinate implementation of such plans;

(u) review and approve mitigation plans and give guidance and directions, where necessary, relating to clean up operations ordered under this Act;

(v) encourage the formation and working of non-governmental organizations, community organizations and village organizations to prevent and control pollution and promote sustainable development;

(w) 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

(x) perform any function that the Council may assign to it

(2) The 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;

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(c) initiate, with the approval of 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;

(d) recommend to Government and the Council the adoption of financial and fiscal programmes, schemes or measures for achieving environmental objectives and goals and the purposes of this Act, including -

(i) taxes, duties, cesses and other levies; and

(ii) incentives, prizes, awards, rewards, subsidies, tax exemptions, rebates and depreciation allowances;

(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 the establishment of similar laboratories in the private sector;

(f) arrange, in accordance with such procedure as may be prescribed, financial assistance for projects designed to facilitate in discharge of its functions; and

(g) acquire assistance of concerned authorities of district administration and other relevant agencies, departments and police assistance for enforcement of this Act.

**Powers of the Agency.**

7. Subject to the provisions of this Act, the 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 its 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 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;

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(g) Director General may authorize any officer or official to enter and inspect or under a search warrant issued by Environmental Protection Tribunal or a Court, search at any 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, or likely to be committed;

(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 the testing and analysis of 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 powers under clauses (f), (g), (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 and regulations and under the direction of the Environmental Protection Tribunal or a Court; and

(k) establish the Sindh Environmental Co-ordination Committee comprising the Director General as its Chairman and such other persons as Government shall appoint as its members to exercise such powers and perform such functions as shall be delegated or assigned to it by Government for carrying out the purposes of this Act and for ensuring coordination among Government Agencies in implementation of environmental policies.

## PART-IV
## SINDH SUSTAINABLE DEVELOPMENT FUND

**Establishment of the Sindh Sustainable Development Fund.**

8. (1) There shall be established a Sindh Sustainable Development Fund.

(2) The Sindh Sustainable Development Fund shall be derived from the following sources, namely—

(a) allocations and grants made or loans advanced by the Government of Sindh or by the Federal Government;

(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

# ANNEX I



(c) voluntary contributions from private, corporate, multinational organizations and other persons.

(d) Any fees generated under the provision of this act including the fines imposed against contraventions including penalties.

(3)The Sindh Sustainable Development Fund shall be utilized in accordance with such procedures as may be prescribed for

(a) providing financial assistance to 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 specified aspect of the environment; and

(b) any other purposes which, in the opinion of the Board, will help achieve environment objectives and the purposes of this Act.

**Management of the Sindh Sustainable Development Fund.**

9. (1)The Sindh Sustainable Development Fund shall be managed by a Board known as the Provincial Sustainable Development Fund Board consisting of—

| | | |
|---|---|---|
| (i) | Additional Chief Secretary, Planning and Development Department, Government of Sindh; | **Chairperson** |
| (ii) | Such officers of Government, not exceeding five (05), as Government may appoint including Secretaries of the Environment, Finance, Industries and Local Government Departments, Government of Sindh. | **Ex-officio Members** |
| (iii) | Such non-official persons, not exceeding five(05), as Government may appoint, including representatives of the Chambers of Commerce and Industry, non-governmental organizations and major donors. | **Non-official Members** |
| (iv) | Director General, Sindh Environmental Protection Agency. | **Secretary/ Member** |

(2) The members of the Board, other than ex-officio members, shall be appointed in accordance with the prescribed procedure.

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(3) A non-official member of the Board, unless he sooner resigns or is removed, shall hold office for a term of three years and shall be eligible for re-nomination, but shall not hold office for more than two terms.

(4) The Board shall frame its own rules of procedure with the approval of Government.

(5) In accordance with such procedures 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 Sindh Sustainable Development Fund in such profit-bearing Government bonds, saving 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 Sindh Sustainable Development Fund for the purposes specified in sub-section (3) of section 8.

(6) The Board shall constitute committees of its members to undertake regular monitoring of projects financed from the Sindh 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.

**Accounts.**

10. (1) The Agency shall maintain proper accounts of the Sindh Sustainable Development Fund and other relevant records and prepare annual statement of accounts in such form as may be prescribed.

(2) The accounts of the Sindh Sustainable Development Fund shall be audited annually by the Auditor General of Pakistan.

## PART-V
## PROHIBITIONS AND ENFORCEMENT

**Prohibition of certain discharges or emissions and compliance with standards.**

11. (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, waste, pollutant, noise or any other matter that may cause or likely to cause pollution or adverse environmental effects, as defined in section 2 of this Act, in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards; or, where applicable, the standards established under Section 6(1)(g)(i); or direction issued under Section 17, 19, 20 and 21 of this Act; or any other direction issued, in general or particular, by the Agency.

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(2) All persons, in industrial or commercial or other operations, shall ensure compliance with the Environmental Quality Standards for ambient air, drinking water, noise or any other Standards established under section 6(1)(g)(i); shall maintain monitoring records for such compliances; shall make available these records to the authorized person for inspection, and shall report or communicate the record to the Agency as required under any directions issued, notified or required under any rules and regulations.

(3) Monitoring and analysis under sub-section (1) and (2), shall be acceptable only when carried out by the Environmental Laboratory certified by the Agency as prescribed in the rules.

**Prohibition of import of hazardous waste**

12. No person shall import hazardous waste into Sindh province or its coastal, internal, territorial or historical waters, except acquiring prior approval of the Agency.

**Handling of hazardous substances.**

13. Subject to the provisions of this Act, no person shall import, generate, collect, consign, transport, treat, dispose of, store, handle or otherwise use or deal with any hazardous substance except-

(a) under a licence issued by the Agency; or

(b) in accordance with the provisions of any other law, rule, regulation or notification for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Government is a party.

**Prohibition of action adversely affecting Environment.**

14. (1) Subject to the provisions of this Act and the rules and regulations, no person shall cause any act, deed or any activity, including

(a) recycling or reuse of hospital waste and infectious waste;

(b) disposal of solid and hazardous wastes at unauthorized places as prescribed;

(c) dumping of wastes or hazardous substances into coastal waters and inland water bodies;

(d) release of emissions or discharges from industrial or commercial operations as prescribed;

(e) recycling or reuse or recovery of hazardous wastes or industrial by-products in an unauthorized or non-prescribed manner or procedure; and

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(l) any activity which may cause adverse environmental affect due to trans boundary projects of Province of Sindh

which lead to pollution or impairment of or damage to biodiversity, ecosystem, aesthetics or any damage to environment and natural resources as defined in section 2 (xxxvi) of this Act.

(2) No person shall generate, handle, transport, dispose of or handle the hospital waste and infections waste except in accordance with the Hospital Waste Management Rules and in such manner as may be prescribed.

(3) No person shall import, manufacture, stockpile, trade, supply, distribute or sell any scheduled plastic product which is non-degradable. The scheduled plastic products must be oxo-biodegradable and the pro-degradant used must be approved by the Agency or any other department or agency and in such manner as prescribed.

**Regulation of motor vehicles.**

15. (1) Subject to the provisions of this Act, no person shall operate or manufacture a motor vehicle or class of vehicles from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the Sindh Environmental Quality Standards or, where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6.

(2) For ensuring compliance with the standards mentioned in sub-section (1), the 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 prescribed.

(3) For ensuring compliance with the standards mentioned in sub-section (1), the Agency may direct that any manufacturer of motor vehicle or class of vehicles shall use such manufacturing standard or design or pollution control devices or other equipment or undergo such testing as may be prescribed.

(4) Where a direction has been issued by the Agency under sub section (2) and (3) in respect of any motor vehicles or class of motor vehicles, no person shall operate or manufacture any such vehicle till such direction has been complied with.

**Certified Environmental Laboratory.**

16 (1) The monitoring, testing and analysis carried out in compliance or for the enforcement of any provisions of this Act.

(2) The laboratory or organization having any facility for environmental monitoring, testing and analysis and intend to perform under sub-section (1) shall register with the Agency in accordance with the Environmental Laboratory Certification Rules as prescribed.

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PART-VI

## ENVIRONMENTAL EXAMINATIONS AND ASSESSMENTS

**Initial environmental examination and environmental impact assessment.**

17. (1) No proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment, and has obtained from the Agency approval in respect thereof.

(2) The Agency shall –

(a) review the initial environmental examination and accord its approval, subject to such terms and conditions as it may prescribe, 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 terms and conditions as it may deem fit to impose or require that the environmental impact assessment be re-submitted after such modifications as may be stipulated or decline approval of the environmental impact assessment as being contrary to environmental objectives.

(3) Every review of an environment impact assessment shall be carried out with public participation and, subject to the provisions of this Act, after full disclosure of the particulars of the project.

(4) The Agency shall communicate its approval or otherwise within a period of two months from the date that the initial environmental examination is filed, and within a period of four months from the date that the environmental impact assessment is filed complete in all respects in accordance with the regulations, 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) The provisions of sub-sections (1), (2), (3) and (4) shall apply to such categories of projects and in such manner as prescribed.

(6) The 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 for inspection to the public during office hours.

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**Strategic environmental assessment.**

**18.** (1) All provincial government agencies, departments authorities, local councils and local authorities responsible for formulating policies, legislation, plans and programmes to be implemented in Sindh province which may cause any environmental impact in the jurisdiction of the province shall, before submitting the same to the competent authority for approval, forward to the Sindh Environmental Protection Agency a strategic environment assessment containing –

(a) description of the objectives and features of the proposed policy, legislation, plan or programme that are in consonance with the principles of sustainable development;

(b) assessment of the adverse environmental effects, if any, likely to be caused during implementation of the policy, legislation, plan or programme alongwith proposed preventive, mitigation and compensatory measures;

(c) analysis of possible alternatives; and

(d) identification of those components of the policy, legislation, plan or programme, if any, in respect of which specific environmental impact assessment need to be carried out in due course.

(2) The Agency shall, in consultation with the concerned Government Agencies and Advisory Committees where established, review the strategic environment assessment, within sixty (60) days of its filing, and prepare a report containing its comments and recommendations in respect thereof which shall be forwarded to the initiating Government Agency, authority, local council or local authority and duly considered by it and the competent authority before approval or otherwise of the proposed policy, legislation, plan or programme.

(3) The provisions of sub-sections (1) and (2) shall apply to such categories of policies, plans and programmes and in such manner as may be prescribed.

**Environmental monitoring.**

**19.** (1) The Agency shall carry out or arrange environmental monitoring of all projects in respect of which it has approved an initial environmental examination or environmental impact assessment to determine whether the actual environmental impact exceeds the level predicted in the assessment and whether the conditions of the approval are being complied with.

(2) For purposes of sub-section (1), the Agency may require the person in charge of a project to furnish such information as it may specify pertaining to the environmental impact of the project, including quantitative and qualitative analysis of –

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(a) discharge of effluents, wastes, emissions of air pollutants, noise and any other matter or action that may be found offensive under section 14 from the project on daily, weekly, monthly or annual basis;

(b) ambient quality of the air, water, noise and soil before, during and after construction and during operation of the project.

(3) On review of the data collected by it and information provided, the Agency may issue such directions to the person in charge as it may consider necessary to ensure compliance with the conditions of the approval.

**Environmental Audit and Review.**

20. (1) The Agency shall from time to time require the person in charge of a project to furnish, within such period as may be specified, an environmental audit or environmental review report or environmental management plan containing a comprehensive appraisal of the environmental aspects of the project.

(2) The report of a project prepared under sub-section (1) shall include:

(a) analysis of the predicted qualitative and quantitative impact of the project as compared to the actual impact;

(b) evaluation of the efficacy of the preventive, mitigation and compensatory measures taken with respect to the project; and

(c) recommendations for further minimizing or mitigating the adverse environmental impact of the project.

(3) Based on its review of the environmental audit report, the Agency may, after giving the person in charge of the project an opportunity of being heard, direct that specified mitigation and compensatory measures be adopted within a specified time period and may also, where necessary, modify the approval granted by it under section 17.

## PART-VII
## ENVIRONMENTAL PROTECTION ORDER

**Environmental Protection Order.**

21. (1) Where the 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 any provision of this Act, the rules or regulations or of the conditions of a licence, or is likely to cause, or is causing or has caused an adverse environmental effect, the Agency may, after giving the person responsible for such

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discharge, emission, disposal, handling, act or omission an opportunity of being heard, by order direct such person to take such measures as the 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 —

(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;

(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 Agency; and

(e) impose a penalty as prescribed.

(3) Notwithstanding the provisions of sub-section (1), in an emergency situation where, for reasons to be recorded, the 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 and that circumstances of the case warrant immediate action in the public interest, it may pass an ad-interim order of the nature described in sub-sections (1) and (2) by providing reasonable opportunity of hearing.

## PART-VIII
## OFFENCES AND PENALTIES

Penalties.

22. (1) Whoever contravenes or fails to comply with the provisions of sections 11, 17, 18 and 21 or any order issued there under shall be punishable with a fine which may extend to five million rupees, to the damage caused to environment 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 the contravention of the provisions of section 11 also constitutes a contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2).

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(2) Whoever contravenes or fails to comply with the provisions of sections 13, 14, 15 and 16 or any rule or regulation or conditions of any license, any order or direction, issued by the Agency, shall be punished with a fine, and in case of continuing contravention or failure with an additional fine which may extend to ten 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 Protection Tribunal and Court shall, as the case may be, 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-sections (1) or (2), the Environmental Protection Tribunal or Court, as the case may be, shall 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.

(5) Where a person convicted under sub-sections (1) and (2) had been previously convicted for any contravention of this Act and its rules or regulations, the Environmental Protection Tribunal, as the case may be, may, in addition to the punishment awarded thereunder -

(a) sentence him to imprisonment for a term that may extend up to three years;

(b) order the closure of the factory;

(c) order confiscation of the facility, machinery and equipment, vehicle or substance, record, document or other object used or involved in contravention of the provisions of this Act;

(d) order such person to restore the environment at his own cost, to conditions existing prior to the contravention or as close to such conditions as may be reasonable in the circumstances to the satisfaction of the Agency; and

(e) order that compensation be paid to any person or persons for any loss, or damage to their health or property suffered by such contravention.

(6) The Director General 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 Protection Tribunal or Court in accordance with such procedure as prescribed.

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(7) Where the Director General is of the opinion that a person had contravened any provision of this Act, he may, subject to the rules, by notice in writing to that person require him to pay to the Agency a penalty in the amount set out in the notice for each day the contravention continues.

**Offences by body corporate.**

23. 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).

**Offences by Government Agencies, local authorities or local councils.**

24. 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 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.

## PART-IX
## ENVIRONMENTAL PROTECTION TRIBUNALS AND COURTS

**Environmental Protection Tribunals.**

25. (1) Government may, by Notification in the Official Gazette, establish as many Environmental Protection Tribunals as it considers necessary and, where it establishes more than one Environmental Protection Tribunal, 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 Protection 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 Government, of which at least one shall be a technical member nominated from amongst the officers of the Agency with suitable professional qualifications and experience in the environmental field.

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(3) For every sitting of the Environmental Protection Tribunal, the presence of the Chairperson and not less than one Member shall be necessary.

(4) A decision of an Environmental Protection 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 there is a difference of opinion between them, the decision of the Environmental Protection Tribunal shall be expressed in terms of the opinion of the Chairperson.

(5) An Environmental Protection Tribunal shall not, merely by 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 Protection 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 Protection Tribunal shall be invalid by reason only of the existence of a vacancy in, or defect in the constitution, of, the Environmental Protection Tribunal.

(8) The terms and conditions of service of the Chairperson and members of the Environmental Protection Tribunal shall be such as may be prescribed.

**Jurisdiction and powers of Environmental Protection Tribunals.**

26. (1) An Environmental Protection 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.

(2) All contraventions punishable under sub-section (1) of section 22 shall exclusively be triable by an Environmental Protection Tribunal.

(3) An Environmental Protection Tribunal shall not take cognizance of any offence triable under sub-section (2) except on a complaint in writing by—

(a) the 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 Agency, of the alleged contravention and of his intention to make a complaint to the Environment Protection Tribunal.

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(4) In exercise of its criminal jurisdiction, the Environmental Protection Tribunal shall have the same powers as are vested under the Code of Criminal Procedure, 1898 (Act V of 1898).

(5) In exercise of the appellate jurisdiction under section 27 the Environmental Protection Tribunal 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 Protection Tribunal shall follow the procedure laid down in the Code of Civil Procedure, 1908 (Act V of 1908).

(7) An Environmental Protection Tribunal may, on application filed by any officer duly authorised in this behalf by the Director General, issue bailable warrant for the arrest of any person against whom reasonable suspicion exists, of his having been involved in contravention punishable under sub-section (1) of section 22:

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 jurisdiction police station.

(8) All proceedings before the Environmental Protection Tribunal shall be deemed to be judicial proceedings within the meaning of sections 193 and 228 of the Pakistan Penal Code (Act XLV of 1860), and the Environmental Protection Tribunal shall be deemed to be a court for the purpose of sections 480 and 482 of the Code of Criminal Procedure, 1898 (Act V of 1898).

(9) No court other than an Environmental Protection Tribunal shall have or exercise any jurisdiction with respect to any matter to which the jurisdiction of an Environmental Protection Tribunal extends under this Act and the rules and regulations.

(10) Where the Environmental Protection 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.

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**Appeals to the Environmental Protection Tribunal.**

27. (1) Any person aggrieved by any order or direction of the Agency under any provision of this Act or the rules or regulations may prefer an appeal with the Environmental Protection Tribunal within thirty days of the date of communication of the impugned order or direction to such person.

(2) An appeal to the Environmental Protection Tribunal shall be in such form, contain such particulars and be accompanied by such fees as prescribed.

**Appeals from orders of the Environmental Protection Tribunal.**

28. (1) Any person aggrieved by any final order or by any sentence of the Environmental Protection 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 lie before the High Court of Sindh.

**Jurisdiction of Judicial Magistrate.**

29. (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 contraventions punishable under sub-section (2) of section 22 shall exclusively be triable by the Court of Judicial Magistrate of First Class having of First Class having jurisdiction.

(2) A Judicial Magistrate shall be competent to impose any punishment specified in sub-sections (2) and (4) of section 22.

(3) A Judicial Magistrate shall not take cognizance of an offence triable under sub-section (1) except on a complaint in writing by—

(a) the Agency; and

(b) any aggrieved person.

**Appeals from orders of the Judicial Magistrate.**

30. Any person aggrieved by any final order or sentence passed by a Judicial Magistrate under section 28 may, within thirty days from the date of the communication of such order or sentence, appeal to the Court of the District and Sessions Judge defined as Green Court under this Act, whose decision thereon shall be final.

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## PART-X
## PUBLIC PARTICIPATION

31.(1)The Agency shall cause relevant details of any proposed project regarding which an Environmental Impact Assessment has been received to be published, alongwith an invitation to the public to furnish their comments thereon within a specified period. **Public participation.**

(2) In accordance with such procedure as may be prescribed, the Agency shall hold public hearings to receive additional comments and hear oral submissions.

(3) All comments received under sub-sections (1) and (2) shall be duly considered by the Agency while reviewing the environmental impact assessment or strategic impact assessment, and decision or action taken thereon shall be communicated to the persons who have furnished the said comments.

## PART-XI
## GENERAL

32. The Agency may, by notification in the official Gazette, make and amend the schedule. **Power to make and amend schedule.**

33. No suit, prosecution or other legal proceedings shall lie against Government, the Council, the Agency, the Director General of the Agency, members, officers, employees, experts, advisors, committees or consultants of the Agency or Environmental Protection Tribunal or Court or any other person for anything which is done or intended to be done in good faith under this Act or rules or regulations. **Indemnity**

34. Any dues recoverable by the Agency under this Act and rules or regulations shall be recoverable as arrears of land revenue. **Dues recoverable as arrears of land revenue.**

35. The provisions of this Act shall have effect notwithstanding anything inconsistent therewith contained in any other law for the time being in force. **Act to override other laws.**

36. The Sindh Environment Protection Agency may, by notification in the Official Gazette, make rules for carrying out the purposes not in consistence of this Act with the approval of Government. **Power to make rules.**

37. (1) For carrying out the purposes of this Act, the Agency may, by Notification in the Official Gazette and with the approval of Government, make regulations not inconsistent with the provisions of this Act or the rules. **Power to make regulations**

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(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, advisors, experts, consultants and employees as per prescribed rules;

(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 sections 17, 18 and 20 applies;

(g) laying down of guidelines for preparation of initial environmental examination, environmental impact assessment and strategic environmental assessment, and development of procedures of their filing, reviews and approval.

(h) laying down standard operating procedures for environmental sampling, examination of water, waste water, gaseous emissions, solid waste and noise;

(i) providing procedures for handling hazardous substances; and

(j) installation of devices in, use of fuels by, and maintenance and testing of motor vehicles for control of air and noise pollution.

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**BY ORDER OF THE SPEAKER**
**PROVINCIAL ASSEMBLY OF SINDH**

**G.M.UMAR FAROOQ**
**SECRETARY**
**PROVINCIAL ASSEMBLY OF SINDH**

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# ANNEX II



## 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.

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**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.

# ANNEX II



(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.

# ANNEX II



(6) The Federal Agency may issue guidelines indicating the basic techniques and measures to be adopted to ensure effective public consultation, involvement and participation in EIA assessment.

**11. Review**

(1) The Federal Agency shall make every effort to carry out its review of the IEE within 45 days, and of the EIA within 90 days, of issue of confirmation of completeness under Regulation 9.

(2) In reviewing the IEE or EIA, the Federal Agency shall consult such Committee of Experts as may be constituted for the purpose by the Director-General, and may also solicit views of the sectoral Advisory Committee, if any, constituted by the Federal Government under sub-section (6) of section 5.

(3) The Director-General may, where he considers it necessary, constitute a committee to inspect the site of the project and submit its report on such matters as may be specified.

(4) The review of the IEE or EIA by the Federal Agency shall be based on quantitative and qualitative assessment of the documents and data furnished by the proponent, comments from the public and Government Agencies received under Regulation 10, and views of the committees mentioned in sub-regulations (2) and (3) above.

**12. Decision**

On completion of the review, the decision of the Federal Agency shall be communicated to the proponent in the form prescribed in Schedule V in the case of an IEE, and in the form prescribed in Schedule VI in the case of an EIA.

**13. Conditions of approval**

(1) Every approval of an IEE or EIA shall, in addition to such conditions as may be imposed by the Federal Agency, be subject to the condition that the project shall be designed and constructed, and mitigatory and other measures adopted, strictly in accordance with the IEE/EIA, unless any variation thereto have been specified in the approval by the Federal Agency.

(2) Where the Federal Agency accords its approval subject to certain conditions, the proponent shall

(a) before commencing construction of the project, acknowledge acceptance of the stipulated conditions by executing an undertaking in the form prescribed in Schedule VII;

# ANNEX II



(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.

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(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

# ANNEX II



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

# ANNEX II



| | | | |
|---|---|---|---|
| (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.

# ANNEX II



**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

# ANNEX II



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

# ANNEX II



## 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

# ANNEX II



**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.

# ANNEX II



**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 |

# ANNEX II



**SCHEDULE IV**

[*See* Regulation 8(2)(a)]

**Application Form**

| | | | | |
|---|---|---|---|---|
| 1. | Name and address of proponent | | Phone:<br>Fax:<br>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) | <u>Available</u> | <u>Measured</u> |
| | | 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? | | <u>Estimated</u> | <u>Reported</u> |
| | | 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:<br>Operation: | | |

<u>Verification.</u> 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)

# ANNEX II



**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)

# ANNEX II



**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)

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# ANNEX II



**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) ______________

# ANNEX II



**SCHEDULE VIII**
(*See* Regulation 21)
**Form of Registers for IEE and EIA projects**

| 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 | |

# ANNEX III

REGISTERED No. M - 302
L.-7646

The Gazette of Pakistan

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, FRIDAY, NOVEMBER 26, 2010

PART II

**Statutory Notifications (S. R. O.)**

GOVERNMENT OF PAKISTAN

**MINISTRY OF ENVIRONMENT**

NOTIFICATIONS

*Islamabad, the 18th October, 2010*

**S. R. O. 1062(I)/2010.**—In exercise of the powers conferred under clause (c) of sub-section (I) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Ambient Air.

**National Environmental Quality Standards for Ambient Air**

| Pollutants | Time-weighted average | Concentration in Ambient Air: Effective from 1st July, 2010 | Concentration in Ambient Air: Effective from 1st January 2013 | Method of measurement |
|---|---|---|---|---|
| Sulphur Dioxide ($SO_2$) | Annual Average*<br>24 hours** | 80 $\mu g/m^3$<br>120 $\mu g/m^3$ | 80 $\mu g/m^3$<br>120 $\mu g/m^3$ | -Ultraviolet Fluorescence method |
| Oxides of Nitrogen as (NO) | Annual Average*<br>24 hours** | 40 $\mu g/m^3$<br>40 $\mu g/m^3$ | 40 $\mu g/m^3$<br>40 $\mu g/m^3$ | - Gas Phase Chemiluminescence |

(3205)

[2944(2010)/Ex. Gaz.] *Price: Rs. 5.00*

# ANNEX III

3206 THE GAZETTE OF PAKISTAN, EXTRA., NOVEMBER 26, 2010 [PART II

| Pollutants | Time-weighted average | Concentration in Ambient Air | | Method of measurement |
|---|---|---|---|---|
| | | Effective from 1st July, 2010 | Effective from 1st January 2013 | |
| Oxides of Nitrogen as ($NO_x$) | Annual Average* | 40 $\mu g/m^3$ | 40 $\mu g/m^3$ | - Gas Phase Chemiluminescence |
| | 24 hours** | 80 $\mu g/m^3$ | 80 $\mu g/m^3$ | |
| $O^3$ | 1 hour | 180 $\mu g/m^3$ | 130 $\mu g/m^3$ | -Non dispersive UV absorption method |
| Suspended Particulate Matter (SPM) | Annual Average* | 400 $\mu g/m^3$ | 360 $\mu g/m^3$ | - High Volume Sampling. (Average flow rate not less than 1,1 m3/minute). |
| | 24 hours** | 550 $\mu g/m^3$ | 500 $\mu g/m^3$ | |
| Respirable Particulate Matter. $PM_{10}$ | Annual Average* | 200 $\mu g/m^3$ | 120 $\mu g/m^3$ | -$\beta$ Ray absorption method |
| | 24 hours** | 250 $\mu g/m^3$ | 150 $\mu g/m^3$ | |
| Respirable Particulate Matter. $PM_{2.5}$ | Annual Average* | 25 $\mu g/m^3$ | 15 $\mu g/m^3$ | -$\beta$ Ray absorption method |
| | 24 hours** | 40 $\mu g/m^3$ | 35 $\mu g/m^3$ | |
| | 1 hour | 25 $\mu g/m^3$ | 15 $\mu g/m^3$ | |
| Lead Pb | Annual Average* | 1.5 $\mu g/m^3$ | 1 $\mu g/m^3$ | - ASS Method after sampling using EPM 2000 or equivalent Filter paper |
| | 24 hours** | 2 $\mu g/m^3$ | 1.5 $\mu g/m^3$ | |
| Carbon Monoxide (CO) | 8 hours** | 5 $mg/m^3$ | 5 $mg/m^3$ | - Non Dispersive Infra Red (NDIR) method |
| | 1 hour | 10 $mg/m^3$ | 10 $mg/m^3$ | |

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

**S. R. O. 1063(I)/2010.—** In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Standards for Drinking Water Quality.

# ANNEX III

PART II] THE GAZETTE OF PAKISTAN, EXTRA., NOVEMBER 26, 2010 3207

## National Standards for Drinking Water Quality

| Properties/Parameters | Standard Values for Pakistan | Who Standards | Remarks |
|---|---|---|---|
| **Bacterial** | | | |
| All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria) | Must not be detectable in any 100 ml sample | Must not be detectable in any 100 ml sample | Most Asian countries also follow WHO standards |
| Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria) | Must not be detectable in any 100 ml sample | Must not be detectable in any 100 ml sample | Most Asian countries also follow WHO standards |
| Treated water in the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria) | Must not be detectable in any 100 ml sample<br>In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period. | Must not be detectable in any 100 ml sample<br>In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12 month period. | Most Asian countries also follow WHO standards |
| **Physical** | | | |
| Colour | ≤ 15 TCU | ≤ 15 TCU | |
| Taste | Non objectionable/Acceptable | Non objectionable/Acceptable | |
| Odour | Non objectionable/Acceptable | Non objectionable/Acceptable | |
| Turbidity | < 5 NTU | < 5 NTU | |
| Total hardness as $CaCO_3$ | < 500 mg/l | ---- | |
| TDS | < 1000 | < 1000 | |
| pH | 6.5 – 8.5 | 6.5 – 8.5 | |
| **Chemical** | | | |
| ***Essential Inorganic*** | ***mg/Litre*** | ***mg/Litre*** | |
| Aluminium (Al) mg/l | ≤ 0.2 | 0.2 | |

# ANNEX III



| Properties/Parameters | Standard Values for Pakistan | Who Standards | Remarks |
|---|---|---|---|
| Antimony (Sb) | ≤ 0.005 (P) | 0.02 | |
| Arsenic (As) | ≤ 0.05 (P) | 0.01 | Standard for Pakistan similar to most Asian developing countries |
| Barium (Ba) | 0.7 | 0.7 | |
| Boron (B) | 0.3 | 0.3 | |
| Cadmium (Cd) | 0.01 | 0.003 | Standard for Pakistan similar to most Asian developing countries |
| Chloride (Cl) | < 250 | 250 | |
| Chromium (Cr) | ≤ 0.05 | 0.05 | |
| Copper (Cu) | 2 | 2 | |
| ***Toxic Inorganic*** | ***mg/Litre*** | ***mg/Litre*** | |
| Cyanide (CN) | ≤ 0.05 | 0.07 | Standard for Pakistan similar to Asian developing countries |
| Fluoride (F)* | ≤ 1.5 | 1.5 | |
| Lead (Pb) | ≤ 0.05 | 0.01 | Standard for Pakistan similar to most Asian developing countries |
| Manganese (Mn) | ≤ 0.5 | 0.5 | |
| Mercury (Hg) | ≤ 0.001 | 0.001 | |
| Nickel (Ni) | ≤ 0.02 | 0.02 | |
| Nitrate ($NO_3$)* | ≤ 50 | 50 | |
| Nitrite ($NO_2$)* | ≤ 3 (P) | 3 | |
| Selenium (Se) | 0.01(P) | 0.01 | |
| Residual chlorine | 0.2-0.5 at consumer end<br>0.5-1.5 at source | — | |
| Zinc (Zn) | 5.0 | 3 | Standard for Pakistan similar to most Asian developing countries |

* indicates priority health related inorganic constituents which need regular monitoring.

# ANNEX III



| Properties/Parameters | Standard Values for Pakistan | Who Standards | Remarks |
|---|---|---|---|
| **Organic** | | | |
| Pesticides mg/L | | PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.*** | Annex II |
| Phenolic compounds (as Phenols) mg/L | | ≤ 0.002 | |
| Polynuclear aromatic hydrocarbons (as PAH) g/L | | 0.01 ( By GC/MS method) | |
| **Radioactive** | | | |
| Alpha Emitters bq/L or pCi | 0.1 | 0.1 | |
| Beta emitters | 1 | 1 | |

*** PSQCA: Pakistan Standards Quality Control Authority.

**Proviso:**

The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The Arsenic concentrations in South Punjab and in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centres are generally old and will take significant resources and time to get them replaced. In the recent past, Lead was completely phased out from petroleum products to cut down Lead entering into environment. These steps will enable to achieve WHO guidelines for Arsenic, Lead, Cadmium and Zinc. However, for bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

**S. R. O. 1064(I)/2010.**—In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Noise.

# ANNEX III



## National Environmental Quality Standards for Noise

| S. No. | Category of Area / Zone | Effective from 1st July, 2010 | | Effective from 1st July, 2012 | |
|---|---|---|---|---|---|
| | | Limit in dB(A) Leq * | | | |
| | | Day Time | Night Time | Day Time | Night Time |
| 1. | Residential area (A) | 65 | 50 | 55 | 45 |
| 2. | Commercial area (B) | 70 | 60 | 65 | 55 |
| 3. | Industrial area (C) | 80 | 75 | 75 | 65 |
| 4. | Silence Zone (D) | 55 | 45 | 50 | 45 |

*Note:* 1. Day time hours: 6.00 a. m to 10.00 p. m.

2. Night time hours: 10.00 p. m. to 6.00 a.m.

3. Silence zone: Zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.

4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

*dB(A) Leq: Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

[No. F. 1(12)/2010-11-General.]

MUHAMMAD KHALIL AWAN,
*Section Officer (PEPC).*

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# ANNEX III

REGISTERED No. M 302
L. 7646

*The Gazette of Pakistan*

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, THURSDAY, AUGUST 10, 2000

PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

**S.R.O. 549 (I)/2000.** In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2.

(1289)

[4138(2000)/Ex.GAZ]

Price : Rs. 5.00

# ANNEX III



(1) for Annex. I the following shall be substituted, namely:_____

**Annex I**

**"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/l, UNLESS OTHERWISE DEFINED)**

| S. No. | Parameter | Existing Standards | Revised Standards Into Inland Waters | Into Sewage Treatment (2) | Into Sea (1) |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | Temperature or Temperature Increase * | $40^{\circ}C$ | $\leq 3^{\circ}C$ | $\leq 3^{\circ}C$ | $\leq 3^{\circ}C$ |
| 2. | pH value ($H^+$) . | 6-10 | 6-9 | 6-9 | 6-9 |
| 3. | Biochemical Oxygen Demand (BOD)$_5$ at $20^{\circ}C$ (1) | 80 | 80 | 250 | 80** |
| 4. | Chemical Oxygen Demand (COD) (1) .. .. .. | 150 | 150 | 400 | 400 |
| 5. | Total Suspended Solids (TSS) .. .. .. | 150 | 200 | 400 | 200 |
| 6. | Total Dissolved Solids (TDS) | 3500 | 3500 | 3500 | 3500 |
| 7. | Oil and Grease | 10 | 10 | 10 | 10 |
| 8. | Phenolic compounds (as phenol) | 0.1 | 0.1 | 0.3 | 0.3 |
| 9. | Chloride (as $Cl^-$) | 1000 | 1000 | 1000 | SC*** |
| 10. | Fluoride (as $F^-$) | 20 | 10 | 10 | 10 |
| 11. | Cyanide (as $CN^-$) total .. | 2 | 1.0 | 1.0 | 1.0 |
| 12. | An-ionic detergents (as MBAS) (2) | 20 | 20 | 20 | 20 |
| 13. | Sulphate ($SO_4^{2-}$) | 600 | 600 | 1000 | SC*** |
| 14. | Sulphide ($S^{2-}$) | 1.0 | 1.0 | 1.0 | 1.0 |
| 15. | Ammonia ($NH_3$) | 40 | 40 | 40 | 40 |
| 16. | Pesticides (3) | 0.15 | 0.15 | 0.15 | 0.15 |

# ANNEX III

PART-II] THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 1291

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| 17. | Cadmium [4] .. .. | 0.1 | 0.1 | 0.1 | 0.1 |
| 18. | Chromium (trivalent and hexavalent [4]. .. | 1.0 | 1.0 | 1.0 | 1.0 |
| 19. | Cooper [4] .. .. | 1.0 | 1.0 | 1.0 | 1.0 |
| 20. | Lead [4] .. .. | 0.5 | 0.5 | 0.5 | 0.5 |
| 21. | Mercury [4] .. .. | 0.01 | 0.01 | 0.01 | 0.01 |
| 22. | Selenium [4] | 0.5 | 0.5 | 0.5 | 0.5 |
| 23. | Nickel [4] .. | 1.0 | 1.0 | 1.0 | 1.0 |
| 24. | Silver [4] | 1.0 | 1.0 | 1.0 | 1.0 |
| 25. | Total toxic metals .. .. | 2.0 | 2.0 | 2.0 | 2.0 |
| 26. | Zinc .. .. .. | 5.0 | 5.0 | 5.0 | 5.0 |
| 27. | Arsenic [4] .. | 1.0 | 1.0 | 1.0 | 1.0 |
| 28. | Barium [4] .. .. | 1.5 | 1.5 | 1.5 | 1.5 |
| 29. | Iron .. .. .. | 2.0 | 8.0 | 8.0 | 8.0 |
| 30. | Manganese .. .. | 1.5 | 1.5 | 1.5 | 1.5 |
| 31. | Boron [4] .. .. | 6.0 | 6.0 | 6.0 | 6.0 |
| 32. | Chlorine .. .. .. | 1.0 | 1.0 | 1.0 | 1.0 |

**Explanations:**

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and $BOD_5$=80mg/l is achieved by the sewage treatment system.

# ANNEX III

PART II] THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 1292

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than 3°C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/l

*** Discharge concentration at or below sea concentration (SC).

Note: 1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be substracted from the effluent for calculating the NEQS limits" and

(2) for Annex-II the following shall be substituted, namely:

<u>Annex-II</u>

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm$^3$, UNLESS OTHERWISE DEFINED)."

| S. No. | Parameter | Source of Emission | Existing Standards | Revised Standards |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 1. | Smoke | Smoke opacity not to exceed | 40% or 2 Ringlemann Scale | 40% or 2 Ringlemann Scale or equivalent smoke number |
| 2. | Particulate matter | (a) Boilers and Furnaces | | |
| | (1) | (i) Oil fired | 300 | 300 |
| | | (ii) Coal fired | 500 | 500 |
| | | (iii) Cement Kilns | 200 | 300 |
| | | (b) Grinding, crushing, Clinker coolers and Related processes, Metallurgical Processes, converter, blast furnaces and cupolas. | 500 | 500 |
| 3. | Hydrogen Chloride | Any | 400 | 400 |

# ANNEX III



| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 4. | Chlorine | Any | 150 | 150 |
| 5. | Hydrogen Fluoride | Any | 150 | 150 |
| 6. | Hydrogen Sulphide | Any | 10 | 10 |
| 7. | Sulphur Oxides (2)(3) | Sulfuric acid/Sulphonic acid plants | | |
| | | Other Plants except power Plants operating on oil and coal | 400 | 1700 |
| 8. | Carbon Monoxide | Any | 800 | 800 |
| 9. | Lead | Any | 50 | 50 |
| 10. | Mercury | Any | 10 | 10 |
| 11. | Cadmium | Any | 20 | 20 |
| 12. | Arsenic | Any | 20 | 20 |
| 13. | Copper | Any | 50 | 50 |
| 14. | Antimony | Any | 20 | 20 |
| 15. | Zinc | Any | 200 | 200 |
| 16. | Oxides of Nitrogen | Nitric acid manufacturing unit. | 400 | 3000 |
| | (3) | Other plants except power plants operating on oil or coal: | | |
| | | Gas fired | 400 | 400 |
| | | Oil fired | - | 600 |
| | | Coal fired | - | 1200 |

**Explanations:-**

1. Based on the assumption that the size of the particulate is 10 micron or more.

2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will case standards to be pro-rated.

3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standards:-

# ANNEX III



A. **Sulphur Dioxide**

Sulphur Dioxide Background levels Micro-gram per cubic meter (ug/m$^3$) Standards.

| Background Air Quality ($SO_2$ Basis) | Annual Average | Max. 24-hours Interval | Criterion I Max. $SO_2$ Emission (Tons per Day Per Plant) | Criterion II Max. Allowable ground level increment to ambient (ug/m$^3$) (One year Average) |
|---|---|---|---|---|
| Unpolluted | <50 | <200 | 500 | 50 |
| Moderately Polluted* | | | | |
| Low | 50 | 200 | 500 | 50 |
| High | 100 | 400 | 100 | 10 |
| Very Polluted** | >100 | >400 | 100 | 10 |

* For intermediate values between 50 and 100 ug/m$^3$ linear interpolations should be used.

** No projects with Sulphur dioxide emissions will be recommended.

**B. Nitrogen Oxide**

Ambient air concentrations of Nitrogen oxides, expressed as $NO_x$ should not be exceed the following:-

Annual Arithmetic Mean 100ug/m$^3$ (0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as Nanogram ($10^9$-gram) per joule of heat input:

| | |
|---|---|
| Liquid fossil fuel .. .. .. | 130 |
| Solid fossil fuel .. .. .. | 300 |
| Lignite fossil fuel .. .. .. | 260 |

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing blowing before emitting into the environment.

[File No. 14(3)/98-TO-PEPC.]

HAFIZ ABDULLAH AWAN
DEPUTY SECRETARY (ADMN)

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# ANNEX IV


MATCHLINE-02
LYARI BASTI ROAD
KESC POWER HOUSE
PROPOSED ROUNDABOUT
FOR BRT & MIXED TRAFFIC
MATCHLINE-01
PROPOSED LOCATION
FOR BUS DEPOT
MATCHLINE-01
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 01 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
CHOWRANGI, SURJANI, KARACHI
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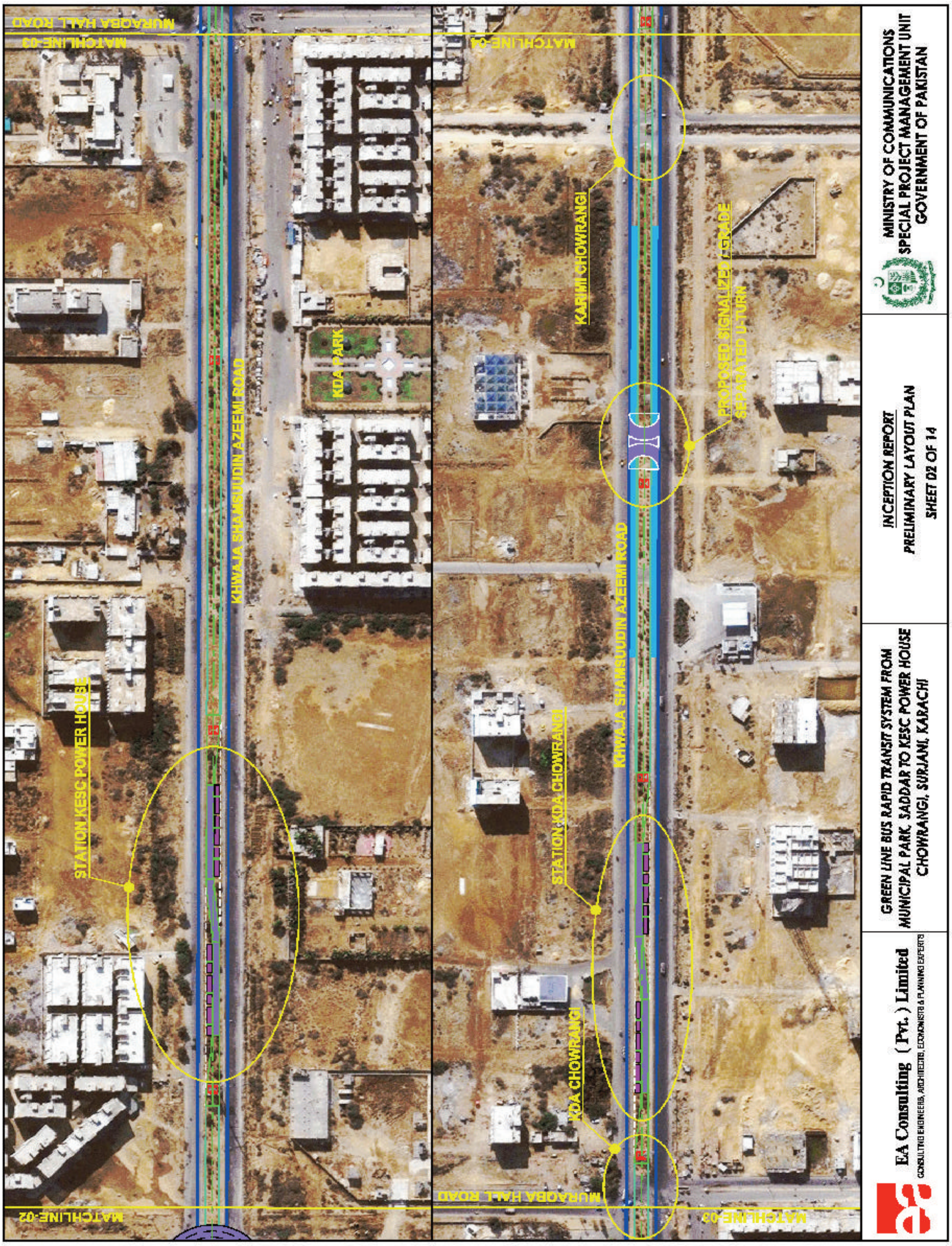
# ANNEX IV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MATCHLINE-03
KHWAJA SHAMSUDDIN AZEEMI ROAD
KDA PARK
STATION KESC POWER HOUSE
MATCHLINE-02
MATCHLINE-04
KARIMI CHOWRANGI
STATION KDA CHOWRANGI
KDA CHOWRANGI
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 02 OF 14
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MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
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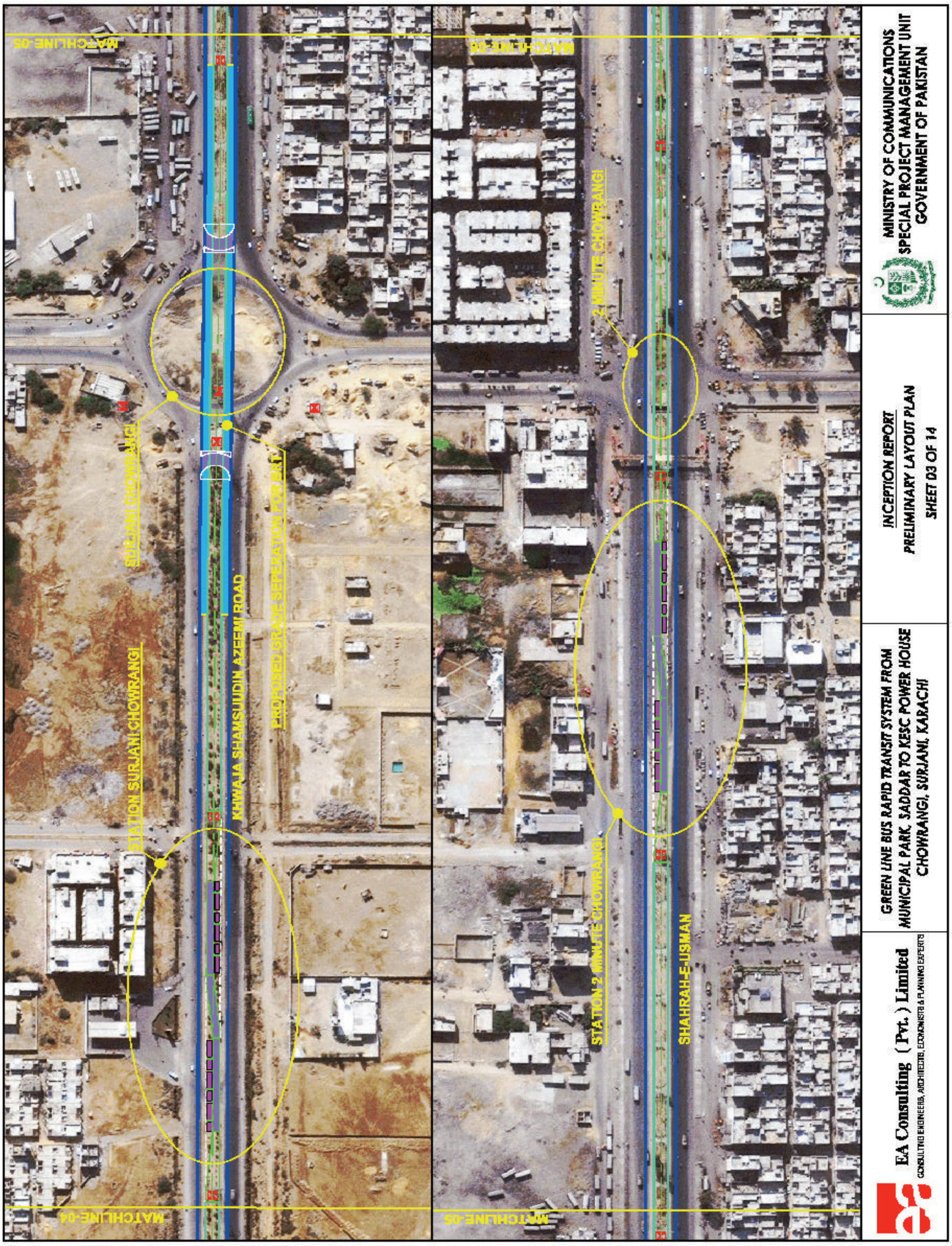
MATCHLINE-05
SURJANI CHOWRANGI
PROPOSED GRADE SEPERATION FOR BRT
KHWAJA SHAMSUDIN AZEEMI ROAD
STATION SURJANI CHOWRANGI
MATCHLINE-04
MATCHLINE-06
2 MINUTE CHOWRANGI
STATION 2 MINUTE CHOWRANGI
SHAHRAH-E-USMAN
MATCHLINE-05
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 03 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
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# ANNEX IV


MATCHLINE-07
MATCHLINE-08
STATION POWER HOUSE CHOWRANGI
ROAD 4200
STATION ROAD 4200
SHAHRAH-E-USMAN
POWER HOUSE CHOWRANGI
PROPOSED GRADE SEPERATION FOR BRT
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
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# ANNEX IV


MATCHLINE-9
MATCHLINE-10
MATCHLINE-08
MATCHLINE-9
SALEEM CENTER
STATION ROAD 2400
SHAHRAH-E-USMAN
STATION U.P MOR
SHAHRAH-E-USMAN
STATION ROAD 2400
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
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# ANNEX IV


RASHID MINHAS ROAD
NAGAN FLYOVER LEVEL-1
NAGAN CHOWRANGI
STATION ROAD 2400
SHAHRAH-E-USMAN
NAGAN FLYOVER LEVEL 2
PROPOSED SIGNALIZED/ GRADE SEPERATED U-TURN
SHAHRAH-E-USMAN
MATCHLINE-10
MATCHLINE-11
MATCHLINE-12
PROPOSED SIGNALIZED U-TURN
ERUM SHOPPING EMPOR
NAGAN FLYOVER RAMP LEVEL-1
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
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# ANNEX IV


MATCHLINE-13
SHAH JAHAN AVENUE
SHAH JAHAN AVENUE
SAKHI HASSAN CHOWRANGI
PROPOSED GRADE SEPERATION FOR BRT
STATION SHAKHI HASSAN
MATCHLINE-12
MATCHLINE-14
2K STOP
STATION JUMMAH BAZAR
MATCHLINE-13
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
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# ANNEX IV


MATCHLINE-15
MATCHLINE-16
SIR SYED AHMED ROAD
PROPOSED GRADE SEPERATION FOR BRT
STATION HYDERI MARKET
STATION FIVE STAR CHOWRANGI
FIVE STAR CHOWRANGI
PROPOSED GRADE SEPERATION FOR BRT
SHAHRAH-E-JAHANGIR
SHAHRAH-E-JAHANGIR
MATCHLINE-14
MATCHLINE-15
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
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SHEET 08 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
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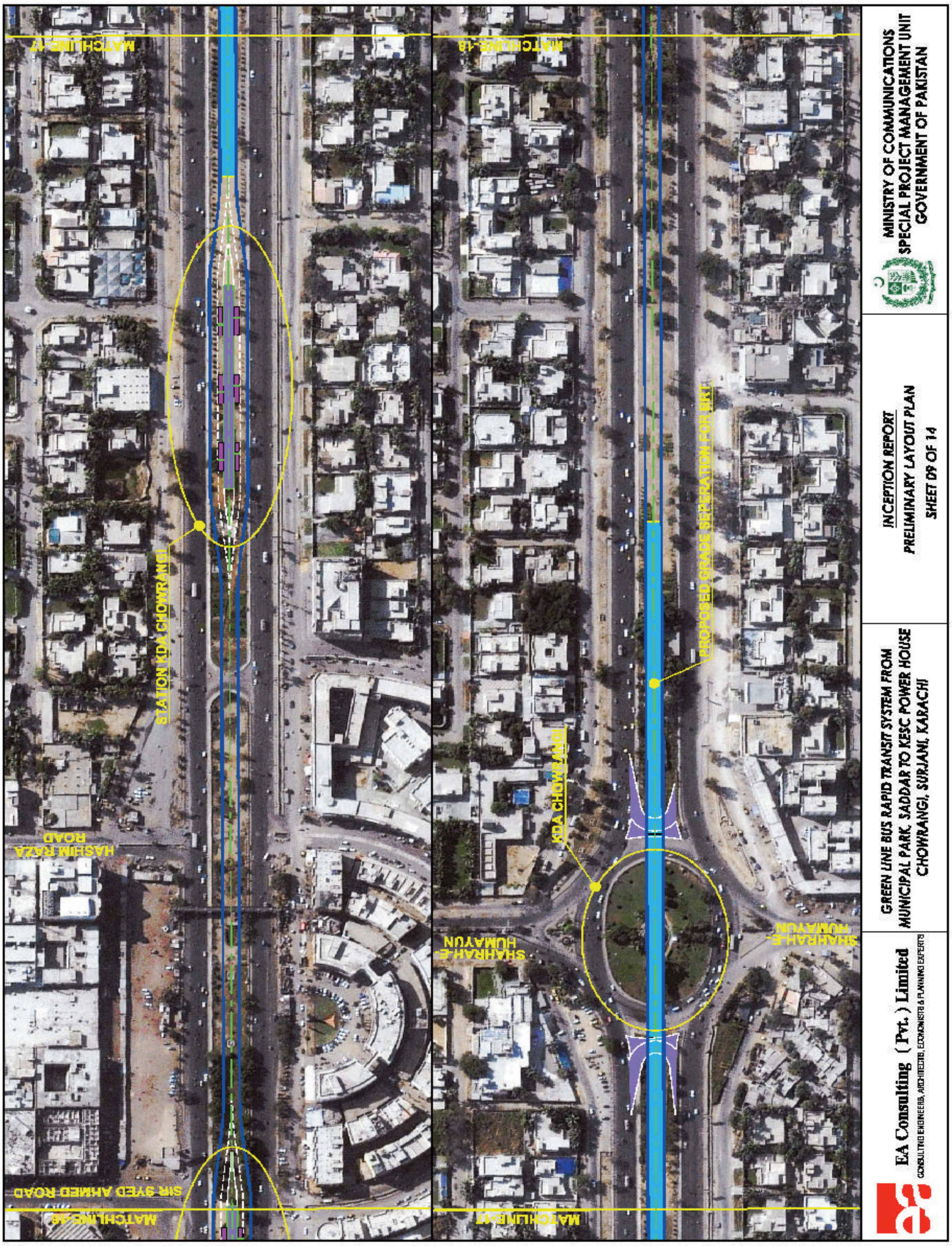
# ANNEX IV


MATCHLINE-17
MATCHLINE-18
MATCHLINE-46
MATCHLINE-47
STATION KDA CHOWRANGI
KDA CHOWRANGI
PROPOSED GRADE SEPERATION FOR BRT
HASHIM RAZA ROAD
SIR SYED AHMED ROAD
SHAHRAH-E-HUMAYUN
SHAHRAH-E-HUMAYUN
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 09 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
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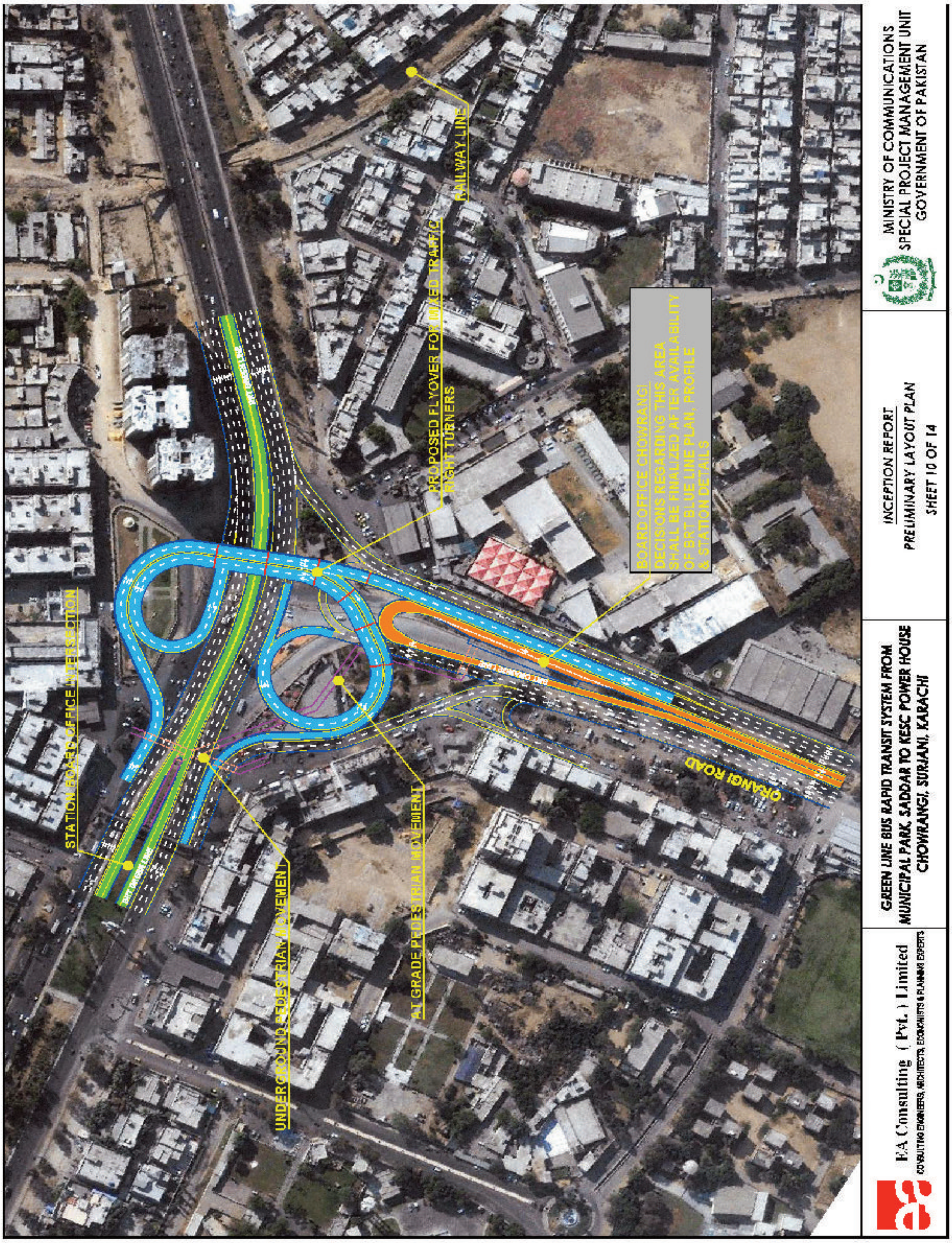
RAILWAY LINE
PROPOSED FLYOVER FOR MIXED TRAFFIC RIGHT TURNERS
BOARD OFFICE CHOWRANGI
DECISIONS REGARDING THIS AREA SHALL BE FINALIZED AFTER AVAILABILITY OF BRT BLUE LINE PLAN, PROFILE & STATION DETAILS
STATION BOARD OFFICE INTERSECTION
UNDERGROUND PEDESTRIAN MOVEMENT
AT GRADE PEDESTRIAN MOVEMENT
ORANGI ROAD
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 10 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE CHOWRANGI, SURJANI, KARACHI
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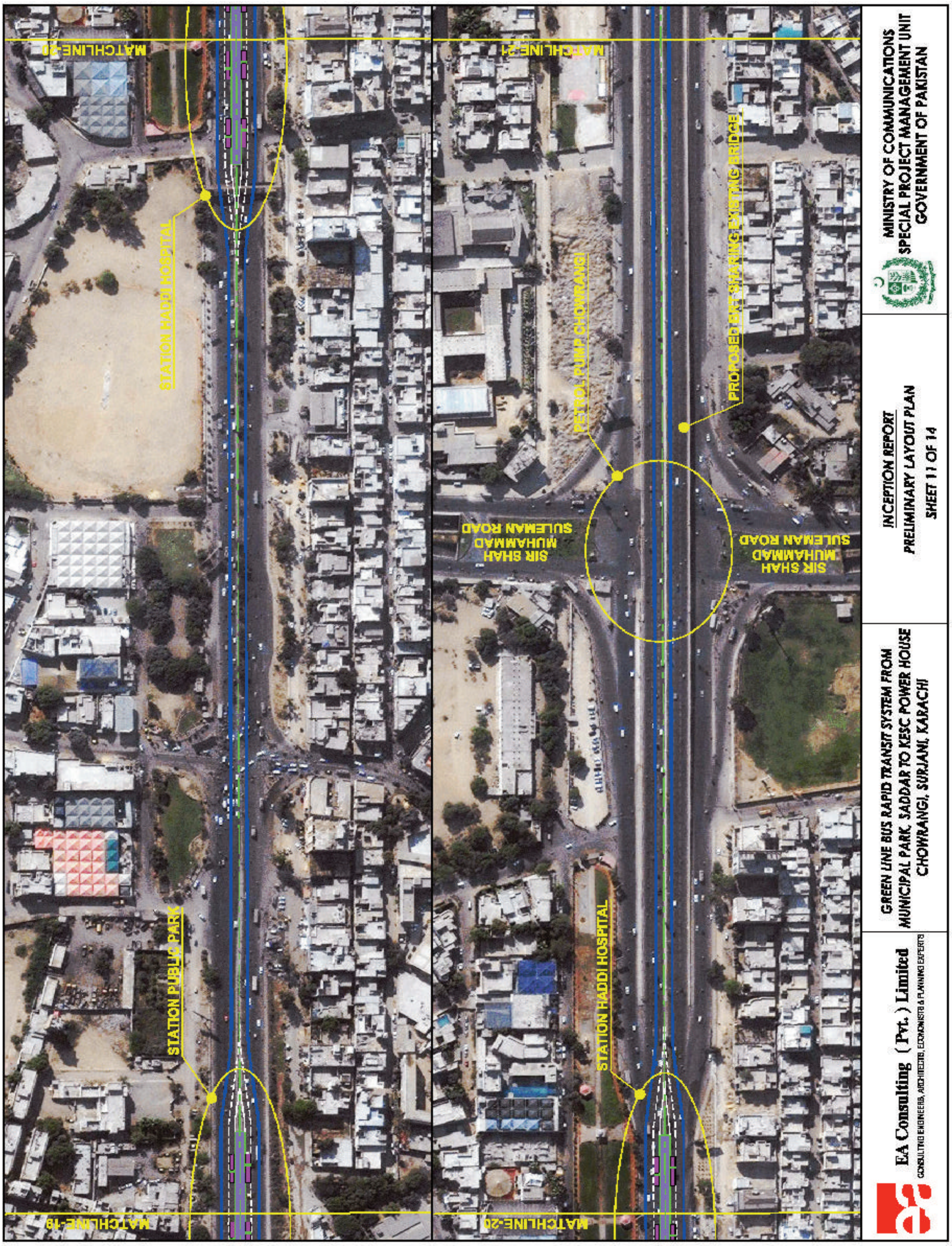
# ANNEX IV


MATCHLINE-20
STATION HADDI HOSPITAL
STATION PUBLIC PARK
MATCHLINE-19
MATCHLINE 21
PETROL PUMP CHOWRANGI
SIR SHAH MUHAMMAD SULEMAN ROAD
SIR SHAH MUHAMMAD SULEMAN ROAD
STATION HADDI HOSPITAL
MATCHLINE-20
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 11 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
CHOWRANGI, SURJANI, KARACHI
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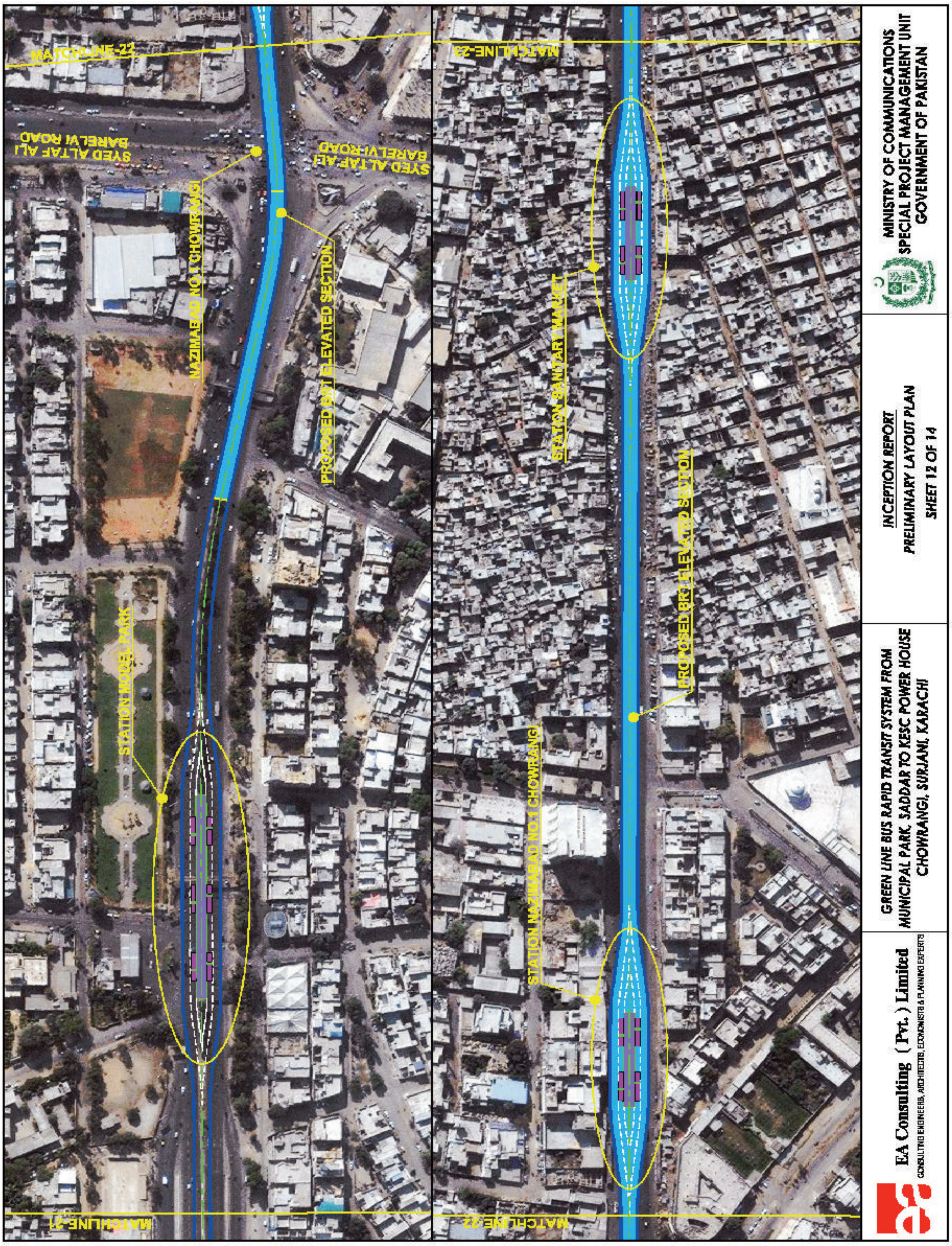
# ANNEX IV


MATCHLINE-22
SYED ALTAF ALI BARELVI ROAD
SYED ALTAF ALI BARELVI ROAD
NAZIMABAD NO.1 CHOWRANGI
PROPOSED BRT ELEVATED SECTION
STATION MODEL PARK
MATCHLINE-21
MATCHLINE-23
STATION SANITARY MARKET
PROPOSED BRT ELEVATED SECTION
STATION NAZIMABAD NO.1 CHOWRANGI
MATCHLINE-22
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 12 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
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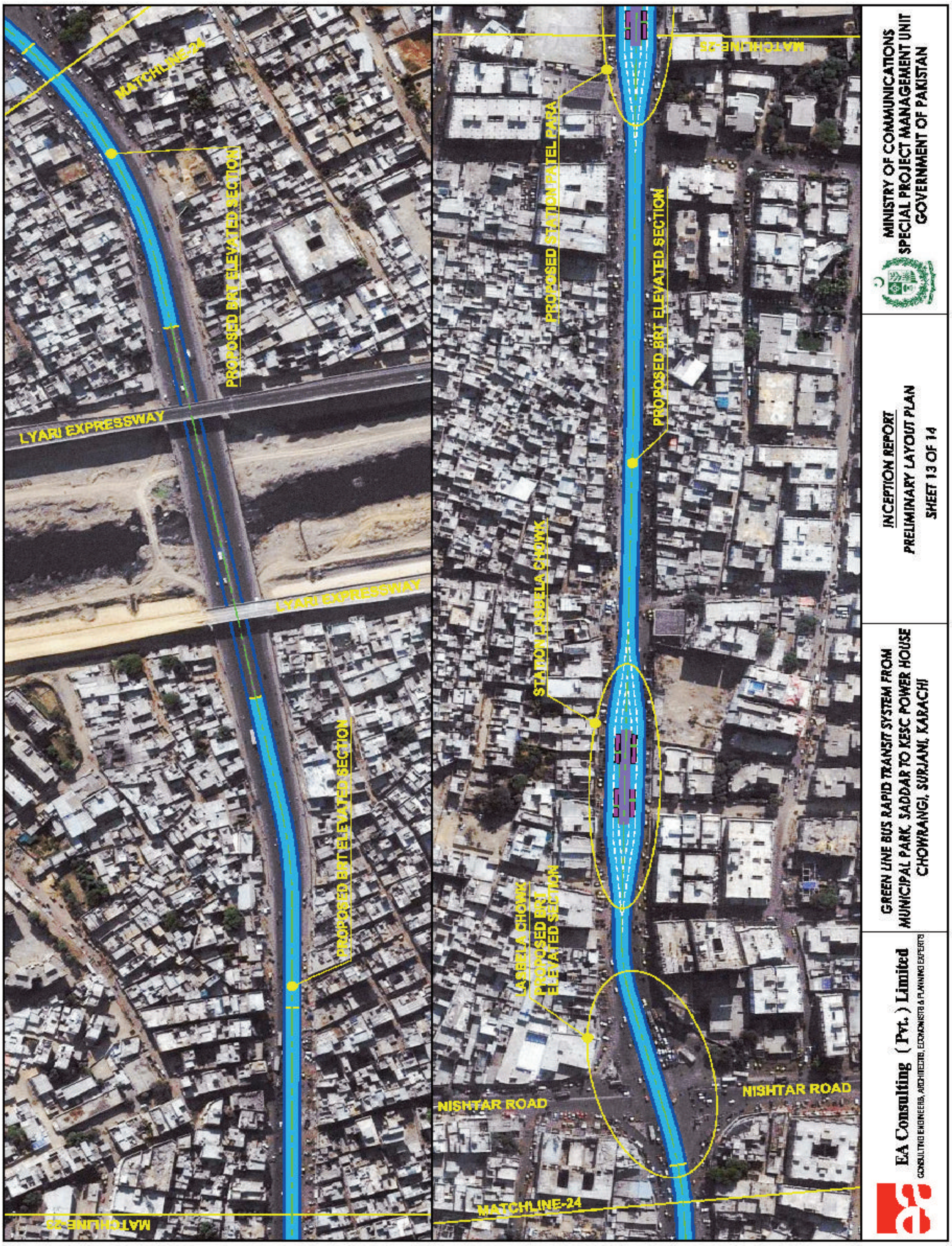
# ANNEX IV


MATCHLINE-24
PROPOSED BRT ELEVATED SECTION
LYARI EXPRESSWAY
LYARI EXPRESSWAY
PROPOSED BRT ELEVATED SECTION
MATCHLINE-23
MATCHLINE-25
PROPOSED STATION PATEL PARA
PROPOSED BRT ELEVATED SECTION
STATION LASBELA CHOWK
LASBELA CHOWK PROPOSED BRT ELEVATED SECTION
NISHTAR ROAD
NISHTAR ROAD
MATCHLINE-24
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 13 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
CHOWRANGI, SURJANI, KARACHI
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# ANNEX IV


GRUMANDAR INTERSECTION
DECISIONS REGARDING THIS AREA
SHALL BE FINALIZED AFTER AVAILABILITY
OF BRT BLUE LINE PLAN, PROFILE
& STATION DETAILS
JIGAR MURADABADI ROAD
M.A. JINNAH ROAD
JAMSHED ROAD
CLAYTON ROAD
JEHANGIR SETHNA ROAD
PROPOSED STATION PATEL PARA
MATCHLINE-25
MINISTRY OF COMMUNICATIONS
SPECIAL PROJECT MANAGEMENT UNIT
GOVERNMENT OF PAKISTAN
INCEPTION REPORT
PRELIMINARY LAYOUT PLAN
SHEET 14 OF 14
GREEN LINE BUS RAPID TRANSIT SYSTEM FROM
MUNICIPAL PARK, SADDAR TO KESC POWER HOUSE
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