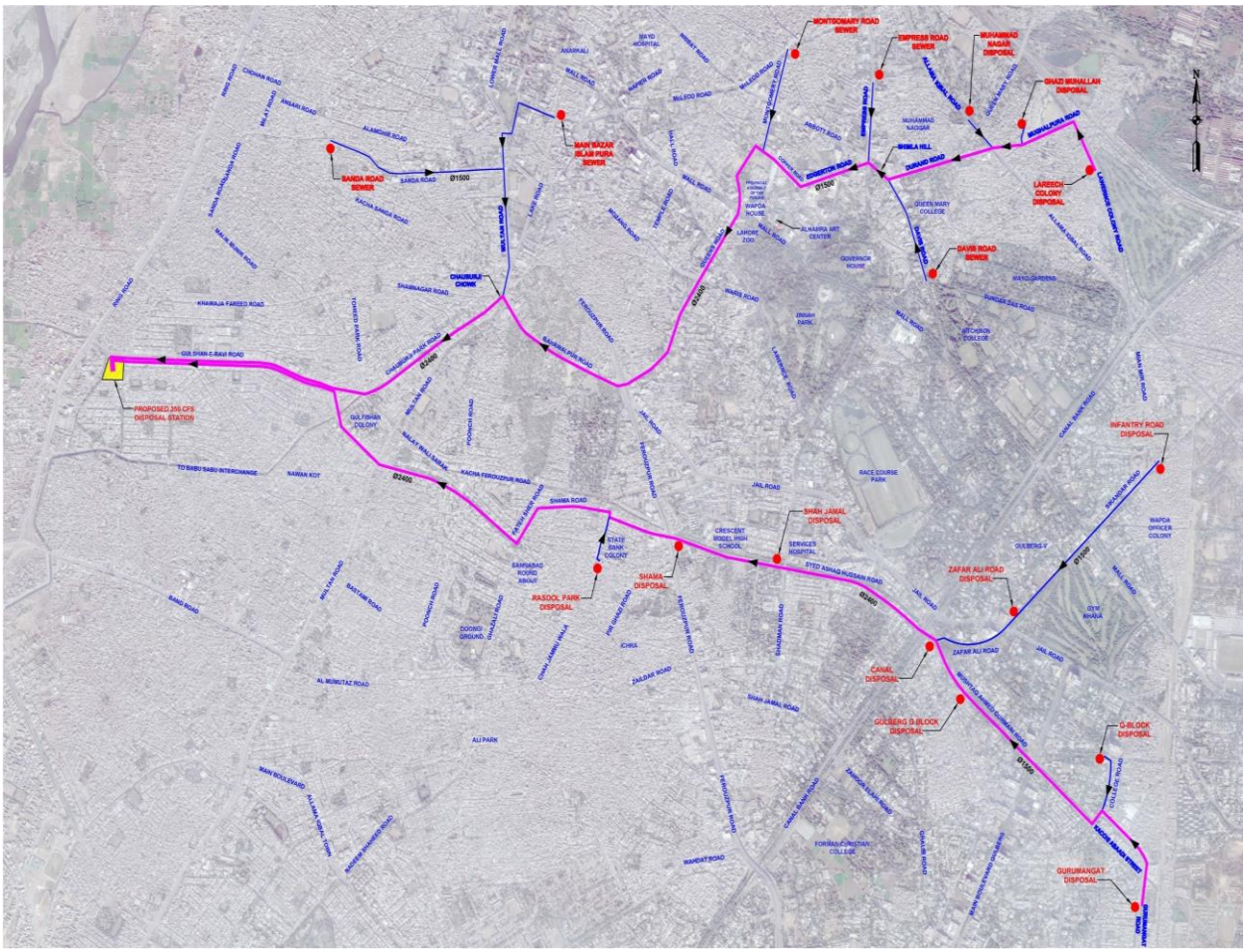
WATER & SANITATION AGENCY (WASA), LAHORE DEVELOPMENT AUTHORITY (LDA), GOVERNMENT OF THE PUNJAB

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI,



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

INITIAL DRAFT REPORT

OCTOBER, 2019

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List of Abbreviations

ALGAS	Asia Least Cost Greenhouse Gases Abatement Strategy
AP(s)	Affected Persons
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BOD	Board of Directors
CC	Construction Contractor
CDGL	City District Government Lahore
CDM	Clean Development Mechanism
CMS	Complaint Management System
COD	Chemical Oxygen Demand
DC	Design Consultant
DCR	District Census Report
DNA	Designated National Authority
DO	Dissolved Oxygen
ECM	Environmental Compliance Manager
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Mitigation and Monitoring Plan
EPA	Environmental Protection Agency
EPD	Environment Protection Department
FGDs	Focused Group Discussions
G.T. Road	Grand Trunk Road
GHGs	Green House Gases
IEE	Initial Environmental Examination
LAA	Land Acquisition Act
LCC	LAR Coordination Committee
LWMC	Lahore Waste Management Company
LWWM	Lahore Water and Wastewater Management
MDGs	Millennium Development Goals
MSL	Mean Sea Level

MTBM	Micro Tunnel Boring Machines/Method
NCS	National Conservation Strategy
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NESPAK	National Engineering Services Pakistan
NGO	Non-Government Organization
NOC	No Objection Certificate
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protection Council
PEQS	Punjab Environmental Quality Standards
PGA	Peak Ground Acceleration
PHA	Parks and Horticulture Authority
PMU	Project Management Unit
PPE	Personal Protective Equipment
RCC	Reinforced Cement Concrete
SAAMA	Services and Assets Management Agreement
SC	Supervision Consultant
STD	Sexually-Transmitted Diseases
TBM	Tunnel Boring Machines/Method
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UAN	Universal Access Number
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
WASA	Water And Sanitation Agency
WB	World Bank
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

Glossary

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EXECUTIVE SUMMARY

Government of Punjab, through the Lahore Water and Sanitation Agency (LWASA), is planning to implement the Lahore Water and Wastewater Management Project (LWWMP) through financing from the Asian Infrastructure Investment Bank (AIIB). It will comprise construction of water supply and wastewater infrastructure. To address the environmental and social impacts of the LWWMP and to comply with the national regulatory as well as AIIB Environmental and Social Policy requirements, the present Environmental and Social Impact Assessment (ESIA) has been prepared for the wastewater component (the proposed project).

Project Background and Rationale

Lahore, the provincial metropolis of the Province of Punjab, the land of five rivers is historical, cultural, and commercial hub and always has been significant even during the Indo-Pak sub-continent era. Lahore has always been the center for mass migration of people from the rural areas. This mass migration creates the problems of congestion and thus resulting in an inadequate infrastructure. With increasing urbanization and industrialization, the volume of domestic sewage being produced is steadily growing in Lahore city. Due to this influx, the existing sewerage systems have become depleted which has resulted in greater burden on the regulating authorities.

Pakistan is in the group of countries that are now moving from the state of water stressed to water scarce countries. High population growth, increasing urbanization, inefficient irrigation practices, un-sustainable water use, and fragmented management are placing enormous pressure on surface and ground water resources. Lahore depends entirely on groundwater to meet the water demand of its 11.1 million population. Water is abstracted through 585 tube-wells installed in the city and then is pumped into the main distribution system. The current state of the water extraction is fast depleting the groundwater. Lahore also lacks bulk conveyance and treatment systems for the domestic and industrial wastewater that it produces. Resultantly, most of the wastewater is disposed into the nearby storm water drains, which eventually discharge into Ravi River untreated. This has serious health and hygiene implications for the residents and major environmental implications for the city's water bodies and Ravi River.

In order to address the above issues, the LWASA has proposed the LWWMP to improve reliability of water supply and wastewater services in the metropolitan city of Lahore and improve operational performance of the LWASA.

The Prevailing Situation

The present sewerage system in some locations consists of oval shaped brick masonry sewers of old British time and the existing sewers laid 25-60 years ago. The existing sewers are deficient to cater the flow from adjoining areas. Particularly, the silted/choked sewer lines and drainage channels are serious hazards to the urban environment. In

addition, the raw sewage is flowing in open storm water drains in some areas. Moreover, monsoon season causes flooding in many places and results in degradation of sanitary environment. Eventually it was felt that a comprehensive sewerage and drainage improvement plan for the area is needed as a first step to solve the problem.

Proposed Project

The proposed project comprises laying of about 28 km long trunk sewer and installing new pumps with a capacity of about 10 cubic meters per second (10 cumecs) at the existing Gulshan-e-Ravi disposal station. The proposed project will employ underground tunneling method of construction, a trenchless technique which minimizes excavation. The total length is divided into two segments. The first segment measuring about 15 km will be constructed from Larech Colony to Gulshan-e-Ravi. The second segment with a length of about 13 km will cover the sewage flow from Infantry Road and Gulberg area to Gulshan-e-Ravi disposal station. Upon completion and diversion of sewage from the surface drains to the newly constructed trunk sewers, the drains in the locality will be rehabilitated and restored. This will enhance the capacity of the surface drainage and provide immense relief from the monsoon related urban flooding, which has been affecting Lahore during intense rain events.

Project Alternatives

Different alternatives were considered for the project with respect to technical, environmental, social and economic aspects. These include: i) 'no-project option'; ii) relief sewer providing required additional capacity; and iii) new sewerage of enhanced capacity (trunk sewer). For construction methods, two broad options were considered: open cut excavation; and micro tunneling avoiding open cut excavation. For the purposed project, the third option has been selected employing micro tunneling technology, avoiding the environmental and social issues associated with the other alternatives.

Policy, Legal and Administrative Framework

According to Punjab Environmental Protection Act, 2012, an environmental and social assessment study is required prior to commencement of any development project. The present document complies with this requirement.

The AIIB Environmental and Social Policy is also applicable for this proposed project. According to this Policy, the proposed project falls under Category A that requires ESIA study (where the project is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented). The proposed project will require application of Environmental and Social Standard (ESS) 1 – Environmental and Social Assessment and Management and ESS 2 – Involuntary Resettlement (which includes land acquisition).

Environmental and Social Baseline

The existing conditions in and around the project area has been studied with respect to the physical and socio-economic environment.

Physical Environment

The topography of the project area is flat. The General height of the area is approximately 220 meters above the Mean Sea Level (MSL). Lahore district is divided into two parts. The low lying alluvial soil is along the Ravi River, and the upland in the east.

The soil deposits at the project site belong to Chung Fun formation indicating the last glacial cycle. It was followed by the period of melting of glaciers, resulting in deposition of clay, silt and sand deposits in late Pleistocene to recent.

The soil in the project area is cohesion less and is of alluvial type deposited by River Ravi. Various soil layers below the ground level include silt, silty clay, silty sand, poorly graded sand with silt and lean clay.

The study area forms the upper part of Punjab plain, which is a part of the Indo-Gangetic depression. This depression is of a synclinal nature. Synclinal depression is a fore deep downward of the Himalayan foreland of variable depth, converted into flat plains by simple process of alluvial deposition.

In Lahore, 76 collecting drains are connected to eight major drains including: Sattukatla drain, Mian Mir drain, lakshami drain, Suk Nehar drain, Upper Chotta Ravi drain, Lower chotta Ravi drain, Siddique Pura drain, and shahdra drain, which discharge polluted water in to Hudyara drain.

The land use of the project area is mainly commercial with some educational facilities, medical facilities, religious sites and recreational facilities.

Air quality sampling has been conducted at ten locations. Four parameters; Sulphur dioxide, oxides of nitrogen, carbon monoxide and particulate matter were analyzed and all are within permissible limits of Punjab Environmental Quality Standards (PEQS), 2016.

The surface water quality has been measured at ten locations. The water samples were analyzed for the parameters specified in PEQS, 2016. All the parameters were within permissible limits except water temperature and cadmium concentration (apparently due to mixing of industrial effluents).

The groundwater sampling has been done at ten locations for analysis. All the parameters analyzed were within permissible limits except TDS and aluminum concentration (apparently due to mixing of industrial effluents).

The noise measurement has been done at ten locations for 24 hours. The results indicated that the noise levels are higher at eight locations according to the PEQS, 2016 as the selected locations are along the busy roads or crossings.

Socio-economic Environment

The location of Lahore City is bounded on the North and West by Sheikhupura district, on the east by India and on the south Kasur district River Ravi flows on the northern side of Lahore. The district comprises five sub-administrative units (Tehsils). According to census of 2017, the overall population of the district was 11,126,285 and among them males were 47.6 percent and 52.4 percent were female. Sex ratio is measured as 109.87 percent. The area of the Lahore district is 1,772 square kilometers, which gives population density of 6,279 persons per square kilometer as against 3,566 persons observed in 1998. The average annual growth rate of population in the district during intercensal period 1998-2017 was three percent.

Public Consultation and Information Disclosure

This consultation process was held with the objectives of sharing information with stakeholders on proposed improvement works and expected impacts on the physical, biological and socio-economic environment of the project corridor; understanding stakeholder concerns regarding various aspects of the project; providing an opportunity to the public to influence project design in a positive manner; and creating a sense of ownership of the proposal in the mind of the stakeholders.

The methods used for public consultation with project stakeholders in order to ascertain their stakes regarding project implementation were focused group discussion, scoping sessions, formal group meetings and informal group meetings. Different categories of stakeholders were contacted including residents, business/ shop owners, office workers, taxi/ rickshaw drivers, pedestrians, vendors, government officers, students and passengers.

The community in the project area supported the proposed project and was of the opinion that it will not only reduce the environmental nuisance but will also help in overcoming the health concerns due to flow of wastewater in the open drains. The major concerns of the stakeholders included dust, noise and vibration, air pollution, safety issues, access constraints, temporary loss of livelihood, structure stability, and traffic disruption during the construction phase.

Environmental Impacts and Mitigation Measures

The proposed project will have both positive and negative impacts during the construction and operational phases, for which proper mitigation measures are necessary. The identification of impacts has been done on the basis of literature review, site surveys and expert opinion on prevailing site conditions and sensitive receptors.

Positive Impacts

The proposed project is expected to reduce if not totally eliminate the prevailing negative impacts – such as public health, hygiene, and odor – associated with flow of raw sewage

in the open drains. The proposed project will also eliminate 12 intermediate sewerage lift stations which are disposing of the sewerage into the open storm water channels. Moreover, the carrying capacity of the storm water drains of the area will be enhanced due to elimination of sewage and wastewater flows, thus reducing the urban flooding caused by intense rain events.

Construction Phase Impacts

The significant impacts associated with the construction activities of the proposed project include traffic disruption; hindrance to the public movement; noise and vibration; dust emissions due to operation of construction machinery; construction waste generation; municipal waste generation from construction camps and offices; accidental leaks and spills of hazardous chemicals from construction activities and machinery; health and safety issues of the workers and public; removal of roadside vegetation; relocation of public utilities; soil erosion and pollution; and disposal of slurry.

The proposed mitigation measures include careful site selection of shafts required for micro tunneling; formulation and implementation of traffic management plan; implementation of solid and construction waste management plan; site safety plans; provision and implementation of personal protective equipment (PPE's) to workers; fencing of construction sites with corrugated sheets; effective liaison with the relevant stakeholders; timely rehabilitation of public utilities; safe disposal of construction and solid waste at Lahore Waste Management Company (LWMC) approved sites.

Operation Phase Impacts

The impacts associated with the operation phase include air and greenhouse gas (GHG) emissions; solid waste generation; and occupational health and safety (OHS) risks for the maintenance workers.

The proposed mitigation measures include improved monitoring, planning, and maintenance of the trunk sewer by WASA; provision of exhaust gas vents at appropriate locations in the design; appropriate tree plantation along the disposal station; and implementation of emergency response plan.

Environmental and Social Management Plan (ESMP)

The Project Management Unit (PMU) for the Project will be LWASA. The PMU will be supported by a team of consultants, the Project Management Consultants (PMC) in implementation of the project. The dedicated team of Environment and Social Specialists of PMC will support PMU in ESMP implementation, reviewing and approving site specific environmental and social management plan (SSESMP) submitted by the contractors, supervising and reporting contractors' environmental and social performance, assessing the contractors' compliance with the submitted SSESMP and contractor's code of conduct, as well as fulfilling requirements of AIIB and other stakeholders.

The construction contractors will be responsible for implementation and adherence to all the mitigation measures and monitoring arrangements outlined in the ESMP associated with their respective activities. The contractors will be hired through proper bidding procedure. The contractors must have qualified environmental and social experts on full time basis to interpret and implement the ESMP.

The ESMP provides a mitigation plan, a monitoring plan and a training program with responsible parties and budget. The ESMP shall become the part of construction contract agreement and shall be strictly enforced during the implementation of the proposed project.

Grievance Redress Mechanism (GRM)

The GRM has been developed for the LWWMP and the same would be followed for the proposed project. It comprises three-tier system to provide a time-bound, early, transparent and fair resolution for project-affected people (PAPs) and other stakeholders grievances. The Environmental and Social (ES) staff of Project Management Unit (PMU) will undertake public awareness campaigns on the GRM with the assistance of ES staff of PMC and contractors. All complaints received verbally or in writing will be properly documented and recorded in the Complaint Management Register(s). In addition, an easy-to-access web-based GRM will be implemented.

ESMP Budget

The cost required for the implementation of ESMP is estimated to be Pak Rupees (PKR) 11.96 Million.

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SECTION-3
DESCRIPTION OF PROJECT

3.1 Type and Category of Project

According to Environmental and Social Policy of AIIB; the project falls under category A that requires ESIA study (where the project is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented). Similarly; according to IEE/EIA Pakistan Regulation, 2000, the proposed projects falls under Category "G" (Waste Disposal) of Schedule-II that requires Environmental Impact assessment (EIA) because proposed project is likely to have adverse impacts on environment.

3.2 Objectives of the Project

3.2.1 Objectives of the LWWMP

The overall objectives of the LWWMP are to improve reliability of water supply and wastewater services in the metropolitan city of Lahore and improve operational performance of the Lahore Water and Sanitation Services Agency.

3.2.2 Objectives of Trunk Sewer (Proposed Project)

- To provide a socially, environmentally and economically sustainable solution for disposal of sewerage and wastewater; and
- To ensure efficiency for quick and safe disposal of sewage / wastewater by lying of Trunk Sewerage System.

3.3 Need of the Project

Lahore, the provincial metropolis of the Province of Punjab, the land of five rivers is historical, cultural, and commercial hub and always has been significant even during the Indo-Pak sub-continent era. Lahore has always been center for mass migration of people from the rural areas. This mass migration creates the problems of congestion and thus resulting in an inadequate infrastructure. With increasing urbanization and industrialization, the volume of domestic sewage being produced is steadily growing in Lahore city. Due to this influx, the existing sewerage systems have become depleted which has resulted in greater burden on the regulating authorities.

The present sewerage system consists of oval shaped brick masonry sewers of old British time and the reinforced concrete cement (RCC) sewers laid 25-60 years ago. The trunk sewers are deficient to cater the flow from adjoining areas. Particularly, the silted/choked sewer lines and drainage channels are serious hazards to the urban environment. Moreover, monsoon season causes flooding in many places and results in degradation of sanitary environment. Eventually it was felt that a comprehensive sewerage and drainage improvement plan for the area is needed as a first step to solve the problem. In this regard M/s NESPAK has carried out several studies in past to resolve the aggravating situation of present system of Central Zone. The studies are listed below:

Master Planning of Central Lahore in 2004

This study involved the construction of Trunk Sewer from Durand Road to Gulshan-e-Ravi Pump Station along with new branch sewers along; Davis Road, Empress Road, Montgomery Road and Sanda Road. Besides lying of new sewers as discussed above, sewer cleaning/rehabilitation has been proposed for all trunk sewers within project area to improve the capacity of existing sewerage system. Six lift stations, which fall into the Central Zone sewerage boundary, were proposed for elimination. This includes Larech Colony disposal station, Ghazi Muhallah disposal station, Muhammad Nagar disposal station, Fruit market lift station, Old fruit market lift station and General bus stand lift station.

The drainage system of the Central Zone is primarily dependent on Central Drain in addition to other secondary drains. Initially, these drains were designed and constructed only for storm water drainage purpose but with the passage of time, sewage from a number of adjoining areas have been connected to them either by gravity or through lift stations as a quick & economical solution without any future planning / growth consideration at that time.

The surface run-off of the Central Zone area has been increased manifold due to rapid urbanization in the city whereas the cross-sections of these drains have been reduced due to encroachments and dumping of solid waste in some of the areas. Also few of the existing culverts including pipe crossings are not adequate, thus restricting the flow.

In order to provide relief to drainage problem, the recommended alternative involved the construction of new drain along McLeod Road, GPO Chowk which was later proposed along Lyton Road crossing Bahawalpur Road along Miani Sahib Graveyard and ultimately falls in Cantonment Drain at Fasih Road. A new culvert at Chuburji Chowk was also proposed to be constructed to carry the design flows.

Laying of Trunk Sewer along Cantonment Drain in 2009

This study involved laying of trunk sewer along the Cantonment Drain. Sewer was proposed in such a way that all the existing disposal stations along Cantonment Drain will be eliminated. Total nine (09) numbers of Disposal Stations were proposed to be eliminated. These disposal Stations includes Jorey Pul Disposal Station, Mustafabad Disposal Station, Sunny Flour Mill Disposal Station, Home Economics College disposal, Gulberg ‘G’ Block Disposal Station, Canal Park Disposal Station, Zafar Ali Road Disposal Station, Shadman Disposal Station, Shama Disposal Station and Rasool Park Disposal Station. A new disposal facility has been proposed in the premises of Gulshan-e-Ravi Disposal Station to accommodate the design flow of proposed trunk sewer along Cantonment Drain.

The trunk sewer was proposed along cantonment drain from Sunny Flour Mills disposal station (D/S) to Gulberg II D/S leading to Gulberg G Block D/S. Sewer is then directed towards Canal Park D/S which leads Zafar Ali Road D/S. The proposed sewer moves along the drain towards Shah Jamal Area D/S and then directs towards Shama D/S and Rasool Park D/S and is ultimately disposed of to Gulshan-e-Ravi D/S. The whole sewer line is designed to incorporate the flows of aforementioned disposal stations under gravity. Therefore, all

disposal stations can be eliminated along the cantonment drain up to Gulshan-e-Ravi disposal station.

Master Plan Report in 2017 by MM Pakistan

WASA, Lahore enlisted the services of Mott Macdonald Pakistan (MMP) to carry out the Master Plan report of Lahore City in order to establish the population growth and urbanization trend and ascertain the short and long term Investment Plans for future developments for a design horizon up to the year 2040. The Central Zone is the heartbeat of Lahore city and there is a dire need of a Trunk sewerage Network without which the alleviation of the environment would not be possible. The impediment in lying of the Trunk sewer in the Central Zone through conventional approach is not possible due to densely populated area. Therefore, an innovative approach would have to be devised in order to address the problem.

These studies were carried out but no practical outcome has been seen so far due to budgetary and other constraints. Due to urbanization and mass development open cut is not feasible anymore.

In view of this aggravating situation there is need of project that intends to improve the sewerage system and drainage system of Central Lahore with minimum disruption and disturbance in day to day activities. LDA and WASA proposed a project to be executed with trenchless/pipe jacking technology namely "Sewerage System from Larech Colony to Gulshan-e-Ravi, Lahore", funded by Asian Infrastructure Investment Bank (AIIB) and entrusted NESPAK to carry out this project. The proposed project is formulated based on these existing studies with only change in execution strategy of the project.

3.3 Analysis of Alternatives

Different alternatives were considered for the current project based on technical, technological, economical, financial, environmental and social parameters. Each alternative was further studied in detail and the best suitable option for the local conditions was selected. The alternatives are discussed in brief below:

- Option-1: No Project
- Option-2: Relief Sewer providing required Additional Capacity
- Option-3: New Sewerage of Enhanced Capacity

3.3.1 Option-1: No Project

In the absence of the project towards improvement of the sewerage situation in the zone, the circumstances are worsening over the period and public had to suffer inconvenience on account of routine sewage overflows and heavy flooding during rains. If the project is not initiated; the situation will exacerbate specially during monsoon season and due to flooding, the socio-economic activities of the project area will be affected and several other problems will arise including odour and vector borne diseases which will further create health issues i.e. dengue. Hence this option is unlikely to be considered.

3.3.2 Option-2: Relief Sewer

Under the option, a relief sewer is proposed that will take care of additional - excess flow from the existing sewerage. The relief sewer will be laid parallel to the existing sewer and during excess flow over and above the existing capacity is encountered, this sewer will come-up for relief and excess - overflows will be taken care by this relief sewer.

The size of the trunk sewer will be almost half of the existing sewer size and will be laid at shallower depths. The cost so involved is assessed as 1/3rd of the new sewerage facilities.

The demerits of the option include:

- Open cut technology will be difficult for its execution, as the project is through very densely populated area of the city and its execution will result in nuisance.
- Existing - temporary sewage pumping stations located at various locations will not be eliminated under the option and hence the issue of their O&M will persist and the pumping stations may remain blocked.
- The continued use of these disposal stations will not help avoid nuisance in the locality and other miscellaneous environmental concerns.
- The existing sewer is reportedly blocked - under capacitated or failed due to 'Microbiologically Induced Corrosion' which will result in seepage of wastewater to the groundwater table, hence deteriorating the groundwater quality.
- Hence this option is also unlikely to meet the intended objective.

3.3.3 Option-3: New Sewerage (Proposed Project)

As per the feasibility studies and detailed design report prepared by M/s NESPAK, Trunk Sewer has been proposed in the area along with construction of new Disposal Station at Gulshan-e-Ravi to care for sewage disposal as well as storm water and reduce the flooding in the area during monsoon in addition to trunk sewer from Mustafabad to Samanabad More. The proposed system is based on following methods/technologies.

a. Open Cut Method

In the built-up urban environment, open cut excavations for lying of infrastructure facilities including sewerage is considered inappropriate mainly incontinence to traffic and general public. For deeper sewerage, deeper excavations may endanger the urban - private property along the route of the sewer and may even become impossible to lay in some of the cases. Moreover, relatively longer periods involved in construction discourage use of open-cut methodology for lying of sewer.

But this method is used here for connection of new line with the existing disposal stations. The total length of cut and cover is just 810 m out of total length of the project.

b. Horizontal Boring/Pipe Jacking Machine

Trenchless technology offers an alternative to the traditional open-cut method of pipeline installation. A pipe jack is defined as a system of directly installing pipe behind an open-face tunnel boring machine (TBM). The pipe is then hydraulically

jacked from a launch shaft, so that it forms a continuous string in the ground. The pipe, which is specially designed to withstand the jacking forces likely to be encountered during installation, forms the final pipeline once the excavation operation is completed.

Comparison of Open Cut Method & Trenchless Technology is discussed below:

Open Cut Method	Trenchless Technology
Open cut method often involves risk	Pipe jacking are safer methods of working
Dismantling of road takes place throughout the pipe path	Dismantling of road only requires for launch and reception shafts for entrance of pipe jacking machine. Substantial cost saving.
Slow Construction, often takes more time	Speedy Construction
Public Inconvenience	No inconvenience to public.
More Traffic disturbance	Traffic disruption are reduced or eliminated, Mobility above ground is not affected
More Environmental effects, soil disturbance	Minimum environmental effects less soil is disturbed /excavated and movement.
Shifting of all underground utilities	Minimum shifting underground utilities, services Cost effective.
More Transportation & Re-handling of materials	Reduce the quantities of incoming and outgoing materials
Maximum visual impact to the local population	No impact to the local population
Less reliability	High degree of reliability
Cost Expensive	Cost effectiveness.

3.4 Project Description

In the absence of a proper wastewater transport infrastructure, the city relies on its open drains, meant to only carry the rainwater, for bulk transport of its wastewater. As part of wastewater management in Lahore, the project will assist LWASA in construction of a modern conveyance system by constructing trunk sewers through underground tunneling (a trenchless technique which minimizes excavation). This will safely transport domestic sewage, serving a population of 0.5 million over an area of about 20 square kilometer in central Lahore. The project will also rehabilitate the storm water infrastructure, thereby not only providing environmental and public health benefits but also addressing the urban flooding problems in Lahore. The construction of a gravity-based transport of wastewater infrastructure will also eliminate the need for intermediate pumping of wastewater at 12 different locations, resulting in cost savings for LWASA in payment of electricity charges.

The total length of sewer to be constructed is about 28 kilometer which is divided into two construction legs. First trunk sewer measuring about 15 kilometers will be constructed from Larech Colony to Gulshan-e-Ravi. This sewer will service the localities of central Lahore including Gahri Shahu, Durand Road, Shimla Hill, Cooper Road, Queens Road, Bahawalpur

Road and Chauburji. The second trunk sewer with a length of 13 kilometers will cover the sewage flow from Infantry Road and Gulberg area to Gulshan-e-Ravi. This sewer will serve the areas of Infantry Road, Zafar Ali Road, Gurumanghat, Shadman, Shama and Rasool Park. Upon completion and diversion of sewage from the surface drains to the newly constructed trunk sewers, the drains in the locality will be rehabilitated and restored. This will enhance the capacity of the surface drainage and provide immense relief from the monsoon related urban flooding as the central Lahore is worst affected during the rains.

3.4.1 Location of the Project Area

Project area lies within the Lahore City; based on topographical features and existing sewerage network, WASA has divided this service area into six (6) zones listed below:

- Central Zone;
- South Zone;
- South East Zone;
- Mehmood Booti;
- Khokhar Road; and
- Shahdara.

The project area lies within the Central Zone which is vey critically with respect to sewerage and drainage situation.

3.4.2 Existing Conditions

The existing WASA service area for sewerage system is about 350 km^2. Based on topographical features and existing sewerage network, WASA has divided this service area into six (6) sewerage catchment areas. **Figure 3.1** exhibits the layout of existing sewerage/drainage system in these sewerage districts.

As per available data with WASA, the sewerage system consist of 582 km length of trunk sewers and 2,926 km of lateral sewers, making a total length of 3,508 km. Twelve (12) major disposal pumping stations and seventy nine (79) intermediate lift stations are part of the overall sewage collection system. All of the wastewater is ultimately discharged into river Ravi without any treatment or used for agricultural purposes. The summary of sewerage catchments is given in **table 3.1.**

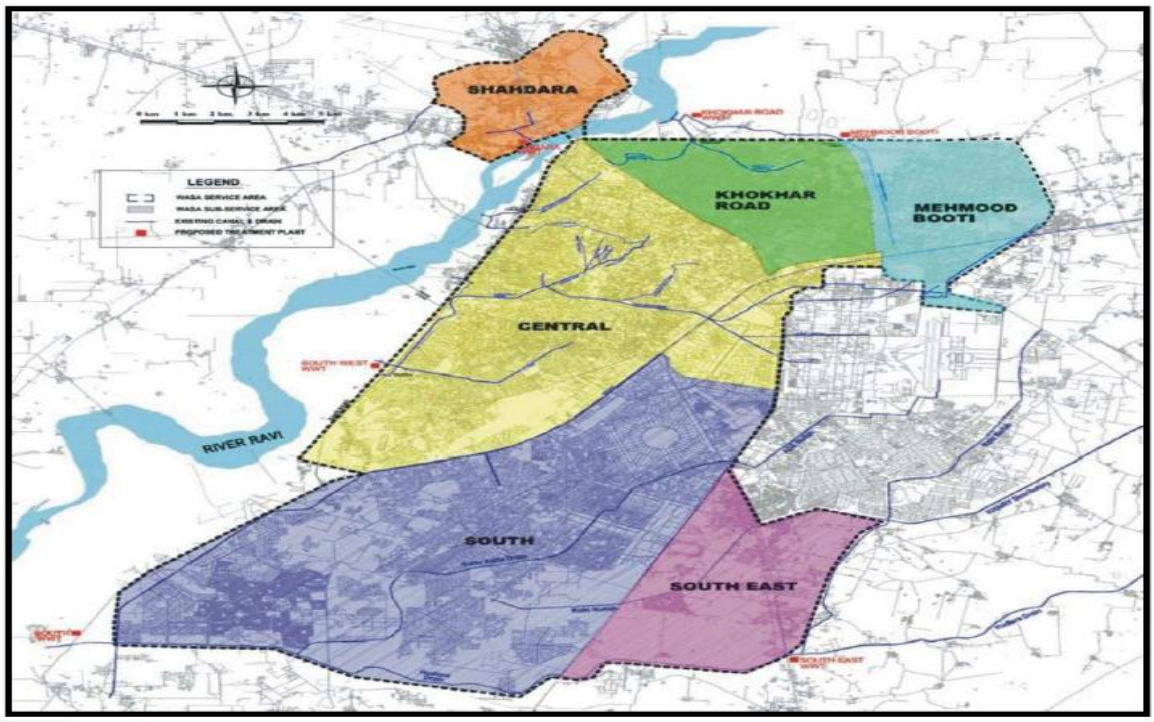


Figure 3.1: Sewerage Catchment Areas of Lahore

Table 3.1: Summary of Sewerage Catchments

Catchment Area	Area (km^2)	Number of Pumping Station		Length of Sewer (km)
		Disposal Stations	Lift Stations	
Shahdara	18.44	1	6	262
Mahmood Booti	22.79	1	10	126
Khokhar Road	29.19	2	18	526
Central	100.26	6	27	1,325
South	138.95	1	17	1,107
South East	39.65	1	1	162
Total	**340.28**	**12**	**79**	**3,508**

- **Existing Sewerage System in Central Catchment Area**

  The sewerage system in the Central Catchment Area consists of 233 km of trunk sewer and 1,092 km of lateral sewer, making a total length of 1,325 km, four (4) main drains, six (6) major sewage pumping stations, two (2) drainage pumping stations and twenty seven (27) intermediate lift stations. The intermediate lift and pumping stations ultimately feed into five (5) major disposal stations. The existing sewerage system mainly consists of reinforced concrete sewers while at some places brick masonry sewers are also present. In most cases, wastewater is discharged into the open drains through sewage lift stations.

Table 3.2 Technical Data of Disposal Stations in Central Catchment Area

Disposal Station	Location	Year of Commissioning	Total Capacity (Cfs)	Total Number of Pumps	Capacity of each pump (No.× Capacity)
Bhatti Gate	Near Data Darbar	2000	100	4	4 × 25 cfs
Main Outfall-1	Bund Road near Saggian Bridge	1945	181	10	2 × 25 cfs 2 × 8 cfs 1 × 40 cfs 5 × 15 cfs
Main Outfall-2	Bund Road near Saggian Bridge	1977	102	4	2 × 25 cfs 2 × 26 cfs
Main Outfall-3	Bund Road near Saggian Bridge	1985	87	5	3 × 25 cfs 2 × 6 cfs
Gulshan-e-Ravi	G-Block, Gulshan-e-Ravi near Bund Road	1992	560	14	8 × 40 cfs 6 × 40 cfs
Multan Road	Sabzazar Scheme, adjacent to Motorway Bypass	1982	240	6	6 × 40 cfs

- **Existing Wastewater Drains in Central Catchment Area**

  The drainage network of central area is very old and primarily dependent on Cantonment Drain. Total catchment area for Cantonment Drain has been estimated to be 23,653 acres. Some secondary/tertiary drains catering small areas of Central Zone are as below:

  - Cantonment Drain
  - Central Drain
  - Gulberg Drain No.1
  - Gulberg Drain No.2
  - Governor House Drain
  - Gulshan-e-Ravi Drain
  - Raj Garh Drain
  - Lower Mall Drain
  - Lake Road Drain
  - Upper Mall Drain
  - Allama Iqbal Town Drain
  - Lower Chotta Ravi Drain

  The proposed project end goal is to eliminate sewage from storm water drains and to enhance the capacity of the system. Drains which lie within the project area are discussed below:

- **Cantonment Drain**
  The total length of this drain starting from Joray Pull to New Babu Sabu pump station is about 63,000 ft. Its width varies from 12 ft to 95.0 ft. while its depth ranges from 6.0 ft to 15 ft. Its original section is greatly reduced due to dumping of solid wastes and encroachments at a number of locations. Capacity of the drain has been reduced due to accumulation of sludge and solid waste at the bottom and the drains flow at full capacity even during dry season.

- **Central Drain**
  Central drain is one of the main tributaries of Cantonment Drain serving the most critical areas of the Central Zone like Lakshami Chowk, Railway Station, Gawal Mandi, Mcleod road, Brandreth road and Hall road. Total length of this drain is about 4 km and its width of the drain varies from 3.5 m to 9.5 m and depth ranges from about 1.2 m to 3.8 m. This drain is badly silted up/filled and encroached at a number of places. This has reduced the original cross section considerably for storm water disposal. Due to ingress of sewage from adjoining areas, this drain is now acting as a Sullage carrier and it flows at its full capacity, like cantonment drain, even in the dry season.

- **Gulberg Drain No.1**
  Gulberg Drain No.1 is an earthen trapezoidal section drain with a high tension line running along the drain. A lot of dumping of solid waste was observed just after canal crossing and hence obstructing the flow. This drain serves several areas including Gulberg and Cantt area. Starting from Garrison Mess, it joins Gulberg Drain No.2 near Main Boulevard. It is mostly uncovered except along Alauddin Road where it is covered. Some encroachments were noted at right side of Kashmir road in Ghous-e-Azam Colony. It is extensively encroached just before railway line crossing. The junction point of Gulberg Drain No. 1& 2 is very well developed from horticulture point of view giving very pleasant look and creating good environment.

- **Gulberg Drain No.2**
  Gulberg Drain No.2 is an earthen trapezoidal section passing through Gulberg area. It joins Gulberg Drain No.1 after crossing Main Boulevard near Home Economics College. Significant dumping of solid waste was observed in the drain downstream of Main Boulevard. Service road is available on one side of the drain with residential buildings right on the other edge. A number of house sewers are discharging waste on its way in addition to main flow from Sunny Flour Mill lift station serving lot of Gulberg area. Ultimately, it crosses Shami road where small drain from Cantonment area is connected with it.

- **Gulshan-e-Ravi Drain**
  This drain serves to carry sewage from Gulshan-e-Ravi pump station to Cantonment Drain. Its total length up to Cantonment Drain junction is 3250 ft. This drain is 15 ft. wide and 4 ft. deep, with well-maintained brick section in good condition.

  In simple words; at present, there is no Trunk sewerage system present in the project area, at many locations of project area, lift stations are constructed which are pumping sewage directly into the nearby storm water channels/drains to work as sullage carriers. These storm

water channels pass through highly populated residential areas and cause environmental nuisance and spread of diseases. Moreover, during monsoon season the storm water bodies cannot cater the additional flow and stagnation is observed in a number of areas causing problems to the inhabitants.

3.4.3 Access Roads

The proposed project can be accessed through various route consists of 28.28 Km length covering the areas within Central Zone of Lahore. The Line A of network collects sewage from Larech Colony, Gahri Shahau, Durand Road, Shimla Hill, Cooper Road, Queens Road, Bahawalpur Road, Chauburgi Chowk and Gulshan-e-Ravi. Second reach covers the area of Infantry Road, Mustafabad, Basti Saddian Shah, Mian Mir Colony, Gulberg, Shadman, Shah Jamal, Shama, Rasool Park, Samnabad, and adjoining localities and further dispose it to proposed 350 cusec disposal station located at Gulshan-e-Ravi. The location map of the proposed project is shown in **figure 3.2.**

3.4.4 Components of the Project

As per Master Plan / recommendation of M/s NESPAK (2005), JICA (2010) and MMP (2018) Master Plan study as discussed in Section 1, improvement of sewerage system has been recommended by laying of new Trunk Sewer through trenchless technology lines one branch start from Larech Colony and other from Infantry Road and converge at Gulshan-e-Ravi Road and lead to Gulshan-e- Ravi Disposal Station, where construction of new pumps have been proposed to dispose the sewage /storm water into river Ravi.

Following are the major components of the proposed Project:

- Trunk sewers, 28 km long and having various diameters; and
- New pumps having a capacity of 10 cubic meter per second (Cumecs) to be installed in the existing Gulshan-e-Ravi Disposal Station.

3.4.5 Route Alignment

Originally the route proposed for sewerage scheme was 33.11 km in length but it was realigned to 28 km in length to accommodate turnings, to minimize crossing with other infrastructural development works, and to maintain traffic safety and convenience and divided into two reaches. The first leg covers area from Larech Colony to Gulshan-e-Ravi (Line A) having a total length of 15.26 Km. The other leg caters the flow from Infantry Road and Gulberg area to Gulshan-e-Ravi (Line B) and comprise of 13.02 Km. The details of the areas to be served under the project are as under:

a. Larech Colony to Gulshan-e-Ravi (Line-A)

The first leg comprises of 15.26 Km sewer which passes through heavily populated areas of Lahore. Excessive and unnecessary turnings were avoided to minimize the number of Launching and Recipient stations and to achieve maximum drive lengths. This line of the sewerage system would serve the localities of Larech Colony, Gahri Shahu, Durand Road, Shimla Hill, Cooper Road, Queens Road, Bahawalpur Road, Chauburgi Chowk, Gulshan-e-Ravi and their adjoining areas. The length Statement of Main Trunk of Line A is shown in **table 3.3.**

Table 3.3: Length Statement of Main Trunk of Line A

Sr. No.	Location	Dia of pipe (mm)	Sewer Segment	Length (m)	Accumulative Length (m)
1.	Colony To Garhi Shahu Bazar	1500	Main Trunk	801	801
2.	Ghazi Muhallah Disposal Lateral	1500	Lateral	122	923
3.	Garhi Shahu Bazar to Garhi Shahu Chowk	1500	Main Trunk	237	1160
4.	Muhammad Naggar Disposal Lateral	1500	Lateral	271	1431
5.	Garhi Shahu Chowk to Shimla Hill	1500	Main Trunk	857	2288
6.	Davis Road Sewer	1500	Lateral	754	3042
7.	Shimla Hill to Edgerton Road	1500	Main Trunk	193	3235
8.	Empress Road Sewer	1500	Lateral	541	3776
9.	Edgerton Road to Copper Road	1500	Main Trunk	943	4719
10.	Montgomery Road Sewer	1500	Lateral	715	5434
11.	Provincial Assembly to Chauburgi Chowk	2400	Main Trunk	3263	8697
12.	Main Bazar Islam Pura Sewer	1500	Lateral	837	9534
13.	Sanda Road Sewer	1500	Lateral	2303	11837
14.	Chauburji Chowk to Gulshan-e- Ravi Disposal	2400	Main Trunk	3419	15256

The general layout plan of Sewer line A is depicted in **Figure 3.3.**

b. Infantry Road to Gulshan-E-Ravi (Line-B)

The Second leg comprises of 12.60 km sewer, which caters the flow from densely populated areas of Lahore. Sewer alignment was kept along the road, or nearly so, with its position refined to reduce the impact on existing infrastructures and residential areas to get maximum advantage of the trenchless technology. This line of the sewerage system would serve the localities of Infantry Road, Mustafabad, Basti Saddian Shah, Mian Mir Colony, Gulberg, Shadman, Shah Jamal, Rasool Park, Samanabad and adjoining Abadies to the disposal station at Gulshan-e-Ravi. The length Statement of Main Trunk of Line A is shown in **Table 3.4.**

Table 3.4: Length Statement of Main Trunk of Line B

Sr. No.	Location	Dia of pipe (mm)	Sewer Segment	Length (m)	Accumulative Length (m)
1.	Gurumangat Disposal to Q Block Disposal	1500	Main Trunk	790	790
2.	Q Block Disposal Lateral	1500	Lateral	405	1195
3.	Q Block Disposal to P Block Disposal	1500	Main Trunk	1473	2668
4.	Infantry Road Disposal to Canal Disposal	1500	Lateral	2246	5327
5.	Canal Disposal to Shadman Disposal	2400	Main Trunk	1313	6640
6.	Shadman Disposal to Shama Disposal	2400	Main Trunk	897	7537
7.	Shama Disposal to Rasool Park Disposal	2400	Main Trunk	545	8082
8.	Rasool Park Disposal Lateral	1500	1500	319	8401
9.	Rasool Park Disposal to Gulshan-e-Ravi Disposal	2400	Main Trunk	4622	13023

The general layout plan of Sewer line A is depicted in **Figure 3.4.**

3.4.6 Detailed Design

The system is designed for the expected wastewater flows in the design year 2032 and the corresponding projected population. The design parameters adopted for the design of trunk sewers using gravity flow are defined below in **Table 3.5.**

Table 3.5: Detailed Design Parameters

Parameters	Dia. of Pipe (1500 mm)	Dia. of Pipe (2400 mm)
Velocity		
Min.	1.00	1.15
Max.	1.16	2.13
Slope		
Min.	0.000697	0.000371
Max.	0.00262	0.00214
Manholes		
Recipient Station (m)	6.9 x 4.9	8.7 x 5.6
Launching Station (m)	8.0 x 4.5	11.0 x 5.0
Pipe Size: 60” and 96”		
Disposal Station: 350 cusecs with an arrangement of 10 No. pumps of 50 cusec each		

Parameters	Dia. of Pipe (1500 mm)	Dia. of Pipe (2400 mm)
Pumping Head		
Total Pumping Head	23 m	
Total Static Head	17 m	
Total Dynamic Head Loss	06 m	

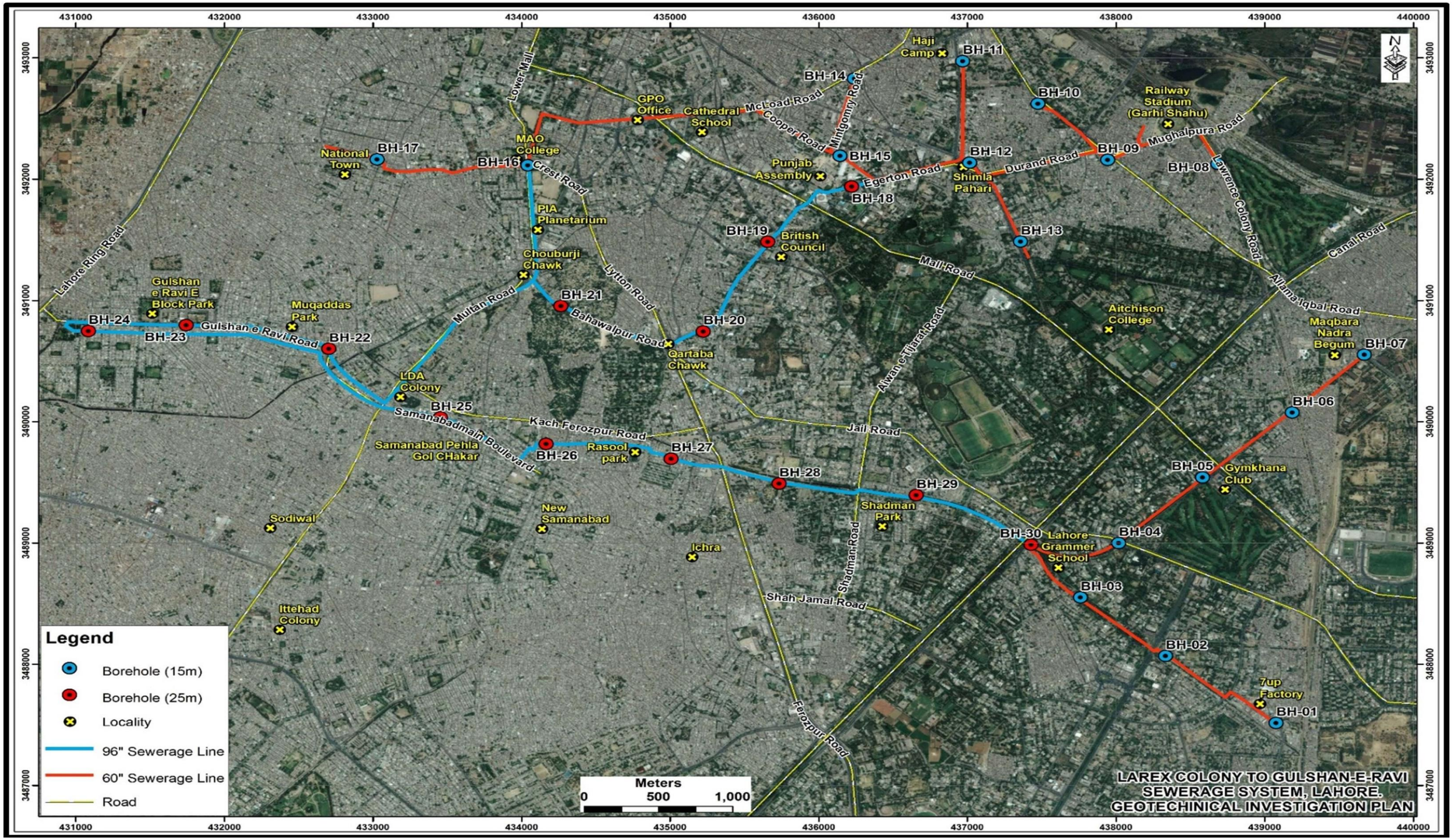
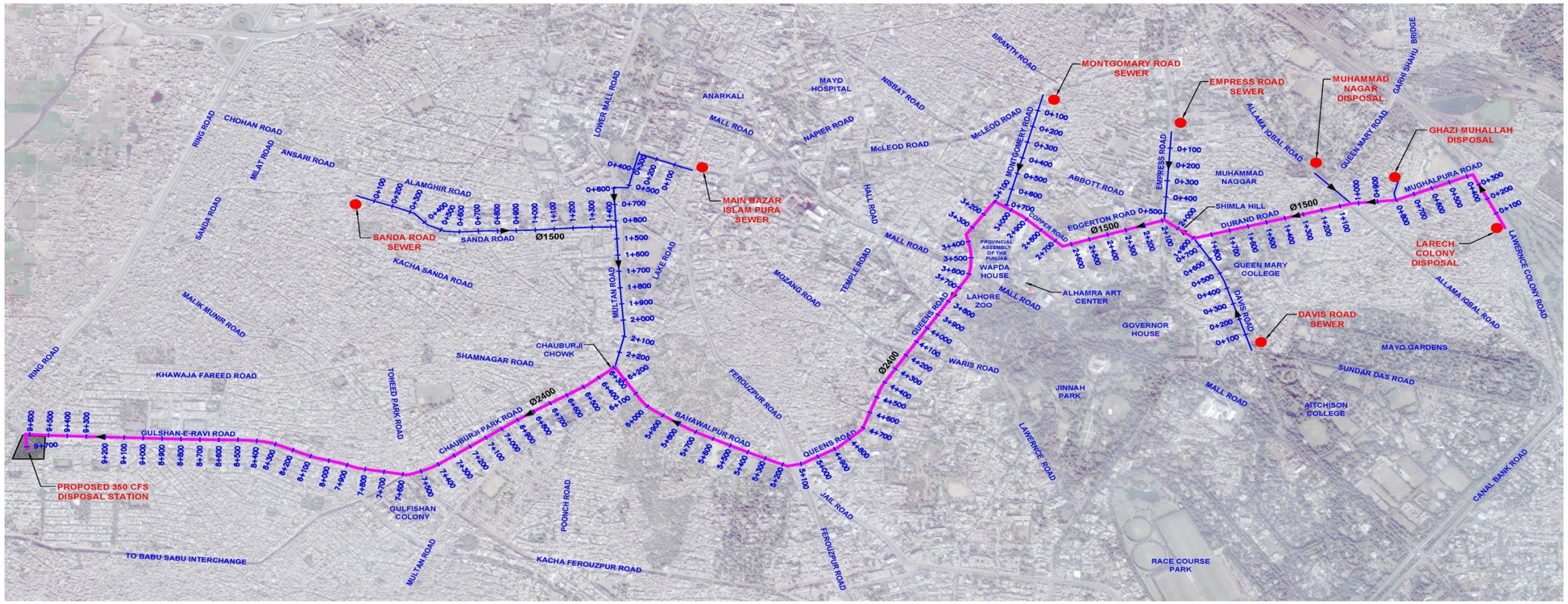


Figure 3.2: Location Map of the Project Area



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LAYING OF TRUNK SEWER FROM LARECH COLONY TO GULSHAN–E–RAVI

TRUNK SEWER GENERAL LAYOUT PLAN LINE–A

SCALE: N.T.S

DATE:– JANUARY, 2019

DRAWING No. 3749/11/T/2J100

REV.:– 0

Figure 3.3 General layout plan of Sewer line A

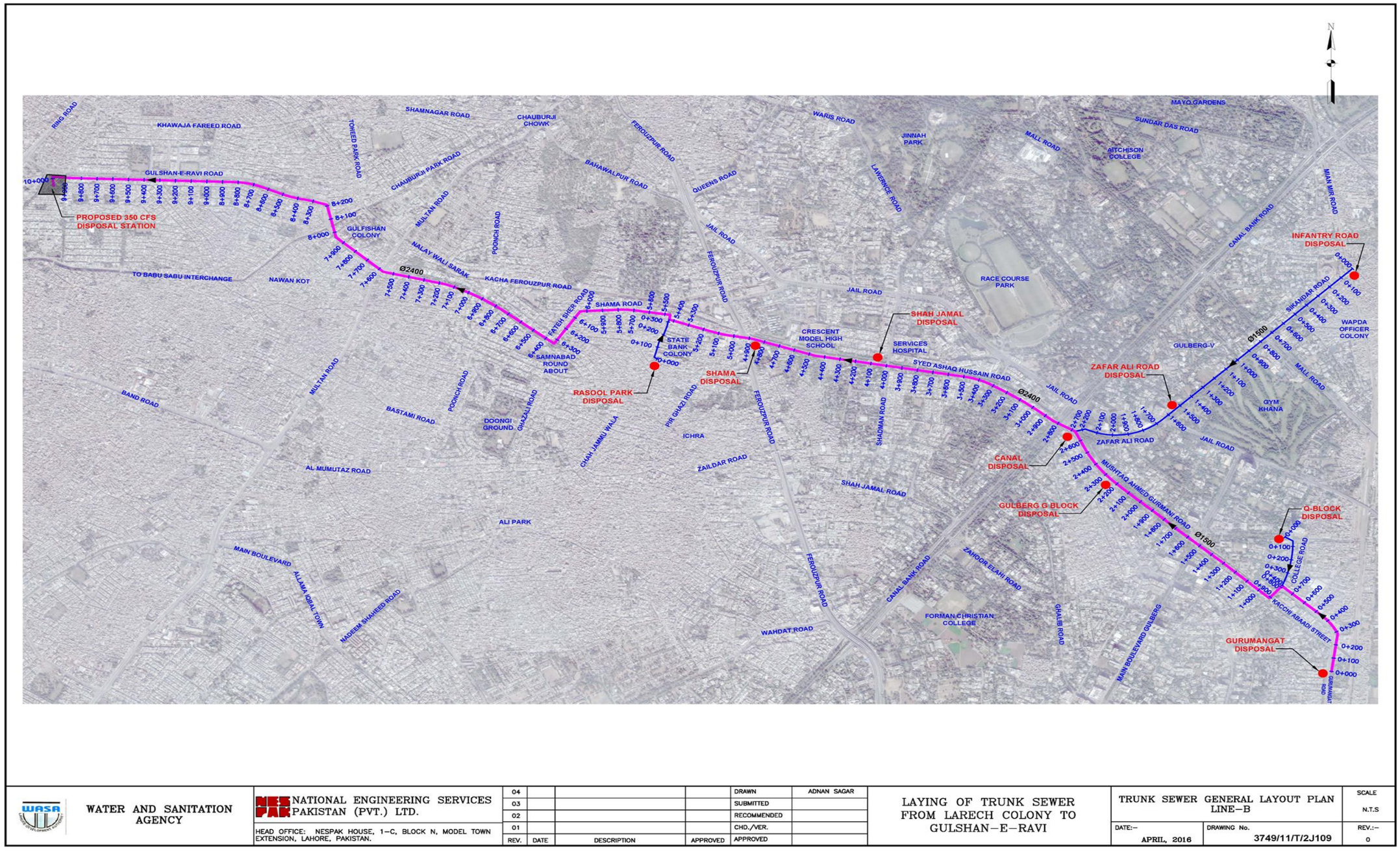


Figure 3.4 General layout plan of Sewer line B

3.4.6.1 Depth of Sewer Pipes

The sewerage system will be laid underground at the depth of about 10 meters.

3.4.6.2 Design Life of the Project

The design life of the sewerage scheme is 25 years and that of machinery is 40 years with following population densities i.e.:

Low	6 - 9 Persons/Kanal
Medium	16 Persons/Kanal
Per capita sewage flow	70 gpcd (80% of water demand)

3.4.6.3 Launching and Recipient Stations

Tunnel boring machine will be launched using launching stations while it will be drawn using the recipient station. For Line A, total 26 launching and 26 recipient stations are designed while for Line B 18 launching stations and 24 recipient stations are designed. **Tables 3.4 & 3.5** depicts brief detail of these stations.

Table 3.4: Recipient Station Line-A

Sr. No.	Station	Location	Segment	Dia. of Pipe	Coordinates	
				(mm)	Easting	Northing
1	RA-01	Larech Colony Disposal	Main Trunk	1500	438646.99	3492284.89
2	RA-02	Garhi Shahau Main Bazar	Main Trunk	1500	438261.79	3492313.41
3	RA-04	Shimla Hill	Main Trunk	1500	436943.30	3492154.24
4	RA-05	Edgerton Road	Main Trunk	1500	436407.44	3491992.36
5	RA-06	Punjab Provincial Assembly	Main Trunk	1500	436049.34	3492268.36
6	RA-07	Mall Road Fountain	Main Trunk	2400	435909.30	3491808.41
7	RA-08	Queens Road	Main Trunk	2400	435506.74	3491214.58
8	RA-09	Queens Road	Main Trunk	2400	435221.46	3490758.77
9	RA-10	Ferouzpur road	Main Trunk	2400	434956.72	3490646.33
10	RA-11	Bhawalpur Road	Main Trunk	2400	434281.82	3490969.72
11	RA-16	Chauburji Park Road	Main Trunk	2400	433801.25	3491085.90
12	RA-17	Chauburji Park Road	Main Trunk	2400	433150.55	3490679.52
13	RA-18	Gulshan-e-Ravi Colony	Main Trunk	2400	432691.32	3490634.05
14	RA-19	Gulshan-e-Ravi Road	Main Trunk	2400	431952.20	3490808.08
15	RA-20	Gulshan-e-Ravi Road	Main Trunk	2400	431244.31	3490828.73
16	RA-03	Muhammad Naggar Disposal	Lateral Sewer	1500	437734.46	3492442.17
17	RA-12	Main Bazar Islampura	Lateral Sewer	1500	434454.32	3492458.98
18	RA-13	Lodge Road	Lateral Sewer	1500	434117.17	3492351.42
19	RA-14	Sanda Road	Lateral Sewer	2400	434027.81	3492105.81
20	RA-15	Lake Road	Lateral Sewer	2400	434097.88	3491451.02
21	RA-21	Sanda Road	Lateral Sewer	2400	432658.65	3492297.39
22	RA-22	Sanda Road	Lateral Sewer	2400	433143.01	3492077.53
23	RA-23	Montgomary Road	Lateral Sewer	1500	436279.26	3492913.28

24	RA-24	Empress Road	Lateral Sewer	1500	436956.18	3492687.68
25	RA-25	Devis Road	Lateral Sewer	1500	437249.49	3491728.76
26	RA-26	Montgomary Road	Lateral Sewer	1500	436083.88	3492225.02

Launching Station Line-A

Sr. No.	Station	Location	Segment	Dia. of Pipe	Coordinates	
				(mm)	Easting	Northing
1	JA-01	Larech Colony Disposal	Main Trunk	1500	438739.75	3492106.42
2	JA-02	Mughalpura Road	Main Trunk	1500	438570.20	3492432.63
3	JA-03	Garhi Shahau Chowk	Main Trunk	1500	437929.90	3492254.46
4	JA-04	Durand Road	Main Trunk	1500	437533.36	3492152.67
5	JA-05	Shimla Hill	Main Trunk	1500	437099.45	3492041.46
6	JA-06	Edgerton Road	Main Trunk	1500	436584.72	3492047.22
7	JA-07	Punjab Provinsial Assembly	Main Trunk	1500	436195.97	3492177.03
8	JA-08	Punjab Provinsial Assembly	Main Trunk	2400	435898.33	3492064.54
9	JA-09	Queens Road	Main Trunk	2400	435744.73	3491566.44
10	JA-10	Queens Road	Main Trunk	2400	435350.38	3490872.18
11	JA-11	Ferouzpur road	Main Trunk	2400	435036.08	3490662.10
12	JA-12	Bhawalpur Road	Main Trunk	2400	434635.81	3490781.73
13	JA-16	Chauburji Chowk	Main Trunk	2400	434046.52	3491251.76
14	JA-17	Chauburji Park Road	Main Trunk	2400	433395.37	3490839.58
15	JA-18	Gulshan-e-Ravi Colony	Main Trunk	2400	432951.79	3490592.75
16	JA-19	Gulshan-e-Ravi Road	Main Trunk	2400	432365.19	3490738.07
17	JA-20	Gulshan-e-Ravi Road	Main Trunk	2400	431451.80	3490822.30
18	JA-21	Gulshan-e-Ravi Road	Main Trunk	2400	430938.30	3490843.34
19	JA-13	Main Bazar Islampura	Lateral Sewer	1500	434171.48	3492560.52
20	JA-14	Lodge Road	Lateral Sewer	2400	434039.19	3492354.19
21	JA-15	Multan Road	Lateral Sewer	2400	434072.96	3491753.87
22	JA-22	Sanda Road	Lateral Sewer	2400	432963.15	3492188.30
23	JA-23	Sanda Road	Lateral Sewer	2400	433592.92	3492085.46
24	JA-24	Montgomary Road	Lateral Sewer	1500	436183.68	3492576.58
25	JA-25	Devis Road	Lateral Sewer	1500	437404.12	3491356.62
26	JA-26	Empress Road	Lateral Sewer	1500	437404.12	3491356.62

Table 3.5: Launching Station Line-B

Sr. No.	Station	Location	Segment	Dia of Pipe	Coordinates	
				(mm)	Easting	Northing
1	JB-01	College Road	Lateral Sewer	1500	438827.50	3487953.22
2	JB-02	Infantary Road	Lateral Sewer	1500	439221.62	3490133.74
3	JB-03	Infantary Road	Lateral Sewer	1500	438956.40	3489888.01
4	JB-04	Mall Road	Lateral Sewer	1500	438698.87	3489649.35

Sr. No.	Station	Location	Segment	Dia of Pipe	Coordinates	
				(mm)	Easting	Northing
5	JB-05	Zafar Ali Road	Lateral Sewer	1500	438345.92	3489322.27
6	JB-06	Jail Road	Lateral Sewer	1500	437946.29	3488962.37
7	JB-07	Canal Bank Road	Lateral Sewer	1500	437518.07	3488939.70
8	JB-08	Gurumangat Disposal	Main Trunk	1500	439086.84	3487137.70
9	JB-09	Gurumangat Road	Main Trunk	1500	438964.03	3487605.65
10	JB-10	College Road	Main Trunk	1500	438690.46	3487683.37
11	JB-11	Main Boulevard Gulberg	Main Trunk	1500	438254.40	3488065.28
12	JB-12	Mustaq Ahmed Road	Main Trunk	1500	437792.34	3488466.09
13	JB-13	Canal Disposal	Main Trunk	1500	437557.61	3488719.62
14	JB-14	Canal Bank Road	Main Trunk	2400	437315.11	3488998.11
15	JB-15	Shadman	Main Trunk	2400	436564.39	3489358.44
16	JB-16	Syed Ashfaq Hussain Road	Main Trunk	2400	435795.24	3489484.06
17	JB-17	Ferozepur Road	Main Trunk	2400	435310.97	3489624.59
18	JB-18	Shama Road	Main Trunk	2400	434865.35	3489753.46
19	JB-19	Shama Road	Main Trunk	2400	434871.34	3489788.68
20	JB-20	FatehSher Road	Main Trunk	2400	434297.22	3489815.00
21	JB-21	Samnabad	Main Trunk	2400	433791.23	3489831.48
22	JB-22	Multan Road	Main Trunk	2400	433041.06	3490110.20
23	JB-23	Gulshan-e-Ravi Colony	Main Trunk	2400	432682.71	3490605.52
24	JB-24	Gulshan-e-Ravi Road	Main Trunk	2400	431928.70	3490778.16
25	JB-25	Gulshan-e-Ravi Road	Main Trunk	2400	431219.17	3490799.88

Recipient Station Line-B

Sr. No.	Station	Location	Segment	Dia of Pipe	Coordinates	
				(mm)	Easting	Northing
1	RB-07	Gurumangat Road	Main Trunk	1500	439126.16	3487418.60
2	RB-08	Gurumangat Road	Main Trunk	1500	438770.20	3487772.82
3	RB-09	Mustaq Ahmed Road	Main Trunk	1500	438458.14	3487889.23
4	RB-10	Mustaq Ahmed Road	Main Trunk	1500	438025.19	3488264.15
5	RB-11	Mustaq Ahmed Road	Main Trunk	1500	437673.33	3488575.21
6	RB-12	Canal Disposal	Main Trunk	1500	437452.75	3488921.31
7	RB-13	Mental Hospital	Main Trunk	2400	436945.32	3489252.29
8	RB-14	Shadman Road	Main Trunk	2400	436261.73	3489408.59
9	RB-15	Ferozepur Road	Main Trunk	2400	435391.46	3489612.11
10	RB-16	Shama Road	Main Trunk	2400	435074.04	3489684.24
11	RB-17	Shama Road	Main Trunk	2400	434550.61	3489826.80
12	RB-18	Samnabad Roundabout	Main Trunk	2400	434131.22	3489575.30
13	RB-19	Samnabad	Main Trunk	2400	433439.10	3490016.05
14	RB-20	Gulshan-e-Ravi Colony	Main Trunk	2400	432744.08	3490362.57
15	RB-21	Gulshan-e-Ravi Road	Main Trunk	2400	432334.29	3490710.71

Sr. No.	Station	Location	Segment	Dia of Pipe	Coordinates	
				(mm)	Easting	Northing
16	RB-22	Gulshan-e-Ravi Road	Main Trunk	2400	431426.40	3490793.48
17	RB-23	Gulshan-e-Ravi Road	Main Trunk	2400	430933.52	3490815.16
18	RB-01	College Road	Lateral Sewer	1500	438841.66	3488108.30
19	RB-02	Infantary Road	Lateral Sewer	1500	439096.84	3490018.15
20	RB-03	Infantary Road	Lateral Sewer	1500	438829.35	3489770.27
21	RB-04	Zafar Ali Road	Lateral Sewer	1500	438512.89	3489477.01
22	RB-05	Zafar Ali Road	Lateral Sewer	1500	438152.14	3489142.70
23	RB-06	Zafar Ali Road	Lateral Sewer	1500	437740.96	3488895.72
24	RB-24	Rasool Park Disposal	Lateral Sewer	1500	434770.26	3489473.27

3.4.6.4 Connection with the Existing Disposal

In order to connect the existing disposal stations with the proposed scheme manholes are provided at every disposal. These manholes are connected with the nearby-proposed stations via open cut excavation. Stations are strategically placed in front of each disposal station in order to minimize the length of open cut excavation. The detail of connection of each inflow point is tabulated below.

Sr. No.	Location	Connecting Station	Length (m)	Method of Connection
1.	Larech Colony	JA-01	45	Open Cut
2.	Ghazi Muhallah	*RA-02	15	Open Cut
3.	Muhammad Nagar	RA-03	25	Open Cut
4.	Infantry Road	JB-02	40	Open Cut
5.	Zafar Ali Road	RB-05	75	Open Cut
6.	Canal	RB-12	40	Open Cut
7.	Sunny Flour Mills	JB-08	60	Open Cut
8.	Gulberg Q Block	RB-08	90	Open Cut
9.	Gulberg G Block	RB-11	25	Open Cut
10.	Shah Jamal	RB-14	72	Open Cut
11.	Shama	RB-15	40	Open Cut
12.	Rasool Park	RB-24	25	Open Cut
13.	Davis Road Sewer	JA-25	50	Open Cut
14.	Empress Road Sewer	RA-24	50	Open Cut
15.	Montgomary Road Sewer	RA-23	50	Open Cut
16.	Main Sewe Br azar Islampura	RA-12	50	Open Cut
17.	Sanda Road Sewer	RA-21	50	Open Cut

3.4.7 Project Administrative Jurisdiction

The proposed Project lies in the Central Zone of Lahore District of Punjab region of Pakistan.

3.4.8 Project Implementation Schedule

The proposed project will be completed with an estimated construction period of 30 months.

3.5 Land Use of the Project Site

Land use of the project area is mainly commercial with some educational facilities, medical facilities, religious sites and recreational facilities. **Figures 3.4** and **3.5** show land-use of the project area. Further details are provided in Section-4.

3.6 Vegetation Features of the Project Site

The study area has a variety of trees shrubs, herbs and grasses along the roadsides and in the lawns of administrative buildings, educational institutions and parks. Further details are provided in Section-4.

3.7 Land Acquisition

There is no land acquisition involved for construction of proposed project.

3.8 Construction Material and Machinery

Most of the construction material is expected to be procured from Punjab and Khyber Pakhtunkhwa (KP) Province of Pakistan. The construction material that will be used for construction activities are:

- Cement;
- Sand;
- Aggregate;
- Bentonite;
- Steel;
- HPPE Pipes;
- Stainless Steel;
- Bricks; and
- Water.

The construction machinery that will be used for construction activities are:

- TBM;
- Excavators;
- Batching Plant;
- Cranes;
- Tractors;
- Trolley;
- Vibratory Roller; and
- Water Tankers.

3.9 Construction Camp (Temporary Facility)

Camp site will be selected keeping in view the availability of adequate area including parking areas for machinery, stores and workshops, access to communication and local markets and an appropriate distance from sensitive areas in the vicinity. Final location will be selected by the contractor after approval from the Proponent.

3.10 Workforce Requirements

The estimated number of workers (including skilled and semi-skilled labour) required for whole construction period is 1,000.

3.11 Power Requirement/ Power Source

- ***During Construction Phase:***

The main source of electricity/electric power during construction phase will be diesel generators.

- ***During Operational Phase:***

Electric power shall be supplied by the Lahore Electric Supply Company (LESCO) during operational phase.

3.12 Water Requirement

The water consumption is estimated to be 80,000[1] gallons/day for 1,000 construction workers during construction phase of the proposed project.

3.13 Wastewater Generation

The wastewater generation is estimated to be 64,000[2] gallons/day for 1,000 construction workers during construction phase of the proposed project.

3.14 Solid Waste Estimation

The solid waste generation is estimated to be 650 kg/day for 1,000 construction workers during construction phase of the proposed project.

[1] WASA Average Daily Per Capita Water Consumption (80 gallons/day)
[2] Design Criteria of Public Health Engineering for Water Supply, Sewerage and Storm Water Drain (Domestic sewage generation = 80% of water consumed/day)

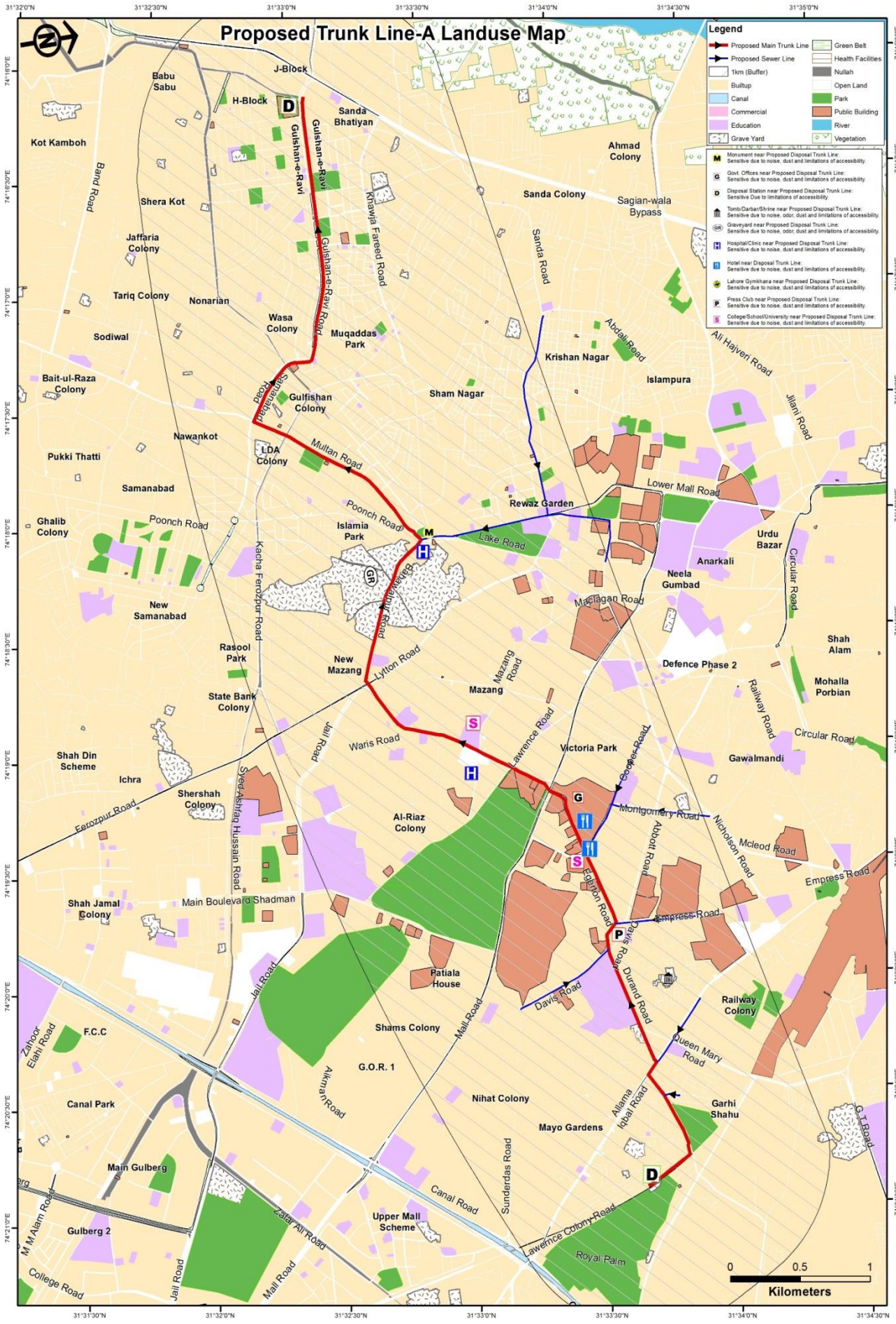


Figure 3.4: Land Use of the Project Area of Trunk Sewer Line A

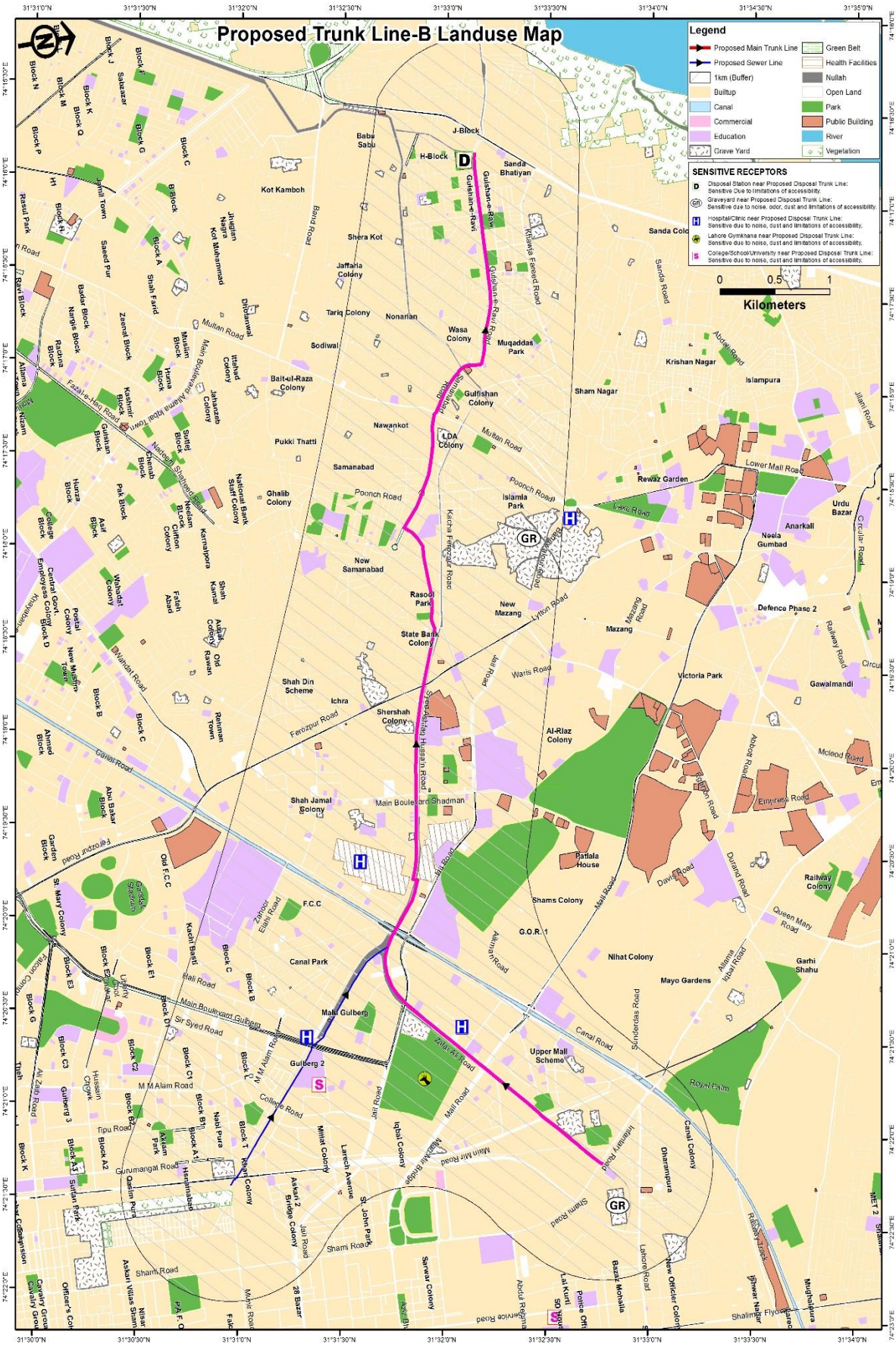


Figure 3.5: Land Use of the Project Area of Trunk Sewer Line B

3.15 Construction Methodology

3.15.1 Trenchless Technology

The Trenchless technology "Horizontal Boring/ Pipe Jacking technology" have been proposed to lay the trunk sewer lines to reduce the traffic disruption and public inconvenience and speedy construction etc. The Tunnel Boring Machine (TBM) will enter from the launch shaft to a required depth and do the horizontal boring and then pipe will be jacked hydraulically behind it. Slope and Direction of sewer pipes are maintained by laser guided TBM.

Several tunneling technologies are in place based on different geological conditions. Based on ASCE 36-15 proposed standard flow chart and recommendations of the MTBM manufacturer, slurry type remote controlled Micro Tunnel Boring Machine (MTBM) is selected for the project.

3.15.2 Slurry MTBM

This machine can excavate the material at the tunnel face and mixed it with bentonite and other lubrication fluids to create slurry. Pressure at the cutting face is balanced with earth removal, groundwater head (if encountered), and propulsion of the tunnel support without manned entry. Excavated material which is captured in the slurry is pumped to the surface and separated. A typical drive shaft arrangement with MTBM lowered in the shaft is shown in the **figure 3.6** below.

Figure 3.6: A Typical Drive Shaft Arrangement with MTBM Lowered in the Shaft

SECTION-4
ENVIRONMENTAL AND SOCIAL BASELINE PROFILE

4.0 General

An environmental and social baseline study is intended to establish a database against which potential project impacts can be predicted and managed later. The ESIA of the proposed project covers a comprehensive description of the project area, including the resources which are expected to be affected by the project, as well as, those which are not expected to be directly affected by the construction and operation of the project. The existing environmental conditions around the proposed project have been considered with respect to physical, biological and socio-economic aspects. Site visits were conducted to survey the field area and to collect environmental data on physical, biological and socio-economic parameters. Consultations were held with the general public and stakeholders of the project area in order to seek the public opinion on the implementation of the proposed project.

4.1 Physical Resources

4.1.1 Topography

The topography of the project area is flat. The General height of the area is approximately 220 meters above the Mean Sea Level (MSL). Lahore district is divided into two parts. The low lying alluvial soil is along the Ravi River, and the upland in the east. Upland is a plain slope from north-east to south-west. The lowlands are generally inundated during the monsoon season by Ravi River, flowing in the west of district along its boundary with district Sheikhupura. **Figure 4.1** represents the topography of the area.

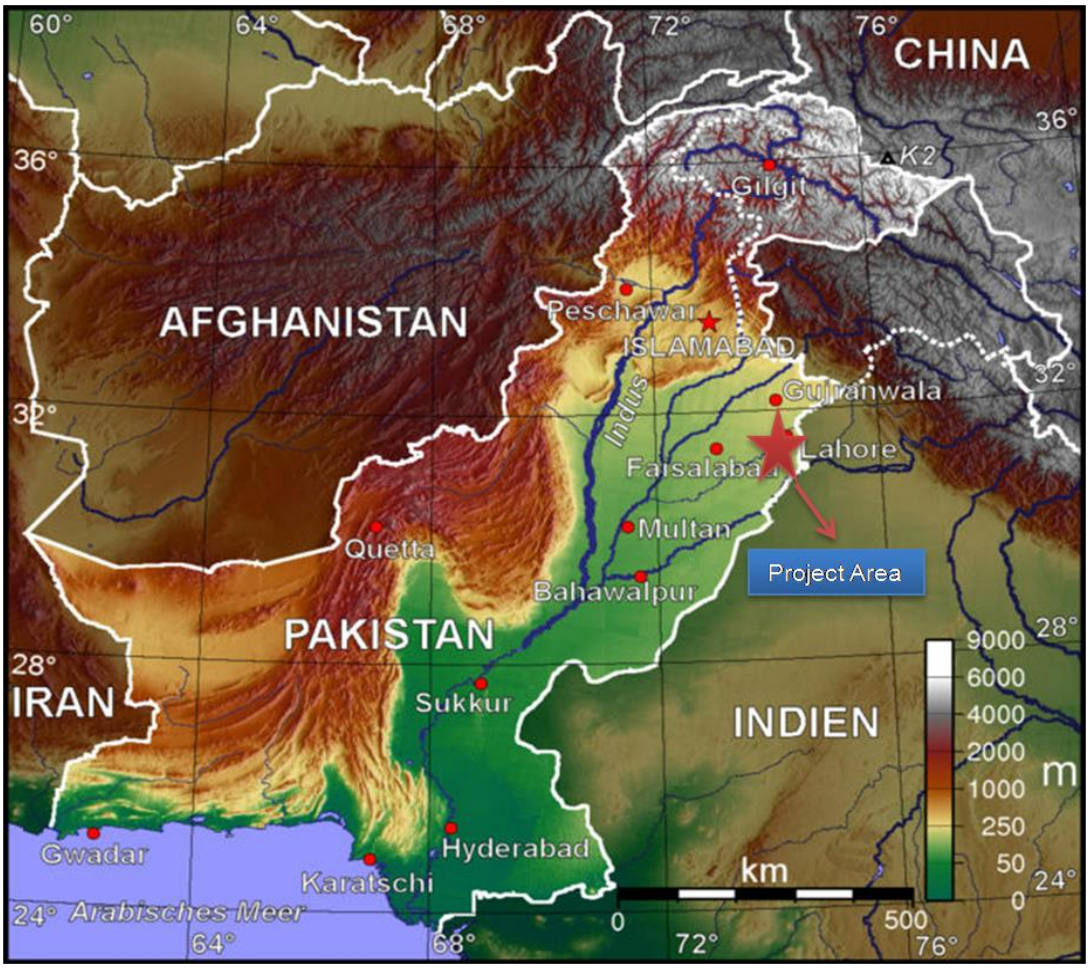


Figure 4.1: Topography of the Study Area

4.1.2 Regional Geology

The soil deposits at the project site belong to Chung Fun formation indicating the last glacial cycle. It was followed by the period of melting of glaciers, resulting in deposition of clay, silt and sand deposits in late Pleistocene to recent. With gradual withdrawal of the sea during the late territory time, shallow water and possibly deltaic deposits were laid down. It became a vast flood plain on which debris of numerous streams have mingled to load it with huge thickness of alluvial material derived from the Himalaya. Though, there is no evidence of any glaciations in the area, the series of great climatic changes during the Pleistocene period had impact on the sedimentation in physiography of this region.

The presence of old channels of Ravi River indicates conformity of the stream oscillation to terrestrial rotation in the deflection of streams. However, abrupt migration indicates period of excessive flooding during which earlier channels were choked with sediments and the streams were forced to create new channels (Kamzi 1964).

These alluvial deposits comprise earthy brown to brown silt, clay and sand. The beds are largely hard, laminated and sandy with inter-beds of clay and layers or lenses of

sand. Geological map of the Study Area is given in **Figure 4.2**. Project site is located in meander belt deposits.

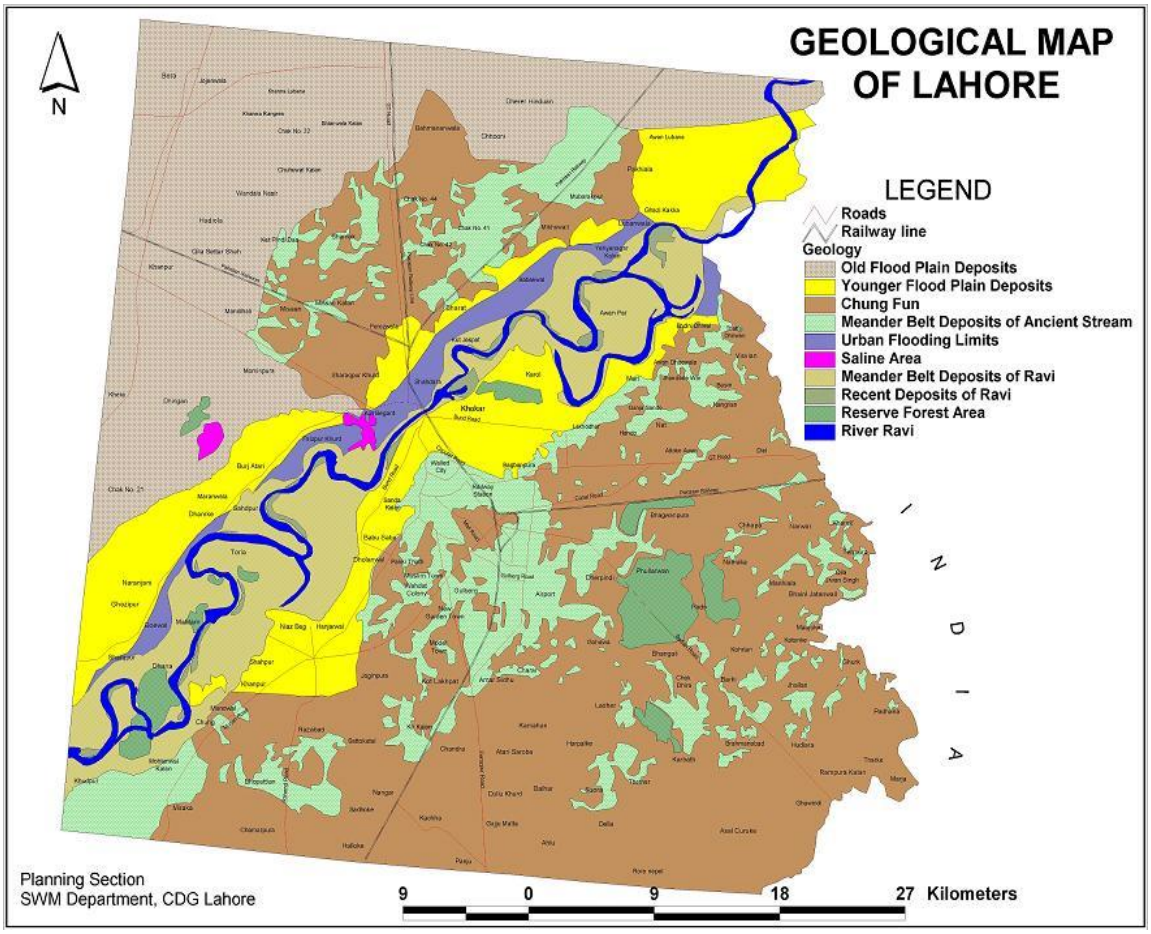


Figure 4.2: Geological Map of the Study Area

The Project Area does not have any valuable minerals. Although, scientific/in depth, investigations haven't been carried out, yet the surveys conducted have failed to discover any minerals worth the name till to- date.

The only minerals worth to value are kallar and kankar in the district Lahore. Kallar is the grey powdery substance collected and taken out from the old village sites and other deserted abodes in the district. It is used for the manufacture of crude saltpeter and also as manure for the top dressing of young cotton and tobacco plants (no longer in the line of extensive cultivation). With the passage of time the demand for Kallar diminished and its use as a trading commodity is on the decline. Kankar is used for metaling roads and its smaller particulars are burnt for lime. It is a kind of limestone gravel and is found, after being dug out at a depth varying from one to eight feet, in many parts of the district particularly the uplands.

4.1.3 Soil

The soil in the project area is cohesion less and is of alluvial type deposited by Ravi River. Various soil layers below the ground level includes: silt, silty clay, silty sand,

poorly graded sand with silt, lean clay etc. Soil Map of the Project Area is given in **Figure 4.3**.

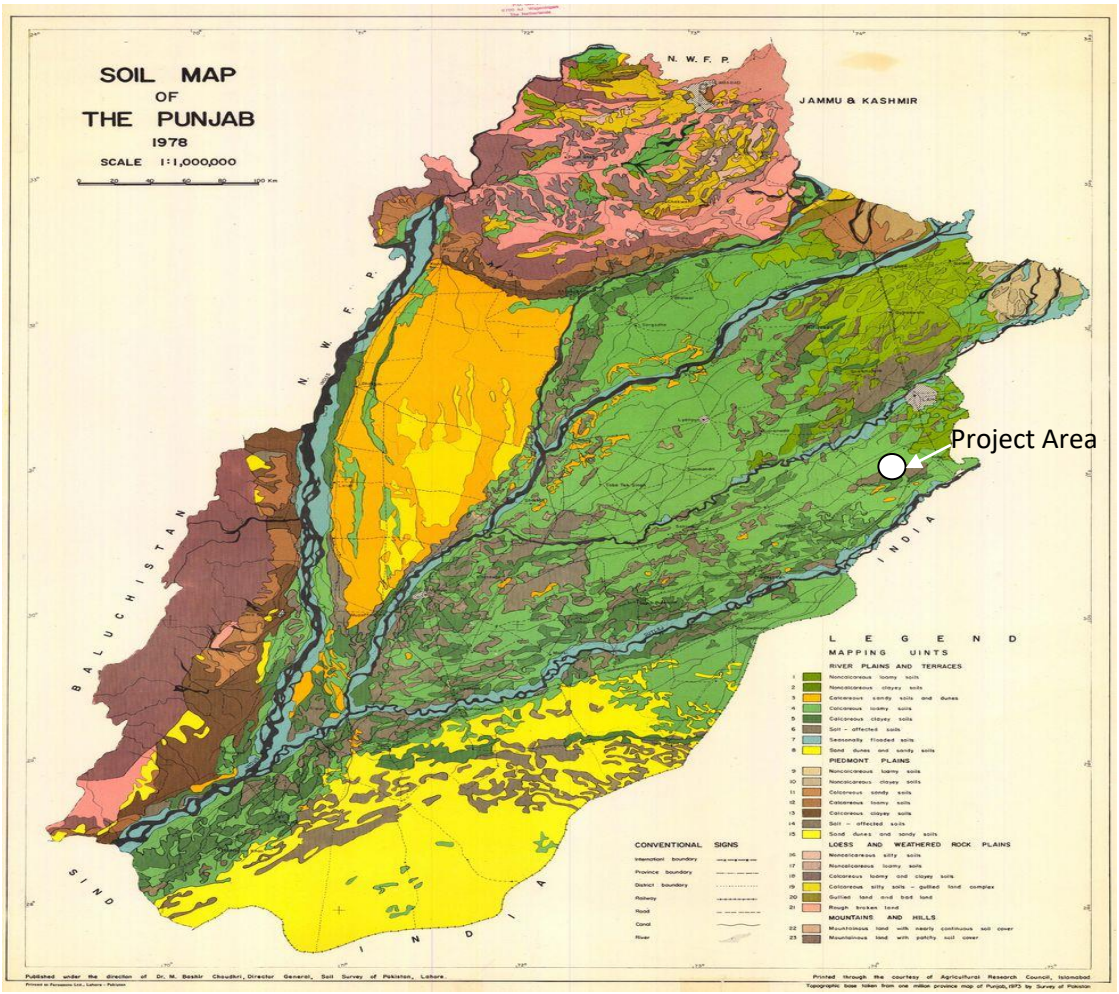


Figure 4.3: Soil Map of the Study area (Source CDGL)

The soil is different in character and generally inclined to be dry. However, it is rich in potential plant nutrients. Rainfall is low and groundwater is saline and brackish at the shallow depth and irrigation is largely dependent on the canals. Tube wells have also been sunk at the greater depths in the project area where fresh water is available. The chemical quality of groundwater in the district varies with depth. However, the sweet potable water is available in a belt five to twenty miles wide paralleling the Ravi River.

Alluvium is soil or sediments deposited by a river or other running water. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel. A river is continually picking up and dropping solid particles of rock and soil from its bed throughout its length. Where the river flow is fast, more particles are picked up than dropped. Where the river flow is slow, more particles are dropped than picked up. Areas where more particles are dropped are called alluvial or flood plains and the dropped particles are called alluvium.

The geotechnical investigation of the project area was carried out by M/s Soil and Foundation Engineering (SAFE) under the full-time supervision of experienced geotechnical engineers of NESPAK, from November 21, 2015 to December 12, 2015.The geotechnical investigations were undertaken to meet the following objectives:

- To delineate the major subsoil types spread over the project area;
- To evolve parameters for the design of foundations for the disposal station and sewerage network; and
- To spell-out the geotechnical considerations for the construction of foundations.

The following geotechnical investigation plan was developed to fulfill the above mentioned objectives:

- Execution of thirteen (13) boreholes up to a maximum depth of 25 m below NSL by straight rotary drilling method and seventeen (17) auger holes of depth ranging from 15 to 20 m below NSL by hand auger drilling method were performed along the sewerage route.
- Execution of two (2) boreholes up to a maximum depth of 25 m below NSL by straight rotary drilling method and two (2) auger holes up to a maximum depth of 25 m below NSL by hand auger drilling method at disposal station.
- Carrying out Standard Penetration Tests (SPTs) in the boreholes, generally at 1.0 m depth interval, where possible.
- Collection and preservation of disturbed & undisturbed soil samples and water samples from the boreholes.
- Carrying out nine (9) field permeability tests at selected horizons (using constant head/ variable head) in selected boreholes.
- Laboratory testing of soil and water samples for the evaluation of classification, moisture content, density, strength, compressibility and chemical characteristics.
- Analyses of field and laboratory data and determination of foundation design parameters including soil parameters, foundation type, foundation depth, foundation size versus net allowable bearing pressure relationships and foundation settlements.
- Study of the geotechnical considerations for the construction of foundations of structures.
- Formulation of Soil Lithological Chart.

From geotechnical investigation it is analyzed that:

- Fill material is present up to a depth of 1 to 4 m below NSL. Below fill material, the overburden soil is mostly consisting of Lean Clay (CL)/Silty Clay (CL-ML)/Silty Sand(SM) and Poorly Graded Sand with Silt (SP-SM) groups.

- Groundwater table was not encountered in any of the boreholes/auger holes up to the maximum investigated depth during field investigations in November - December 2015.
- It is recommended to support the disposal station structures (i.e. screening chamber, wet wells & pump house) on mat foundations.
- Owing to the presence of low concentrations of salts in subsurface soils, it is recommended to use Ordinary Portland Cement (OPC) in all the construction below NSL.
- If weak/soft soil is encountered at the excavation base level, further excavation and replacement with select fill is recommended. This select fill should be compacted in layers appropriate to the type and size of compaction equipment, to at least 75 % relative density or 95 % of Modified Proctor dry density, as appropriate.
- Temporary excavations may be carried out at stable slopes as determined by trials at site. However, if excavations have to be made very close to the existing foundation like roads or buildings, suitable excavation support system should be designed.

4.1.4 Climate and Meteorology

Seasonal climatic conditions must be considered for the design and execution of Project. The climate including air, temperature, precipitation, humidity and evaporation is an influencing factor, affecting the construction of plant and other engineering structures. However, to determine the overall effect of the climatic stresses, daily and seasonal temperature changes, site altitude, direct solar radiation, and precipitation must be considered.

The project area has extreme climate. It has hot summer and cold winters. The summer starts from April and lasts till September. May, June, and July are the hottest months. The mean maximum and minimum temperature ranges from 40.4 ºC and 27.3 ºC respectively for these months. The winter seasons lasts from November to March. December, January and February are the coldest months. The mean maximum and mean minimum temperature ranges from 21.1ºC to 7.2 ºC in January. [1]

The project area receives rains in all the seasons but monsoon rain is pronounced and constitutes a definite rainy season between the month of July and September. The average rainfall is about 629 millimeters per year. **Table 4.1** summarizes month-wise temperature, precipitation, and relative humidity while **Figure 4.4** and **Figure 4.5**show the graphical presentation of humidity and precipitation in the study area.

[1]Meteorological Data for Lahore, (2004-2008)

Table 4.1: Average Monthly Temperature, Precipitation and Relative Humidity (2004-2008)

Month	Mean Temperature		Precipitation (mm)	Relative Humidity AT 0500 HRS (%)	Relative Humidity AT 2000 HRS (%)
	Maximum	Minimum			
January	19.8	5.9	28.92	80.4	51.9
February	22.0	8.9	37.14	79.0	52.4
March	27.1	14.0	34.3	68.6	42.2
April	33.9	19.6	44.32	50.2	25.3
May	38.6	23.7	24.38	45.7	27.2
June	40.4	27.3	91.62	59.1	40.9
July	36.1	26.8	150.52	76.7	60
August	35.0	26.4	161.42	78.8	65.9
September	35.0	24.4	67.28	74.4	56.4
October	32.9	18.2	11.74	70.6	44.2
November	27.4	11.6	4.44	77.1	48.8
December	21.6	6.8	9.94	82.9	53.73
Annual	**30.8**	**17.8**	**666**	**70.34**	**47.4**

Source: *Meteorology Department Lahore*

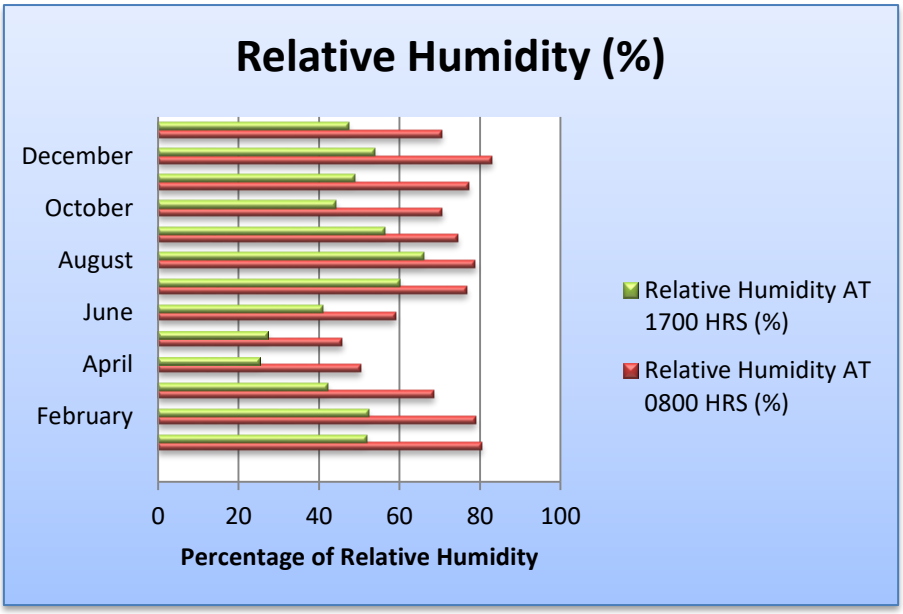


Figure 4.4: Relative Humidity in the Study Area (2005-2008)[2]

[2]Meteorological Data for Lahore, (2004-2008)

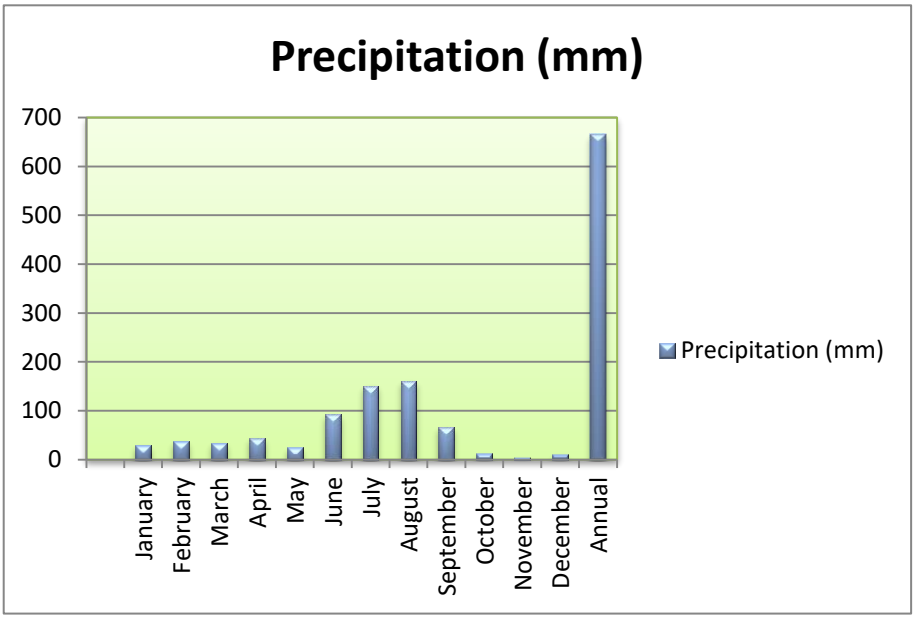


Figure 4.5: Average Rainfall in the Project Area (2004-2008)[3]

Based on climatic elements, five seasons are recognized in the project area:

i) Pre-monsoon Season

Pre-monsoon refers to the period from April to June prior to the setting in of the monsoon. This is the hottest and the driest season, with persistent dry and hot winds. Day time temperature rises to 40.4^0 C. The flows in the river begin to rise simultaneously due to snow-melt water in the high mountains. The water table falls to the maximum depth.

ii) Monsoon Season

Monsoon is the main rainy period, which starts at the beginning of July, reaches its climax in August and gradually, subsides in September. High intensity Rainfall causes soil erosion which is a function of erosivity and erodibility. The cool monsoon winds followed by heavy showers lower the temperature to great extent. The part of rain percolates into the soil and is conserved in the subsoil and part adds to the groundwater. The conserved moisture in the soils is generally sufficient to rejuvenate the vegetation. All plants grow rapidly and mature towards the end of the season. With the start of monsoon season, the rivers flow at their peak level. The groundwater level is improved toward the end of the season in September and October.

iii) Post-monsoon Season

Post monsoon season refers to autumn (October-November). The temperature starts falling but the extreme aridity prevents plants to flower early and set seed toward mid-seasons. Groundwater level rises as a result of infiltration from rainfall.

[3]Meteorological Data for Lahore, (2004-2008)

iv) Winter Season

Winter refers to the period from December to January. The lowest temperatures (< 2^{o}C) and cold winds characterize this season. The plants become dormant and most of them dry out. Most of the trees shed their leaves and few remain green or partly green. Sometimes this season becomes severe due to cold Siberian winds. Groundwater level declines in this season due to low flows in the rivers and no or little rains which usually fall in light showers causing little soil erosion.

v) Spring Season

Spring refers to the period from February to March. Temperatures become pleasant. The mean maximum temperature is 27^{o}C with the highest precipitation of 41.2 mm and relative humidity of 57.6 percent. Some light showers of rain may also fall without generating run off. The vegetation sprouts again because of conserved moisture from winter and spring rains, if any. The water table starts falling. Data about wind direction and wind speed for the year 2004, 2005, 2006, and 2007 is available on the format of average daily basis. While, on hourly basis it is available for the year 2008 only. **Table 4.2 and Table 4.3&Table 4.4** shows the average wind speed and wind direction for the year 2004-2007.

Table4.2: Average Wind Speed (m/sec) (2004-2007)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	0.57	0.93	0.77	0.98	0.98	1.13	1.08	0.82	0.72	0.72	0.21	0.46
2005	0.62	0.72	1.03	1.49	1.44	1.34	0.87	0.51	0.514	0.51	0.51	0.36
2006	0.67	0.67	1.03	1.08	1.23	1.13	0.72	0.57	0.668	0.62	0.51	0.57
2007	0.51	0.82	1.03	1.08	1.39	1.29	1.03	0.82	0.72	0.46	0.15	0.36

***Source**: Meteorology Department Lahore*

Table4.3: Wind Direction at 0800 (2004-2007)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	5S7E	N63W	N54W	N37E	N10W	S72E	S77E	S77E	S22W	N10W	S45E	N23E
2005	N62W	N45E	N54W	N60E	N15E	S89E	S82E	S61W	S57E	S	N54W	C
2006	N37W	N45W	N3E	N36E	S79E	N85E	S56E	S53E	S22E	N45W	N68W	W
2007	N45W	N54E	N3E	N18W	N51E	S15E	S28W	S47E	N77E	N45W	N45W	N28W

***Source**: Meteorology Department Lahore*

Table 4.4: Wind Direction at 1700 (2004-2007)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	N56W	N55W	N78W	N44W	S71W	S13E	S16E	N56E	S80W	N69W	S75W	W
2005	N80W	N62W	N44W	N67W	N63W	S52W	E	S71W	N54E	W	N68W	N68W
2006	N55W	N47W	N41W	N51W	S46W	S30W	S61E	N67E	N61W	N76W	N71W	N65W
2007	N77W	N55W	N70W	N82W	N39W	S47W	S36E	N67E	N32W	N61W	W	N65W

***Source**: Meteorology Department Lahore*

The wind data for the year 2008 is only available on hourly basis and given in **Table 4.5** to draw wind rose by using wind direction, speed and frequency of occurring.

Table 4.5: Wind Speed and Direction 2008

Wind Speed m/sec	N	NE	E	SE	S	SW	W	NW	All Dir.
0									4906
1	2	2	9	4			3	3	23
2	74	108	120	162	51	87	199	132	836
3	72	235	70	258	26	174	163	320	1318
4	34	49	39	101	5	41	112	75	456
5	51	103	25	151	13	73	64	221	701
6	18	10	18	22	3	4	14	23	112
7	20	41	3	42	5	19	16	52	195
8	7	2	2	3			3	8	25
9	10	9	2	15		1	13	11	49
10	12	5		6		1	31	5	32
11	1							3	5
12	1	1				1	1	4	7
13		2		1			1	3	7
14							1	1	2
15	2					1		1	5
16									
17								1	1
18	1					1	1	2	5

Wind Speed m/sec	N	NE	E	SE	S	SW	W	NW	All Dir.
19									
20 or above	1					1			2

Source: *Meteorology Department Lahore*

Calm wind was observed 56 percent of the time and wind speed 3 meter per second was recorded 15 percent of the time. The predominant directions are South-East and North-West in the speed ranges of 3 to 6 m/sec. Wind speed and wind direction for the year 2008 for Lahore city is given in **Figure 4.6**.

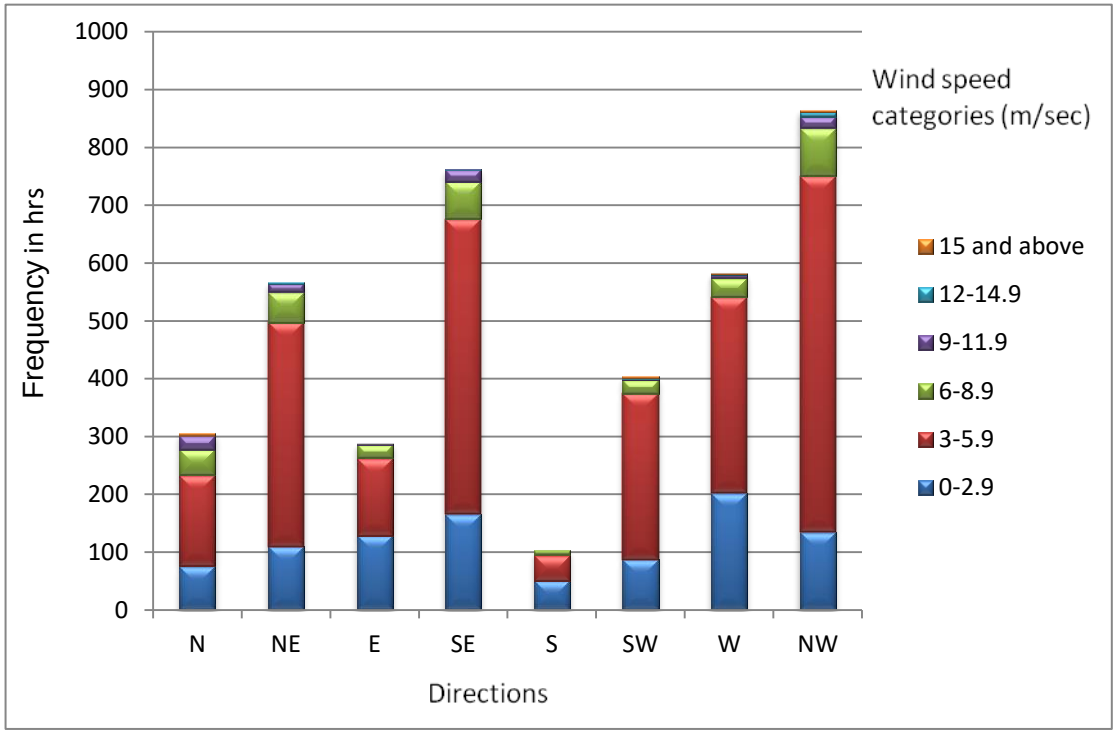


Figure 4.6: Wind Speed and wind direction in the city of Lahore 2008.

In winter (November-February) the predominant direction are West and North West, in summer (March-June) the predominant direction is South-East while in Monsoon/ summer season (July-October) the predominant direction is South East. Seasonal wise wind rose indicating wind direction and speed is shown in **Figure 4.7, 4.8& 4.9**.

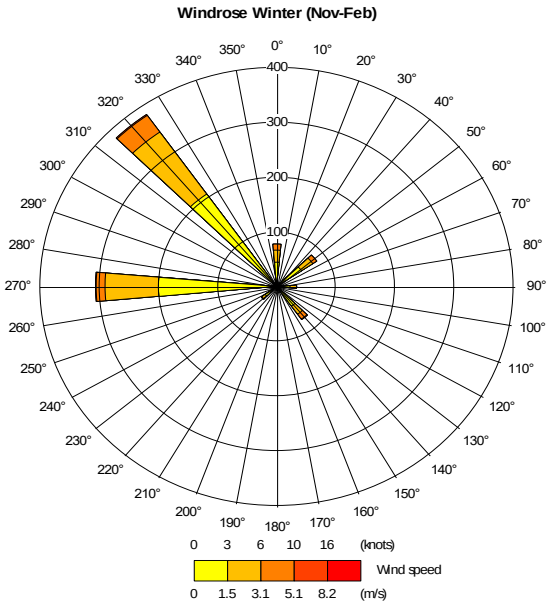


Figure 4.7: Wind Rose for the Winter 2008, Lahore[4]

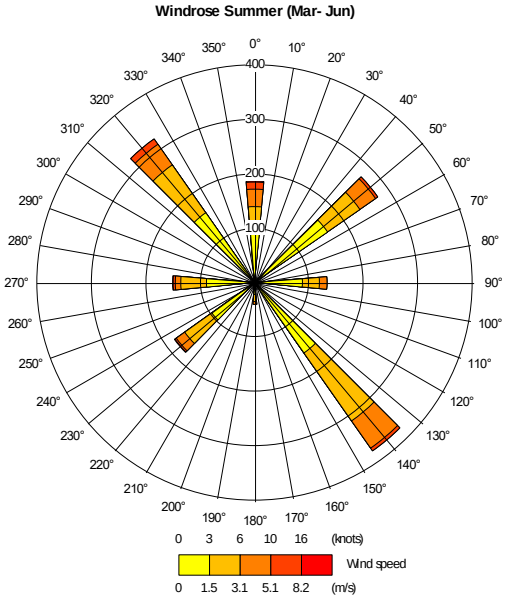


Figure 4.8: Wind Rose for the Summer (Mar-June) 2008, Lahore[5]

[4] Meteorological Data for Lahore, (2004-2008)
[5]Meteorological Data for Lahore, (2004-2008)

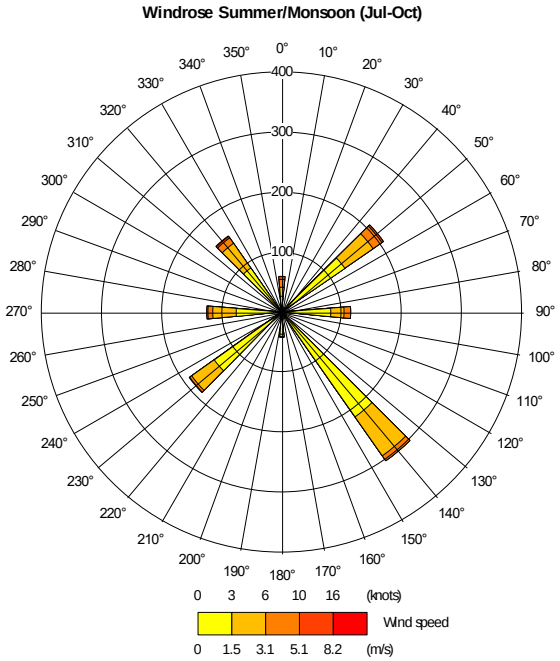


Figure 4.9: Wind Rose for the summer/ Moon soon (July-OCT) 2008, Lahore[6]

4.1.5 Hydrology and Ground Water

Hydrogeology

The Study Area forms the upper part of Punjab plain, which is a part of the Indo-Gangetic depression. This depression is of a synclinal nature. Synclinal depression is a fore deep downward of the Himalayan foreland of variable depth, converted into flat plains by simple process of alluvial deposition.

- The aquifer underlying the Study Area comprise unconfined alluvium with a thickness of about 1050 feet (rock has been encountered at depth 1050 ft in the deepest test bore hole drilled near Thokhar Niaz Bag in Punjab) as a part of regional groundwater investigation. Hydrological map showing that the Project Area falls in Bari Doab is shown in **Figure 4.10**.

- It is part of the large inter alluvial upper Bari Doab, which is bounded by the Ravi River in northwest and the Sutlej River to the southeast. The Bari Doab along with other Doabs like Rechna, and Chaj form the vast alluvial plain of the upper Indus Plain in Punjab.

The alluvium is derived from the erosion of mountain ranges in north. It has been deposited and reworked by the large meandering rivers and tributaries of the Indus River and comprises a random distribution of fine to coarse sand with lenses of silty clay and clay of varying thickness and extension. Borehole logs for tube-

[6] Meteorological Data for Lahore, (2004-2008)

wells shows that the lenses of less permeable material are neither thick nor continuous so, in spite of their heterogeneity, the alluvial sediments constitute an aquifer which on regional basis behaves as a single homogeneous unconfined water body.

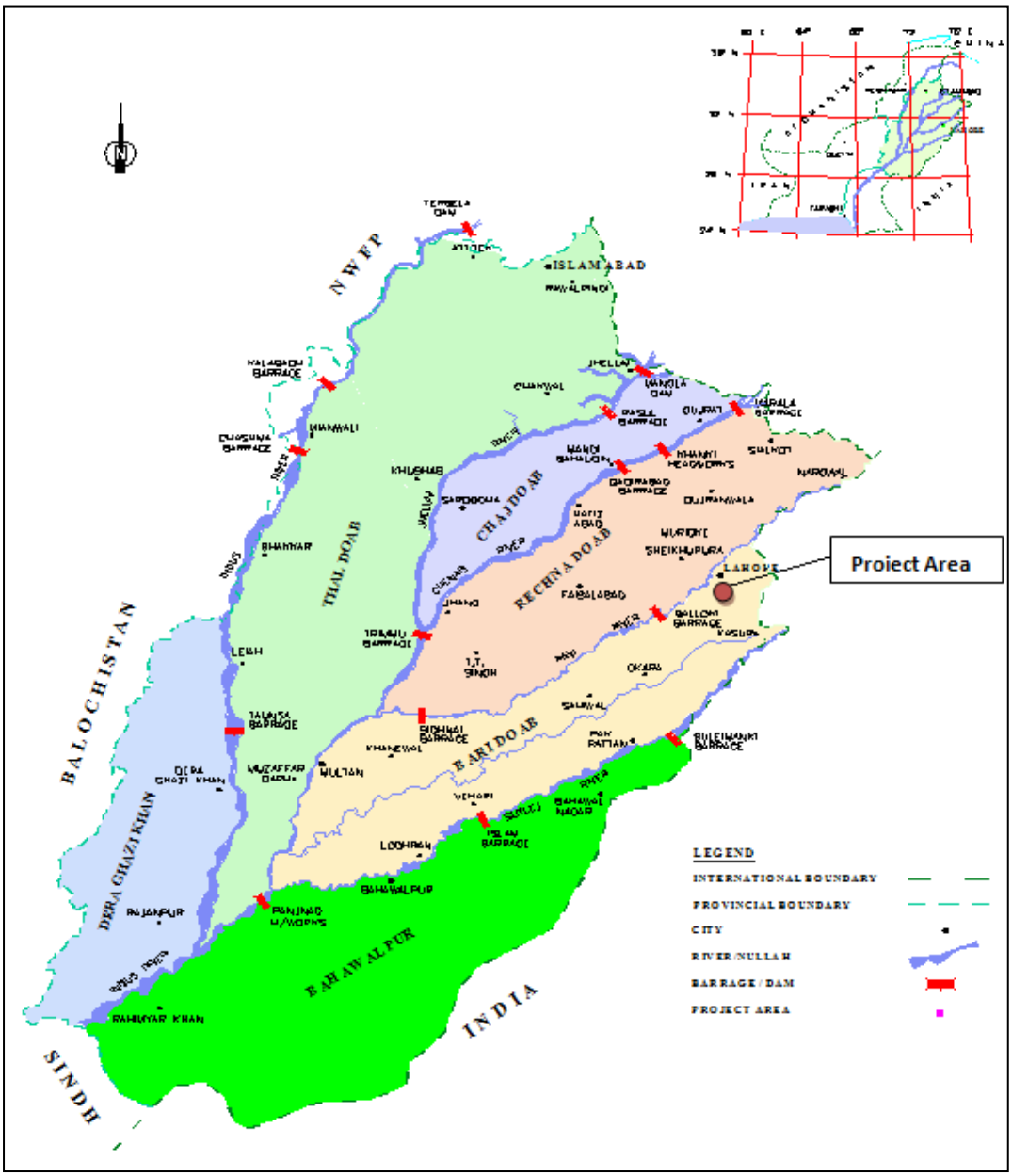


Figure 4.10: Hydrology of the Study Area

Regional Flow Pattern and Condition of Groundwater

The regional groundwater flow in the area is from northeast, the Jammu and Kashmir foothills which are at higher elevation, towards the southwest along the general slope of the area.

The previous studies and behavior of existing shallow and deep tube wells in the area have shown that in spite of local variation, aquifer overall behaves as a single

homogeneous water body and 73 % of the total consists of sand. The water table in the study Area ranges from 15ft (surrounding areas) to 100 ft. in the center of city. This condition is during the monsoon season, when the water table is the high and the annual fluctuation is reported not more than 10 feet.

Before the introduction of controlled irrigation system in Punjab, the water table was deep towards the center of Doabs and was shallow along the rivers. After the introduction of controlled irrigation system in the region, water table started rising as a result of leakage/seepage from irrigation canals and infiltration from irrigation applications on crop fields. As a result, the area became water logged until about 1960 when a quasi-equilibrium state was reached, controlled in part, by evapo-transpiration and drainage.

After Indus Waters Treaty was signed in 1960 between Pakistan and India, canal supply to the area reduced because the barrage controlling the canal flow was located in India. Link canals were constructed and tube-wells were installed in the area to meet the short fall of crops water requirement. With passage of time, annual crops intensity in Punjab has increased from 70% to around 140 %. As canals cannot supply the required water for higher cropping intensity, groundwater has been tapped for meeting high crop water demands. Therefore, stress on groundwater abstraction by irrigation tube-wells has increased accordingly.

Groundwater flow to the area has partly been checked due to creation of a large deep bowl of around 130 ft deep in Lahore City located in north east of the Industrial state by the declining of water table. This has happened due to high groundwater abstraction for meeting the demand of public water supply for large population and for industries. Therefore, water table in the area is showing declining trend.

Recharge and Discharge of Groundwater

The main recharge source to the groundwater is from regional groundwater flow, from the piedmonts of Kashmir mountain range located in northeast at a distance of around 150 km, and follows the general slope of the area that is northeast to southwest along the Ravi River with an average slope 1.22 ft/ mile.

Recharge to the area is also supplemented by leakage from canal system, seepage from the irrigated fields and infiltration from rainfall. The regional groundwater flow is the dominant component of recharge and assures the sustainability of the quantity and quality of groundwater. The main sources of discharge in the area are the evapo-transpiration and groundwater abstraction by the industrial and irrigation tube-wells.

Evapo-transpiration is considered to be negligible when depth to water table is more than 10 feet. The net effect of all the discharges are that the depth of post monsoon

groundwater in the area never more than 10 feet in the surrounding of the Lahore city, which is also an indicator of groundwater sustainability.

The aquifer underlain the Study Area is highly potential with more than 1000 ft thick saturated column of sand and extends up to the piedmont of Kashmir hills located in north east at a distance of more than 100 km. The regional groundwater flow starts from the piedmonts of Kashmir's mountains and passing through the Rechna Doab enters into the Bari Doab and forms one large water body (aquifer). The River Ravi divides the area into Bari Doab in south and Rechna Doab in north.

A number of industrial and irrigation tube-wells up to 4 cusec[7]capacity are already operating in and around the Project Area.

According to DCR 1998, Lahore City has 400 WASA public water supply tube-wells with a capacity of 4 cusec each at about 600 ft[8]depth.The latest count shows 507 tube wells in Lahore. In addition to this the large numbers of industrial tube-wells in and around Lahore are being operated.

Drainage

Industrial drain carrying the industrial effluent from Quaid-e-Azam Industrial Estatefalls in to Sattukatladrain.Sattukatla carries the industrial effluent and falls in to Hudyara drain and Hudyara drain polluted by the wastewater of Sattukatla and eight other major drains of the city, finally, discharges wastewater in to the River Ravi near village Khudpur in district Lahore

In Lahore, 76 collecting drains are connected to eight major drains including: Sattukatla drain, Mian Mir drain, lakshami drain, Suk Nehar drain, Upper Chotta Ravi drain, Lower chotta Ravi drain, SiddiquePura drain, and shahdradran, which discharge polluted water in to Hudyara drain.

4.1.6 Air Quality

Atmospheric pollution, particularly in urban areas like Lahore, has a strong impact on daily life. Motor vehicles are a major source of air pollution. However, factories and cottage industry inside the Lahore City are also contributing to the air pollution. Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon monoxide (CO), Ozone (O_3) and particulate matter (PM) are considered pollution indicators. For the current studies, air quality monitoring was conducted by Apex Laboratory, within the project area and its surroundings. Air quality was conducted near Home-economics College, Punjab Institute of Cardiology, Lahore Gymkhana, Queen's Merry College, District

[7]District Census Report (DCR), Lahore; 1998
[8]District Census Report (DCR), Lahore; 1998

Jail Lahore, Charring Cross, Ganga Ram Hospital, Mianisab Graveyard, Choburji, Gulshan e Ravi Disposal Station. Four parameters; SO_2, NO_x, CO and PM_{10}were analyzed. The monitoring locations are presented in map as given in **Figure 4.11-a.**

Table 4.6 Ambient Air Quality Analysis

Sr. No.	Locations	Monitoring Duration	Parameters			
			NO_2 µg/m³	**SO_2 µg/m³**	**CO mg/m³**	**PM_{10} µg/m³**
1.	Home-economics College	24 hr	26.8	56.1	1.56	72.0
2.	Punjab Institute of Cardiology		40.2	64.3	1.99	87.8
3.	Lahore Gymkhana		30.4	43.6	1.10	41.1
4.	Queen's Merry College		16.3	25.3	1.46	45.2
5.	District Jail Lahore		18.1	30.7	1.82	60.3
6.	Charring Cross		24.2	47.2	1.90	59.2
7.	Ganga Ram Hospital		27.3	53.0	1.34	96.6
8.	Mianisab Graveyard		19.9	40.5	0.90	56.9
9.	Choburji		40.2	68.3	2.33	94.2
10.	Gulshan e Ravi Disposal Station		20.3	56.1	1.29	103.7
PEQS, 2016 Limit			**80 µg/m³ for 24 hrs**	**120 µg/m³ for 24 hrs**	**5 mg/m³ for 8 hrs**	**150 µg/m³**

Ambient air quality monitoring results indicate that concentration of SO_2, NO_x, CO and PM_{10} were within permissible limits.

4.1.7 Surface Water Quality

The surface water quality was measured at Ten (10) locations. The water samples were analyzed for the parameters specified in PEQS, 2016. The monitoring results are given in **Table 4.7.** The locations are shown in map **(Annexure IX).**

Table 4.7: Surface Water Quality Monitoring, 2016

Sr. No.	Parameters	Unit	Test Results (Surface Water)										PEQS, 2016
			Home-economics College Drain	Drain near Lahore Gymkhana	Lahore Branch canal	Larech Colony Pumping Station	Drain after Gulshan Ravi D/S	Gulshan Ravi D/S	Drain before Gulshan Ravi D/S	River Ravi near Mohlanwal	River Ravi near Motorway Bridge	Drain near Shadman	
1	Temperature	^{0}C	15	14	15	13	17	15	16	16	15	16	**=<3^{o}C**
2	pH	--	7.5	6.8	6.6	6.6	8.7	7.2	7.5	6.5	6.8	6.9	**6-9**
3	Color	TCU	7	8	4	8	8	6	5	4	3	5	
4	Biochemical Oxygen Demand	mg/l	9	17	44	42	2	27	6	20	8	19	**80**
5	Chemical Oxygen Demand	mg/l	20	39	106	103	6	66	15	50	20	14	**150**
6	Total Dissolved Solid	mg/l	390	335	126	326	382	331	277	516	88	311	**3500**
7	Total suspended Solid	mg/l	36	59	12	38	29	35	19	92	21	22	**200**
8	Grease & Oil	mg/l	0.8	0.5	N.D.	09	1	0.6	0.9	0.8	N.D.	N.D.	**10**
9	Fecal Coli	Number/ 100 ml	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**-**

10	Phenolic compounds	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.3	N.D.	**0.1**
11	Chlorides	mg/l	29	89	4	35	66	97	59	112	5	139	**1000**
12	Fluorides	mg/l	N.D.	N.D.	1.0	0.8	1.4	N.D.	1	N.D.	3	N.D.	**10**
13	Cyanide	mg/l	N.D.	0.02	0.02	N.D.	N.D.	N.D.	N.D.	N.D.	0.3	N.D.	**1**
14	An-ionic Detergents	mg/l	N.D.	N.D.	N.D.	2	N.D.	N.D.	2	N.D.	N.D.	2	**20**
15	Sulphate	mg/l	213	176	321	232	212	125	223	421	143	342	**600**
16	Sulphides	mg/l	0.3	0.03	0.4	0.2	0.03	0.4	0.3	0.3	0.5	0.062	**1**
17	Ammonia	mg/l	12	27	12	15	17	15	17	23	11	21	**40**
18	Calcium	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**-**
19	Cadmium	mg/l	0.017	0.034	0.043	0.029	36	14	32	53	23	0.016	**0.1**
20	Chromium	mg/l	0.4	0.06	0.8	0.08	0.03	N.D.	0.03	0.07	N.D.	0.07	**1**
21	Copper	mg/l	0.03	0.01	0.08	0.02	0.02	0.55	0.52	0.10	0.11	0.03	**1**
22	Lead	mg/l	0.003	0.03	0.01	0.03	0.072	0.09	0.06	0.093	N.D.	0.09	**0.5**
23	Mercury	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.003	N.D.	0.003	**0.01**
24	Selenium	mg/l	0.09	0.04	N.D.	0.01	0.05	0.07	0.078	N.D.	N.D.	0.09	**0.5**

25	Nickel	mg/l	0.004	0.2	0.05	0.02	0.003	0.3	0.03	0.09	0.03	0.05	**1**
26	Silver	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	0.8	0.4	0.05	N.D.	0.09	**1**
27	Zinc	mg/l	0.13	0.07	0.9	0.025	0.01	0.04	0.07	0.10	0.02	0.06	**5**
28	Arsenic	mg/l	0.005	0.025	0.05	0.025	N.D.	0.02	0.25	0.025	0.01	N.D.	**1**
29	Barium	mg/l	0.03	0.02	0.09	0.06	0.17	0.02	0.01	0.6	0.01	0.2	**1.5**
30	Iron	mg/l	N.D.	N.D.	0.07	N.D.	N.D.	0.8	0.4	N.D.	N.D.	N.D.	**8**
31	Manganese	mg/l	0.08	N.D.	N.D.	0.077	0.7	0.7	0.8	N.D.	0.8	N.D.	**1.5**
32	Boron	mg/l	0.32	1.0	0.09	1.7	0.9	0.9	0.3	0.9	0.6	0.9	**6**
33	Total chloride	mg/l	0.02	0.03	0.02	0.02	0.01	0.06	0.02	0.03	0.02	0.07	**1**
34	Pesticides	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**-**

All the parameters are within permissible limits except temperature of water at all locations and cadmium concentration at Drain after Gulshan Ravi D/S, Gulshan Ravi D/S, Drain before Gulshan Ravi D/S, River Ravi near Mohlanwal and River Ravi near Motorway Bridge.

4.1.8 Ground Water Quality

The major source of drinking water supplied to Lahore is through ground water reservoirs. Thus, quality of groundwater is very important in terms of public health. The groundwater monitoring is done at following locations; the sampling map shows the selected location for analysis. The analysis is done for the parameters specified in PEQS, 2016. **Table 4.8** gives groundwater quality monitoring results. The locations are shown in map **(Annexure X).**

Table 4.8 Groundwater Quality Monitoring Results

Sr. No.	Parameters	Unit	Test Results (Drinking Water)										PEQS, 2016
			Home-Economics College	Punjab Institute of Cardiology	Lahore Gymkhana	Queen's Merry College	District Jail Lahore	Charring Cross	Ganga Ram Hospital	Mianisab Graveyard	Chobur ji	Gulshan e Ravi Disposal Station	
1	**pH**	-	6.8	6.9	7.7	7..7	7.3	7.9	6.9	7.6	7.9	7.5	**6.5-8.5**
2	**Color**	TCU	O.K	O.K	O.K	O.K	O.K	O.K	O.K	O.K	O.K	O.K	**<15**
3	**Taste & Odour**	-	O.K	O.K	O.K	O.K	O.K	O.K	O.K	O.K	O.K	O.K	**Acceptable**
4	**Turbidity**	NTU	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	O.K	**<5**
5	**Total Hardness as $CaCO_3$**	mg/l	122	154	144	123	89	221	211	102	124	123	**<500**
6	**Total Dissolved Solids**	mg/l	1099	258	692	234	223	436	334	302	444	223	**<1000**
7	**E. Coli**	Number/100 mL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**0/100 ml**
8	**F. Coli**	Number/100 mL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**0/100 ml**

9	**Total Coliform**	Number/100 mL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**0/100 ml**
10	**Aluminum**	mg/l	0.11	0.21	0.53	0.11	0.27	0.02	0.12	0.04	0.16	0.04	**0.2**
11	**Antimony**	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**0.005**
12	**Arsenic**	mg/l	0.025	0.025	0.05	0.025	0.05	N.D.	0.025	0.025	0.025	N.D.	**<0.05**
13	**Barium**	mg/l	0.3	0.1	0.4	0.3	0.2	0.03	0.3	0.09	0.2	0.05	**0.7**
14	**Cadmium**	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	**0.01**
15	**Chloride**	mg/l	0.01	0.03	0.01	0.01	12	0.8	3	20	33	121	**250**
16	**Chromium**	Mg/l	N.D.	0.001	0.005	0.003	0.008	0.006	0.02	N.D.	N.D.	N.D.	**0.05**
17	**Copper**	mg/l	0.30	0.16	0.11	0.30	0.01	0.01	0.75	0.02	0.01	0.02	**2**
18	**Cyanide**	mg/l	0.006	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.002	N.D.	N.D.	**0.05**
19	**Flouride F^{-1}**	mg/l	N.D.	N.D.	0.03	0.03	N.D.	N.D.	N.D.	0.02	N.D.	N.D.	**<1.5**
20	**Lead**	mg/l	0.006	0.01	0.008	0.008	0.003	0.004	0.003	0.003	0.003	0.02	**0.05**
21	**Manganese (Mn)**	mg/l	N.D.	0.06	0.06	0.03	N.D.	0.03	0.05	0.03	0.03	0.07	**0.5**

22	**Mercury**	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**0.001**
23	**Nickel**	mg/l	N.D.	N.D.	0.004	0.009	0.005	0.004	N.D.	N.D.	0.006	0.002	**0.02**
24	**Nitrate (NO_3), Nitrogen**	mg/l	3.7	0.7	0.8	3.7	0.7	8.0	2.9	0.4	1.1	2	**<50**
25	**Nitrite(NO_2), Nitrogen**	mg/l	0.026	0.003	0.006	0.026	0.006	0.006	0.9	0.010	0.023	0.5	**3**
26	**Selenium**	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.002	N.D.	**0.01**
27	**ResidualChlorine**	mg/l	0.06	0.2	0.09	0.06	0.8	0.01	0.04	0.06	0.01	0.3	**1.5**
28	**Zinc**	mg/l	0.04	0.13	0.01	0.04	0.24	0.03	0.01	0.07	0.04	0.3	**5**
29	**Pesticides**	µg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**-**
30	**Phenols, Total (Phenolic Compound)**	mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**-**
31	**Poly-nuclear Aromatic HC**	g/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	**-**

32	**Alpha Emitters or pCi**	Bq/l	N.D.	N.D.	N.D	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	-
33	**Beta Emitters**	Bq/l	N.D.	N.D.	N.D	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	-

All the parameters analyzed are within permissible limits except TDS at Home Economics College and aluminum concentration at Lahore Gymkhana.

4.1.9 Noise

The locations selected for noise monitoring were; Home-economics College, Punjab Institute of Cardiology, Lahore Gymkhana, Queen's Merry College, District Jail Lahore, Charring Cross, Ganga Ram Hospital, Mianisab Graveyard, Choburji, Gulshan e Ravi Disposal Station. The noise measurements were taken for 24 hours. Day time and night time averages are given in **Table 4.9.** The sampling locations are located on map (**Annexure XI).**

Table 4.9: Noise level Monitoring

Sr. No.	Locations	Category	Noise Levels (dB)			
			Day Time (6:00 am – 10:00 pm)		Night Time (10:00 pm – 06:00 am)	
			Maximum Average	PEQS	Maximum Average	PEQS
1.	Home-economics College	Silence Zone	68.61	55	62.71	45
2.	Punjab Institute of Cardiology	Silence Zone	77.5	55	69.28	45
3.	Lahore Gymkhana	Commercial Zone	67.86	70	58.42	60
4.	Queen's Merry College	Silence Zone	68.11	55	63.85	45
5.	District Jail Lahore	Commercial Zone	70.85	70	61.5	60
6.	Charring Cross	Commercial Zone	71.64	70	59.92	60
7.	Ganga Ram Hospital	Silence Zone	73.73	55	69.07	45
8.	Mianisab Graveyard	Silence Zone	70.76	55	64.21	45
9.	Choburji	Commercial Zone	73.94	70	70.35	60
10.	Gulshan e Ravi Disposal Station	Commercial Zone	63.91	70	59.71	60

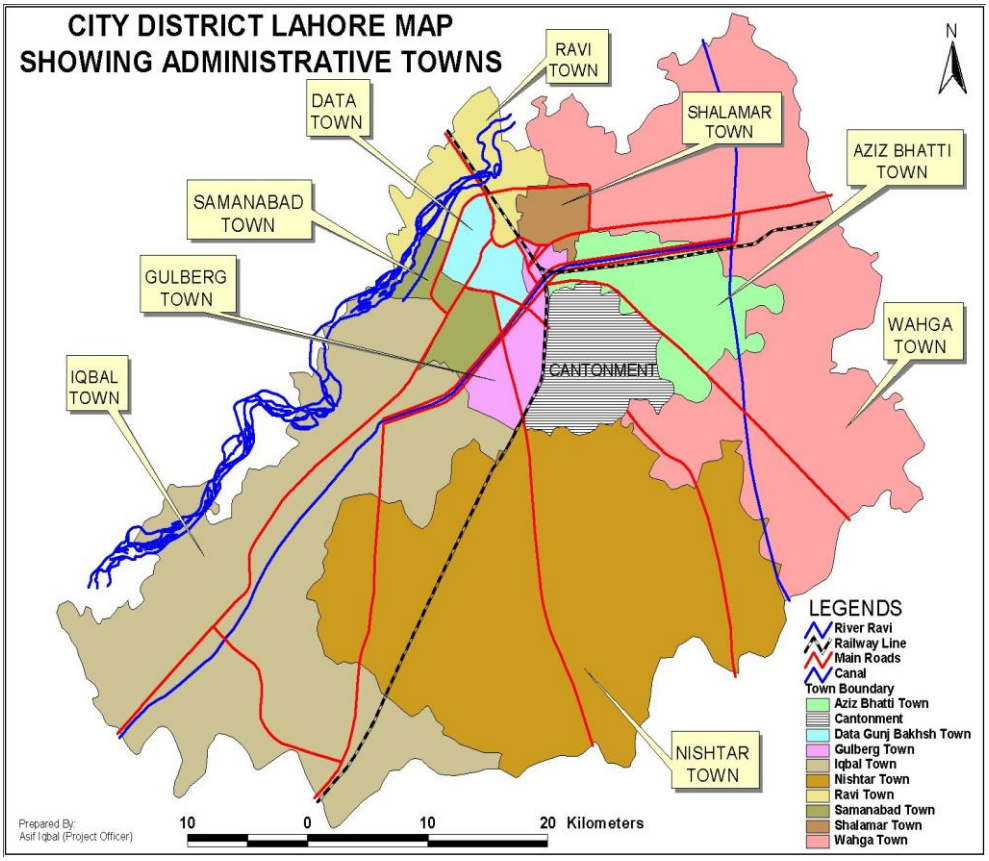
The results indicate that the noise levels are higher at eight locations as the selected locations are along the busy roads or crossings. The traffic is always on the go on these roads which contributes to the higher levels of noise.

4.1.10 Solid Waste

Lahore, having a population of approximately 10million (projected population for year 2016), is experiencing urban sprawl and industrialization leading to a generation of enormous amount of solid waste from many sources, like household waste,

commercial activities, industries, hospitals, animal waste, all of which are contributing in creating environmental and health hazards for citizens.

For the collection of the solid waste, city has been divided in nine (09) towns which include: Ravi Town, Shalimar Town, Wahga Town, Aziz Bhatti Town, Data Ganj Baksh Town, Samanabad Town, Gulberg Town, Allama Iqbal Town and Nishter Town as shown in **Figure 4.11**.



Source: *SWM Department*

Figure 4.11: Administrative zone map for the collection of Solid waste

Estimated per capita per day waste generated is 0.65 kg and the total waste generated is about 5700 tons/day. The lifting capacity of the solid waste management department is about 4500 tons/day. Around 350-450 tons of organic waste is utilized for compost preparation by private contractors on build, operate and transfer (BOT) basis under public-private partnership contract with City District Government Lahore (CDGL). Currently, 60 percent of the Municipal Solid Waste is stored, collected, transported and disposed in open dumps (on dumping sites of Saggian, Bagarian, Kahna Kacha and Mehmood Booti) while 40 percent remains uncollected and lies along roadsides, streets, railway lines, depressions, vacant plots, drains, storm drains, in or around waste containers (where available), open heaps at road sides, informal collection points and open sewers.

The total solid waste generated in different towns is given in the **Table 4.10**.

Table 4.10: Solid Waste Generated in the Study Area & Other Towns

Towns	Estimated Population (2008)	Waste generation (Tons/ day)
Ravi	1,124,944	731
Shalimar	909,155	591
Wahga	707,395	460
Aziz Bhatti	732,332	470
Data GanjBuksh	1,106,874	719
Samanabad	1,151,215	748
Gulberg	*851,709*	*554*
AllamaIqbal	1,108,379	720
Nishter	1,056,154	686
Total	**8,748,175**	**5,679**

Source: CDGL

On 29thMrach, 2010, City District Government Lahore (CDGL) established Lahore Waste Management Company (LWMC) under section 42 of the Companies Ordinance 1984. LWMC is governed by a Board of Directors (BOD), headed by a Chairman. After the establishment of the company, as per Services and Assets Management Agreement (SAAMA) between CDGL and LWMC, all the functions and assets of SWM department (CDGL) and TMAs have been entrusted to LWMC. LWMC aims to develop an integrated system of solid waste management to ensure efficient collection, transportation, recovery, treatment and disposal of waste generated in Lahore. Some major projects launched by LWMC are in progress for development of integrated system of solid waste management.

4.1.11 Seismology

Study area is located in the tectonic zone of down wrap and platform slop in the seismic zone of noticeable earthquake from 3.1 to 4.9 on Richter scale (Atlas for Pakistan). According to building code of Pakistan prepared by NESPAK recently, it is located in Seismic Zone 2A of Pakistan (Lower limit of moderate damage). Zone 2A represents peak ground acceleration (PGA) from 0.08 to 0.16g. **Figure 4.12** shows the seismic zoning map of Punjab with the project area falling under Seismic Zone-2A.

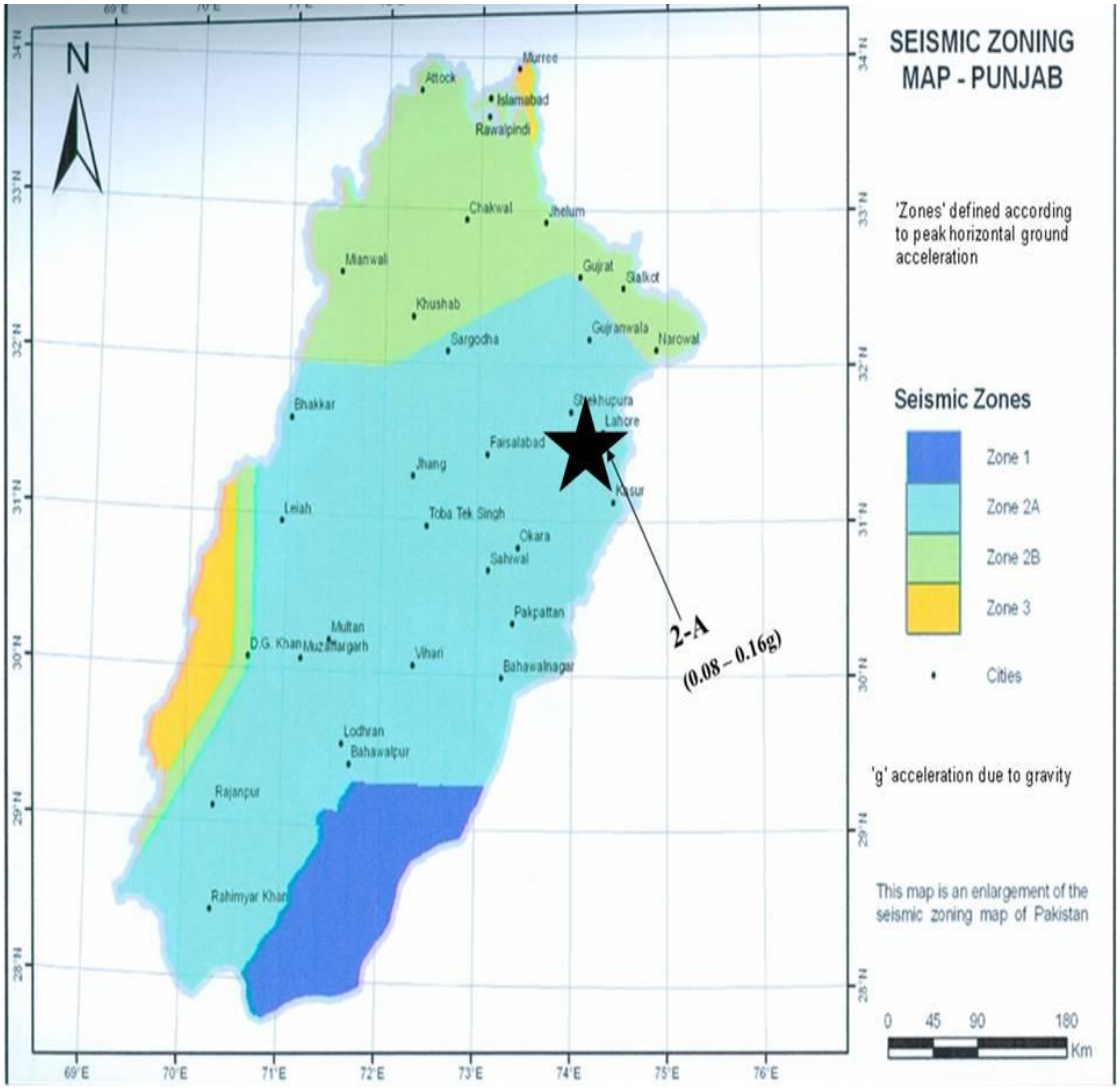


Figure 4.12: Seismic Zoning Map of Punjab

4.1.12 Soil Liquefaction

Cohesion-less soils existing under submerged conditions are prone to liquefaction under earthquake or dynamic loading conditions. The resistance of the cohesion-less soil to liquefaction will depend on the density of the soil, confining stresses, soil structure (fabric, age and cementation), the magnitude and duration of the cyclic loading, and the extent to which shear stress reversal occurs.

Soil liquefaction describes the behavior of soils that, when loaded, suddenly go from a solid state to a liquefied state, or having the consistency of a heavy liquid. Liquefaction is more likely to occur in loose to moderate saturated granular soils with poor drainage, such as silty sands or sands and gravels capped or containing seams of impermeable sediments. During loading, usually cyclic un-drained loading, e.g. earthquake loading, loose sands tend to decrease in volume, which produces an increase in their pore-water pressures and consequently a decrease in shear strength, i.e. reduction in effective stress.

Deposits most susceptible to liquefaction are young (Holocene-age, deposited within the last 10,000 years), sands and silts of similar grain size (well-sorted), in beds at least several feet thick, and saturated with water. Such deposits are often found along riverbeds, beaches, dunes, and areas where windblown silt (loess) and sand have accumulated.

The soils profile in the study area contains layers of cohesion-less material below groundwater table. These layers exist at medium dense to dense state of compactness and the soil deposits are not likely to liquefy during earthquakes. Various studies in the area show that the soils at the study area are safe against liquefaction failure for a PGA of 0.16g.

4.1.13 Drainage

All of the Lahore districts drain ultimately to River Ravi which is the major natural surface water resource located in the northern part of the district. River Ravi receives huge amount of wastewater from the city of Lahore and other industrial discharges from different sources especially Hudyara Drain, a natural drain which carries pollution loads from both Pakistan and India. Most wastewater discharge reaches to Ravi in the 60km stretch between Bulloki and Lahore. These wastewater discharges, along with reduction in available water in River Ravi for dilution, has greatly deteriorated the quality of river water. River Ravi runs merely as a sullage carrier near Lahore during low flow season.

Besides, there are 76 minor drains which finally fall in eight (8) major drains namely Satto Kattle drain, Lakshimi Drain, Suk Neher Drain, Upper Chota Ravi Drain, Siddique Pura Drain and Shahdara Drain. Presently, all these drains collect wastewater from different areas of Lahore and finally fall into River Ravi.

4.1.14 Environmental Sensitive Receptors

Land use Pattern

Land use of the project area is mainly commercial with some educational facilities, medical facilities, and religious sites and recreational facilities. **Figure 4.13 &4.14** shows land-use of the project area.

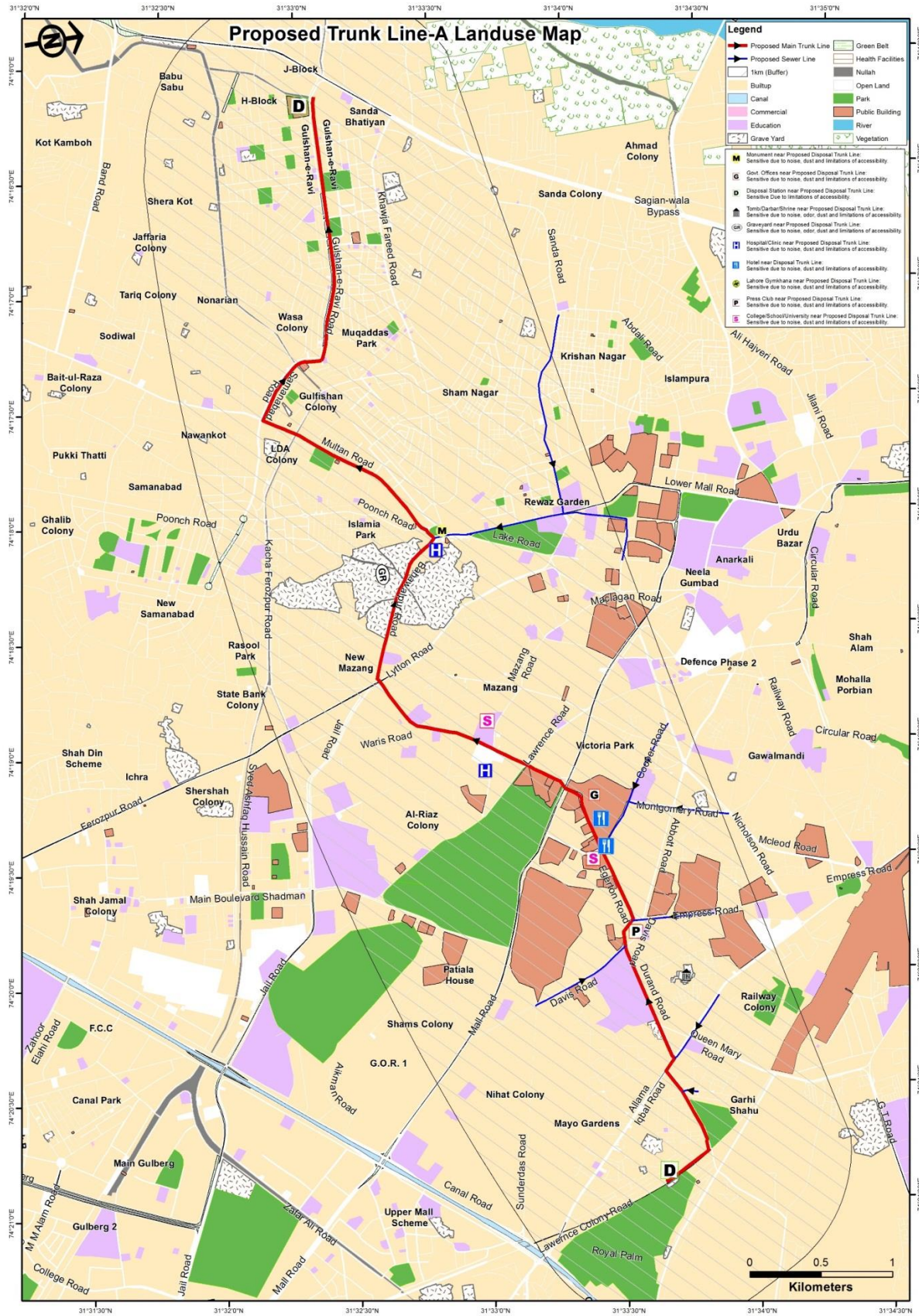


Figure 4.13: Land-Use of the Project Area

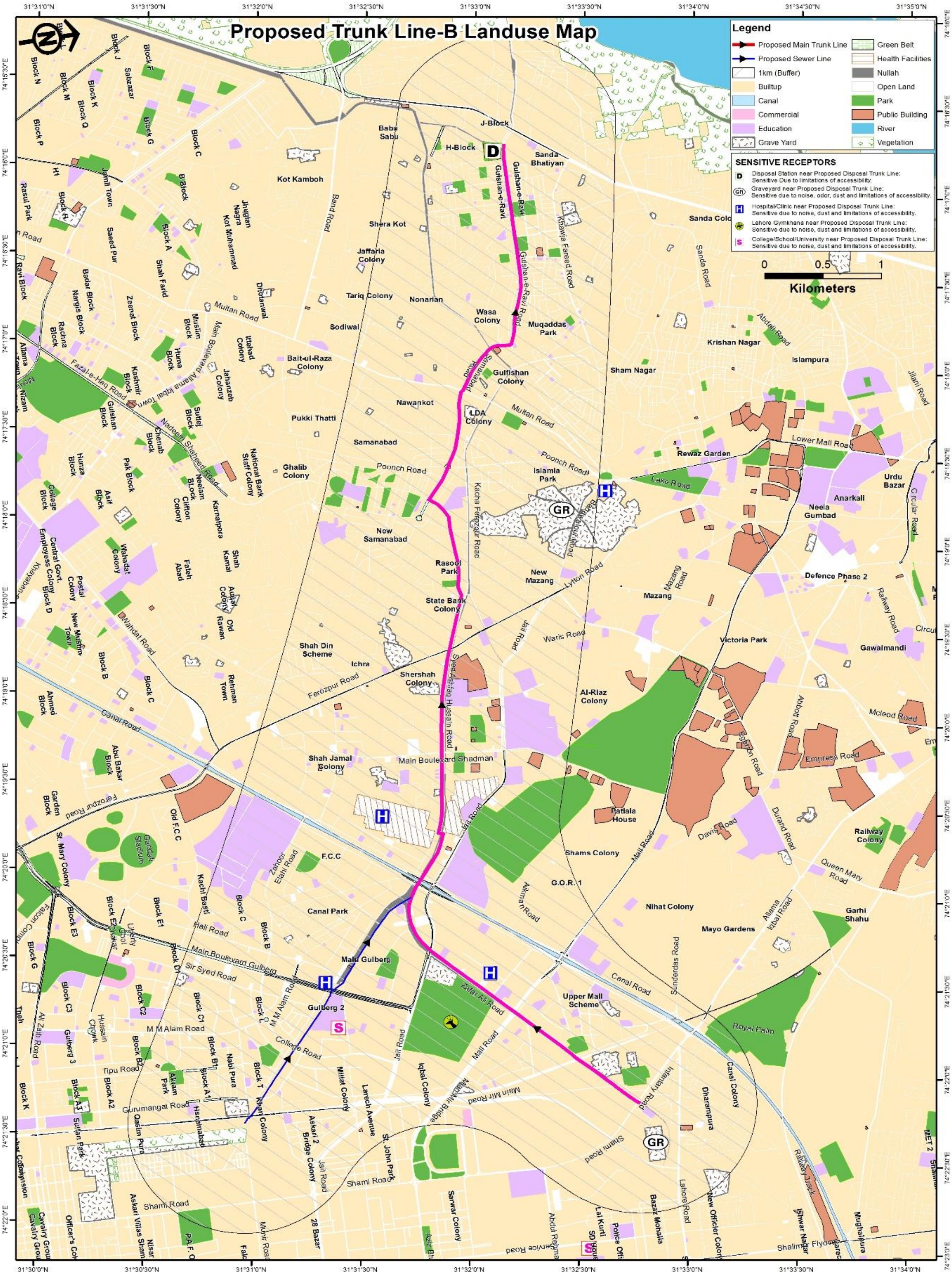


Figure 4.14: Land-Use of the Project Area

These sensitive receptors and their respective sensitivity are listed in the **Table 4.11.**

Table 4.11: Environmental Sensitive Receptors and their Sensitivity

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
1	**Educational institutions**	
Line A		Sensitivity due to access, dust, noise and vibrations especially during teaching hours during construction phase.
	Govt. Abu ul Khair Middle School	
	Queen Merry School	
	Q. M. College	
	Aiwan e Iqbal/NUML	
	Govt. Post-graduate Islamia College	
	Fatima Jinnah Medical College	
	Dastkari school for Women	
	Govt. Jinnah Degree College	
	SCAS College	
	Elite Grammar School	
	Al Barakah School	
Line B		Sensitivity due to access, dust, noise and vibrations especially during teaching hours during construction phase.
	Gulberg Girls High School	
	SICAS Boys Campus	
	Home Economics college	
	Govt. FCC Girls Primary School	
	WISE Group of colleges	
	Lahore Law College	
	LGS Boys	
	Beacon House College Campus	
	Allied School	
	COTHM College	
	Dar e Arqam	
	Shahid Sethi Academy	
	Crescent Model	

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
	Allied School	
	KIPS	
	Abdali Grammar School	
	School of Advanced Sciences	
	CDG Middle School	
	Allied School	
	Alflah School	
	IBL Group of Colleges	
	British Grammar School	
	KIPS	
	PACS School	
	Eden Rose School System	
	Sir Syed School	
	The Punjab Academy	
	Allied School	
	American Lyceum	
	Pak Angels Kinder Garden	
	Dar e Arqam/Unique Academy	
	Allied School	
	Silk School	
	American Lycetuff	
	Eden Rose School System	
	JPS School	
	Dar e Arqam	
	School of Arts and Textile	
	Eden Rose School System	
	American Lycetuff	
	KIPS	
	Smart School	
	American Lyceum	

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
	Tube Well	
	Future School	
	Rana Acdemy	
	Jenny Vocational Institute	
	Dastkari School for Women	
	Pak Angels School	
2	**Health Institutions**	
Line A		Sensitivity due to noise, vibrations and access at some places during construction phase.
	Al-Tabeeb	
	Dispensary	
	DG Health Sciences	
	Ganga Ram Hospital	
	Suraya Azeem Hospital	
	Qarshi Hospital	
	Line B	Sensitivity due to noise, vibrations and access at some places during construction phase.
	Mushtaq Gurmani Clinic	
	Surgimed Hospital	
	Akram Medical Complex	
	Mian Medical Complex	
	Cardiology Hospital	
	Mental Hospital	
	Naz Hospital	
	Masjid	
	Hamza Hospital	
	Al-Raza Clinic	
	Umair Clinic	
	Jalal free Dispensary and Hospital	
	Ahmad Dental Clinic	
	Private Clinics	
	Zaheer Memorial Hospital	

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
	Abu Bakar Hospital	
	Waris Shah Homeo College & Hospital	
	Clinix	
	Gulshan Clinic	
3	**Mosques/Shrines**	
Line A		Sensitivity due to noise, vibrations and access at some places during construction phase.
	Masjid	
	Masjid	
	Graveyard	
	Masjid Hanfia	
	Darbar Anayat Ullah + Masjid	
	Qartaba Masjid	
	Masjid	
	Jamia Masjid Shafi e Mehshar	
	Jamia Masjid Karimia	
	Madrasa	
	Mianai Saab Graveyard	
	Shah Shani Darbar	
	Ghazi Alam Din Shaheed	
	BB Pakdaman	
	Darbar Baba Shamsher Shah Wali	
	Masjid e Shohda	
	Cathedral Church	
Line B		Sensitivity due to noise, vibrations and access at some places during construction phase.
	Jamia Masjid Khubabib	
	Fehmul Quran	
	Gora Graveyard	
	Graveyard	
	Masjid	
	Darbar/Masjid	

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
	Riazul Atfal	
	Jamia Masjid Siddiqa Ghosia	
	Jamia Masjid Umar Farooq	
	TMA office + Masjid	
	Masjid Ghosia	
	Jamia Masjid Aks e Jamil	
	Darbar baba Langar Shah	
	Masjid	
	Masjid	
4	**Historical Sites**	
Line A		
	Choburji	
	Punjab Assembly	Sensitivity due to noise, vibrations and access at some places during construction phase.
	Lahore High Court	
	Alfalah Building	
	Summet Minar	
	WAPDA House	
5	**Important Buildings/sites**	
Line A		
	Quaid e Azam Prosperity Fund	
	Cine Star	
	Shimla Hill/Press Club	
	LDA Plaza	
	Holiday Inn	Sensitivity due to noise, vibrations and access at some places during construction phase.
	Flattie's Hotel	
	Punjab Assembly	
	Forest Department	
	Red Crescent Society	
	CCPO office	
	Salvation Army Territory Headquarter	

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
	LESCO Chief Engineer	
Line B		Sensitivity due to noise, vibrations and access at some places during construction phase.
	Pakistan Post	
	TUV Austri	
	Lahore Grande	
	Lahore Gymkhana	
	District Jail Lahore	
	Police Station	
	Dula Bhati Chowk	
6	**Utilities**	
Line A		
	Larech Colony Disposal Station	Sensitive due to disruption in services and inconvenience to public
	Grit Station	
	Tube Well	
	PTCL office	
Line B		
	Larech Colony Pumping Station	Sensitive due to disruption in services and inconvenience to public
	Tube well/Filtration Plant	
	Pumping Station	
	WASA Tubewell	
	Filtration Plant	
	Tube well	
	Grid Station	
	Tube Well	
	Tube well	
	Disposal Station	
	Gulshan e Ravi Disposal Station	
7	**Residential Areas**	Sensitivity due to noise and vibrations. Exposure to dust and access problems may occur at certain

Sr. No.	Name/Type of Physical Sensitive Receptor	Remarks
		locations during construction phase.
8	**Commercial Areas**	Sensitivity due to noise and vibrations. Exposure to dust and access problems may occur at certain locations during construction phase.

4.2 Ecological Resources

As climate of Lahore is semi-arid and subtropical, the vegetation of the area falls under scrub, dry, tropical thorn forest type as per phyto-geographical classification of the area.

The tract, in which the project site exists, was once covered with native vegetation consisting, of trees like Karir (Capparisdeciduas), Wan (Salvadoraoleoides) and Jand (Prosopisspicigera). With the onslaught of civilization, this vegetation was cleared for agricultural purposes.

Due to rapid increase in the population of the city and to cater for its public utility buildings, housing and commercial requirements, these agricultural lands were converted into public buildings, business centers, educational institutions and housing colonies.

4.2.1 Flora

The study area has a variety of trees, along the roadsides, in the lawns of administrative buildings, educational institutions and parks, consisting of the following major species.

Several types of floral species are present in Lahore, however, some of the principal trees, shrubs (plants) and herbs (ground covering plants) are given below in **Table4.12**, which illustrates their nomenclature including local names, English names and Botanical names.

Table 4.12: Inventory of Trees Present in Lahore District

Sr. No.	Common Name	Scientific Name
1	Neem	Azadirachtaindica
2	Eucalyptus	Eucalyptus camaldulensis
3	Jaman	Syzygiumcumini
4	Shisham	Dalbergiasissoo
5	Sirris	Albizzialebbek

Sr. No.	Common Name	Scientific Name
6	Bakain	Meliaazedarach
7	Pipal (Sacred Fig)	Ficusreligiosa
8	Banyan	Ficusbengalensis
9	Toot (Mulbery)	Morus alba
10	Molsary	Mimusopselengi
11	Bottle Palm	Cocos species
12	Bottle Brush	Callistemon lanceolatus
13	Palm	Cocos species

Source: *Site survey, Feb-March 2015*

These trees are mostly of medium size with a girth between 2' to 4'. In addition to the trees, ornamental shrubs such as molesary, palms etc. and seasonal flowers have been raised in the compounds of educational institutions, office buildings, parks and lawns of houses for beautification of the landscape and to improve the aesthetics of the area.

Natural Shrubs and Herbs

Shrubs and herbs existing in the open and non-developed areas include Calatropis (calatropisprocera), Bhang (cannabis sativa) and Bathu (Chenopodium species).

Grasses

The project site is at present covered with mostly Khabbal grass, while Kana grass (Saccharummunja) also exists, along the depressions, where water accumulation occurs.

4.2.2 Fauna

Mammals

Common mammals found in the area are dogs, cats, house rats and bats. Small Indian Mongoose and Indian Palm Squirrel have also been reported. These are mostly seen in areas where houses have already been constructed or are under construction.

Reptiles

Snakes such as cobra, kraits etc. were once common in the tract, but now cases of snake bites are very rare, as these reptiles have been either killed by expanding urbanization or they have moved away. Lizards such as Spiny tailed lizard (Uromastixhardwickii) and fringed toed lizard (Acanthodactylus cantoris) are also reported by the residents of the area.

Amphibians

Amphibians frequently seen in and around the project area, especially during rainy season, include common Frog (Ranatigrina) and Indus valley toad.

Birds

House sparrow (Passer domesticus), House crow (Corvussplendens) and Mynah (Acredotherestristis) are the most common in the area. In addition, following birds have also been observed in the area.

1. Nightingale (Pycnontuscafer)
2. Parrot (Psittaculakrameri)
3. Pigeon (Columba livia)
4. Hoopoe (Upupaepops)

There are no endangered species of flora and fauna in the study area.

Wildlife Sanctuaries and Game Reserves

No wildlife sanctuary or game reserve is located in the vicinity of the study area.

Critical Habitats

No wild life sanctuary or game reserve (critical habitats), exists near the project area or the study area and therefore it can be stated that this project does not affect any critical habitat as, no critical habitat is located close to the project area.

4.3 Social Environment

This section deals with the social conditions of the Project Area. During the desk/ office study, available reports/ documents were comprehensively studied. During the field survey interviews with the residents, shopkeepers, students, pedestrians, drivers, and hospital employees were held and observations were taken after giving due consideration to the desk/ office study results.

4.3.1 Political and Administrative Setup

The project area falls in Lahore City of the Lahore District. District Co-ordination Officer is the highest ranked administrator of the district. For the collection of revenue and administration, the districts are subdivided into Tehsils. Local governments also administer the area through Union Councils and Tehsils. The total area of the district Lahore is 2,300 square kilometers.

4.3.2 Demographic Characteristics of the Project Area

The location of Lahore City is bounded on the North and West by Sheikhupura district, on the east by India and on the south Kasur district River Ravi flows on the northern side of Lahore. The district comprises of five sub-administrative units (Tehsils).

According to census of 2017, the overall population of the district was 11,126,285 and among them males were (47,6%) and (52.4%) were female. Sex ratio is measured as 109.87 percent. The area of the Lahore district is 1,772 square kilometers, which gives population density of 6,279 persons per square kilometer as against 3,566 persons observed in 1998. The average annual growth rate of population in the district

during intercensal period 1998-2017 was 3 percent. **Table 4.13** gives population, its inter censal increase and average annual growth rate since 1951 of Lahore district.

Table 4.13: Population and Inter censal Increase and Growth Rates

Description	1951	1961	1972	1981	1998	2017
Population (in 000's)	1,135	1,626	2,588	3,545	6,319	11,126,285
Intercensal Increase (%)	43.3	59.2	37.0	78.3	-	-
Average Annual Growth Rate (%)	3.7	4.1	3.8	3.5	-	-

Source: *DCR of Lahore District, 1998*

A) Rural and Urban Distributions

The urban population was 5,209,088 or 82.4 percent of the total population of the Lahore district, which grew at an average rate of 3.3 percent during 1981-98. The growth decreased from 3.7 percent, which was observed during 1972-81. There are one Metropolitan Corporation, two Town Committees and one Cantonment in the District.

There were 261 Mauzas (a smallest revenue unit) in 1998. Of these 61 had population over 5 thousand, another 61 had 2 to 5 thousand, 64 had one to two thousand, and 74 had under one thousand persons while one was un-inhibited.

B) Religion

The population of the district is predominantly Muslims i.e. 93.9 percent. The next higher percentage is of Christians with 5.8 points followed by Ahmadis 0.2 percent. While other minorities like Hindu etc. are very small in number as shown in the **Table 4.14** given below:

Table 4.14: Percentage of Population by Religion and Rural/ Urban Areas

Religion	Lahore District		
	All Areas	Rural	Urban
Muslims	93.9	90.9	94.5
Christians	5.8	8.9	5.2
Hindu	0	*	0
Ahmadis	0.2	0.1	0.3
Others	*	*	*

** Refers to a very small number Source: DCR Lahore District, 1998*

C) Ethnic Structure

The main castes and groups of the Lahore district are Arain, Jat, Rajput, Malik, Pathan, Mughal, Sheikh, Komboh and Gujjar. Besides, there are also village artisans, which include Lohars (blacksmiths), Tarkhan (carpenter), Kumhars (potters), Mochis (cobblers), Machhis (water-carries), barbers and weavers etc.

D) Mother Tongue

The mother tongue refers to the language used for communication between parents and their children in any household. Punjabi is the predominant language being spoken by majority (86.2 percent) of the population of the district followed by Urdu, Pushto and Siraiki being spoken by 10.2, 1.9, and 0.4 percent. Sindhi is spoken by 0.1 percent.

E) Sex Ratio

Number of males for every 100 females was 111 percent recorded in 1998 Census in the district, which had decreased from 115 in 1981. The ratio was 112 percent in rural areas and it was 111 in urban areas.

F) Marital Status

The population above 15 years was classified into never married, married, widowed and divorced. 36.2 percent of the total population was never married, 58.6 percent married, 4.9 percent widowed and 0.3 percent divorced. The percentage share of never married male was higher than that of females, being 41.3 percent and 30.3 percent respectively. The percentage of never married females was higher in urban than in rural areas.

Table 4.15 gives details about percentage of population 15 years and above by marital status, sex and rural and urban residence.

Table 4.15: Population Percentage Distribution by Marital Status, Sex and Rural/ Urban Areas

Marital Status		Lahore District		
		All Areas	Rural	Urban
Never Married	Both Sexes	36.2	31.5	37.1
	Male	41.3	36.8	42.2
	Female	30.3	25.4	31.2
Married	Both Sexes	58.6	63.2	57.7
	Male	55.5	59.3	54.8
	Female	62.1	67.6	61.1
Widowed	Both Sexes	4.9	5.1	4.9
	Male	2.9	3.7	2.8
	Female	7.2	6.7	7.3
Divorced	Both Sexes	0.3	0.2	0.3
	Male	0.2	0.2	0.2
	Female	0.4	0.3	0.4

Source: *DCR of Lahore district, 1998*

G) Migration

The total number of life time in-migrants in Lahore district was 1,034,848 or 16.4 percent of the population of the district. Of total life time in-migrants 890,427 persons settled in the towns. Of total district migrants 71.7 percent came from other districts of the Punjab, 10.1 percent were from Sindh, NWFP and Baluchistan, 1.3 percent from Azad Kashmir and Northern Areas while remaining 16.9 percent were Pakistanis who repatriated from other countries. There were only 11 migrants whose birth place was not reported. **Table 4.16** throws light on life time in-migrants with their decomposition by place of origin, and place of settlement in rural and urban areas of the district.

Table 4.16: Life Time Migrants in the District by Rural/ Urban Areas, 1998

Description	Migrants by Residence		
	All Areas	Rural	Urban
Total in-migrants	100	100	100
Migrants from the same province	71.7	79.4	70.5
Migrants from other provinces	10.1	6.1	10.7
Migrants from AK/ NA	1.3	0.8	1.4
Migrants from other countries	16.9	13.7	17.4
Migrants from places not reported	**	0	*

Source: DCR of Lahore District, 1998

* Including FATA and Islamabad Capital Territory ****** refers to very small number.

4.4 Economic Conditions

A) Economically Active Population of the Lahore District

The economically active population is defined here as the persons working, most of the time during the year preceding the census date i.e. 5th March 1998, looking for work, laid off and un-paid family helpers assisting their family. The economically active population as enumerated in the last census was 21.8 percent of the total population or 29.5 percent of the 10 years and over i.e. the population exposed to the risk of entering the economically active life at any time. The formal percentage is known as Crude Activity Rate (CAR), while the latter is known as Refined Activity Rate (RAR). Of the total male population 39.9 were economically active, while 60.1 percent were inactive, 25.4 percent children under 10 years, 18.0 percent students, 1.9 percent domestic workers, while 14.8 percent were landlords, property owners, retired persons, disabled etc. Further details can be seen in **Table 4.17**.

Table 4.17: Percentage (%) of Population by Economic Categories, Sex and Rural Urban Areas, 1998

Economic Category	All Areas			Rural			Urban		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
Economically	21.8	39.9	1.6	20.7	37.9	1.3	22.0	40.4	1.6

Economic Category	All Areas			Rural			Urban		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
Active									
Not Economically Active	78.2	60.1	98.4	79.3	62.1	98.7	78.0	59.6	98.4
Children under 10	26.1	25.4	26.8	31.1	30.3	32.0	25.0	24.3	25.7
Students	9.8	18.0	0.6	7.0	13.2	0.1	10.3	19.0	0.7
Domestic Workers	34.5	1.9	70.9	32.6	2.5	66.4	34.9	1.8	71.8
Others	7.9	14.8	0.1	8.5	16.1	00	7.7	14.5	0.1
Unemployment Rate	**20.7**	**21.4**	**2.2**	**21.5**	**22.1**	**1.2**	**20.5**	**21.2**	**2.4**

Source: *DCR of Lahore District, 1998*

B) Unemployment

Unemployment rate is measured as ratio of looking for work and laid off in total economically active population comprising employed, looking for work, laid off and unpaid family workers, generally representing in percentage. The unemployment rate was 20.7 percent, which was mainly due to unemployment amongst males representing 21.4 percent, while female unemployment rate was just 2.2 percent. This is because of their small proportion in total economically active population.

C) Employed Population by Occupations

In 1998 of the total employed persons, 44.7 percent had elementary occupations, followed by service workers, and shop and market sale workers, 17.5 percent and professional 9.2 percent. In rural areas people having elementary occupations, were again in majority followed by skilled agricultural and fishery works and service workers and shop and market sale workers represented 52.5, 23.7, and 8.4 percent respectively. The highest percentage in urban area is of elementary occupations too, followed by service workers and shop and market sales workers and crafts and related trade workers and having 43.2, 19.3 and 9.1 percent respectively. Further details are given in **Table 4.18**.

Table 4.18: Percentage of Employed Population by Occupation and Rural/Urban Areas, 1998

Occupation		All Areas	Rural	Urban
No.	Description			
1	Legislators, Senior Officials and Managers	0.7	0.1	0.8
2	Professional	9.2	2.5	10.5
3	Technicians and Associate Professionals	3.4	2.1	3.7
4	Clerks	4.1	1.2	4.6
5	Services Workers and Shop and Market Sales Workers	17.5	8.4	19.3

6	Skilled Agricultural and Fishery Workers	5.7	23.7	2.1
7	Craft and Related Trade Workers	8.5	5.3	9.1
8	Plant and Machine Operators and Assemblers	5.1	3.8	5.4
9	Elementary Occupations	44.7	52.5	43.2
10	Others	1.1	0.3	1.3

Source: *DCR of Lahore District, 1998*

D) Industry, Trade and Trade Centers

After Karachi, Lahore is the biggest industrial area in Pakistan. There has been a steady expansion of industries in and around Lahore since independence. There are many large industrial units in the district. These units manufacture cotton, woolen and silk cloths, carpets and rugs, textile products, lather and rubber foot wears, wearing apparel, pharmaceutical goods, soap, iron and steel products, heating, plumbing and lighting equipment, hardware, miscellaneous fabricated products, agriculture machinery, engines and turbines, textile machinery, printing machinery, metal working machinery, pumps and compressors, household machinery, water generators, motor generators, transformers, electric fans, communication equipment's, cycles and rickshaws. There are also a good number of printing and publishing units and body building workshops. Besides, there are units of canning and preservation of food, edible oils, beverages, metal and wood furniture, rubber products, chemicals, glass products, repair of railway equipment, toys, stationary etc.

4.5 Transportation

Lahore is one of the most accessible cities of Pakistan. In addition to the historic Grand Trunk Road (G.T. Road), a Motorway (M-2) was completed in 1997 from Lahore to Islamabad. The government has built underpasses to ease congestion and prevent traffic jams, and according to official figures, Lahore has the highest number of underpasses in Pakistan.

Railways

The Pakistan Railways headquarters is located in Lahore**.** Pakistan Railways provides an important mode of transportation for commuters and connects distant parts of the country with Lahore for business, sight-seeing, pilgrimage, and education. The Lahore Central Railway Station, built during the British colonial era, is located in the heart of the city.

View of Railway Station, Lahore

4.6 Educational Facilities

Educational facilities in Lahore are mainly being provided by the Government of Punjab, the city government and the private sector and voluntary organizations. To a limited extent the high school education is also being managed by the Federal Government through the operation of few institutes located in the cantonment area.

Of the total educated persons 12.6 % are below primary, 23.2 % had passed primary, 22.5 % middle, 18.2 % Matriculation, 9.3 % Intermediate, 7.2 % Graduates, 2.6 % Post graduates while 0.6 % were certificate holders.

Total number of Government schools in Lahore District is 409 out of which, 223 are boy schools and 186 are girls' schools while total number of students studying in these schools are 121,417 out of which, 46,625 are boys while 74,792 are girls. Similarly, total numbers of Municipal Corporation based schools in Lahore are 103 out of which, 44 are boy schools and 59 are girl schools. In these 44 boy schools total number of students is 4,575 and the total number of girl students is 9,606.

Similarly, there are number of colleges and universities are dealing with all fields of Science and arts. The Educational Facilities located from Qaddafi stadium to Data Darbar include The Educators, Joan Mcdonald School, Punjab college, ICMAP, Virtual university, M.A.O College, Punjab university, G.C. University, University of Education etc. The numeric details of these institutes are given in **Table 4.19**.

Table 4.19: Population-Institution Relationship

Sr. No.	Type of Institutions	Number	Number of population served
1	Higher Secondary Schools and Intermediate Colleges	36	182990
2	Degree Colleges	38	173359
3	Universities	52	48025

Source: *DCR of Lahore District, 1998*

4.7 Health Facilities

Ample medical and health facilities are available in the Lahore Metropolitan Corporation area and its urban areas. Shaukat Khanam Hospital is the latest addition in the medical care facilities in Lahore for the most dangerous disease in the country. i.e. Cancer. There are also other hospitals of voluntary organizations which provide health cover to the general public. King Zaid Bin Sultan Hospital is also a very advanced addition in the medical care for Lahore. Among the prominent hospitals are General Hospital, Lady Willington Hospital, Mayo Hospital, Fatima Jinnah Hospital, The Children Hospital, Services Hospital, and Ganga Ram Hospital etc. Besides, a number of private medical practitioners, Hakims and homeopathic doctors are also

practicing in the city. Some famous Health facilities located in the Project vicinity are Hameed Latif Hospital, Wapda Hospital, Lady Willington.

4.8 Archeological and Cultural Property/ Places of Interest

The most common places of interest in Lahore city are discussed as following:

a) Royal Fort Lahore

Royal Fort Lahore/Shahi Qila is located at an eminence in the north-west corner of the Walled City. The Citadel is spread over an area of 50 acres. Many visitors from the foreign and local tours of different educational institutions come to see this historical place every year. The front gate of the Fort is called the Alamgiri Gate of the Royal Fort.

b) Minar-e-Pakistan

About 59.5 meters tall monument, called Minar-e-Pakistan is situated near the Royal Fort in the spacious Iqbal Park (previously known as Minto Park), where the historical resolution for the creation of Pakistan was adopted on the 23rd March, 1940. Around the minar, there are spacious parks with beautiful Cyprus trees and flowers all over. The total area of the minar including the park is 22 acres.

c) Badshahi Mosque

The imperial or the Badshahi Mosque is across the courtyard from Alamgiri Gate of the Royal Fort. It has beautiful gateway and a courtyard that is said to be the largest mosque courtyard in the world for outdoor prayers.

d) Shalamar Garden

The Shalamar Garden, also written Shalimar Garden, was built by the great Mughal emperor Shah Jahan. Construction began in 1641 A.D and was completed in a year. It is one of the The Shalimar Gardens are located near Baghbanpura along the Grand Trunk Road some 5 kilometers northeast of the main Lahore city. Shalimar Gardens draws inspiration from Central

Asia, Kashmir, Punjab, Persia, and the Delhi Sultanate. Every year a festival of Hazrat Madhu Lal Hussain is also being organized near this Garden and Tourists from all over the country visit it.

4.9 Impact Assessment Survey of the Project Area

The Impact Assessment Survey of project area was conducted in order to derive primary data / information and also to identify the impacts and their magnitudes on the affected population. A sample of 356 respondents was taken on the basis of random sampling technique, which included shop keepers, residents, pedestrians, drivers, hospital management, students and Govt. & other line departments etc. During the survey, both males and females were contacted for information. The purpose of survey was to get response about the perceived impacts and preferences towards the project implementation. The social survey questionnaire is attached as **Annex XIII.**

4.9.1 Survey Results

i) Gender Ratio in the Project Area

Total 356 respondents were contacted, comprising of 75% males and 25% females. Efforts were made to include the majority of the population in the sample and contact the maximum population during the survey. **Table 4.20** shows Gender ratio of the respondents interviewed.

Table 4.20: Gender Ratio of the Respondents

Sr. No.	Gender Ratio	Number	Percentage
1	Male	268	75
2	Female	88	25
Total		**356**	**100**

The pie chart given below reflects the gender distribution in the proposed project area.

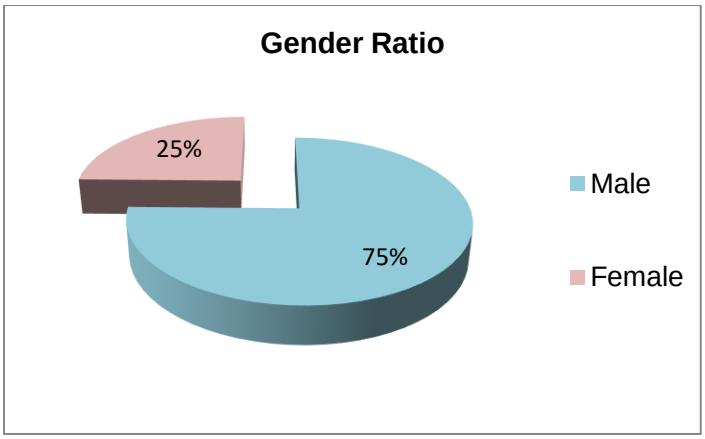


Figure 4.15: Gender Ratio in the Project Area

ii) Age Distribution

The demographic characteristics of the sample survey show **(Table 4.21)** that 21% of the respondents were up to 25 years of age. 24% of the respondents were aged between 26 – 35 years, 25% were 36 – 45 years and 30% were more than 46 years of age. These figures show that by and large respondents were mature enough to give their opinion about the construction of the Sewerage System from Larech Colony to Gulshen-e-Ravi and foresee its impacts.

Table 4.21: Age Composition of the Respondents

Sr. No.	Frequency Distribution	Number	Percentage
1	15 – 25	75	21
2	26 – 35	87	24
3	36 – 45	88	25
4	46 and above	106	30
Total		**356**	**100**

The bar graph given below shows the age composition of the respondents

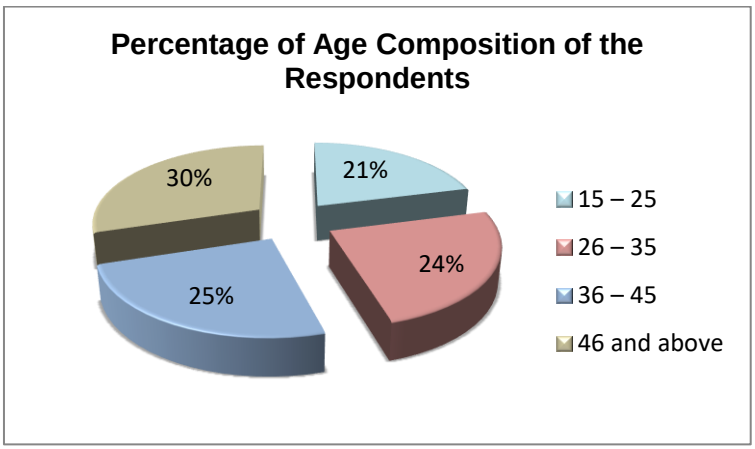


Figure 4.16: Age Composition of the Respondents in the Project Area

iii) Education

Education distribution of the respondents is shown in **Table 4.22.** From the data presented in the table it is clear that majority of the respondents (26%) were Illiterate &17% persons of the respondents were primary, 20% were middle schooling, 19% were metric level and 10% were intermediate,7% of the respondents were graduate. While 1% of the respondents are educated up to masters & above.

Table 4.22: Educational Level of the Respondents

Sr. No.	Educational Level	Number	Percentage
1	Illiterate	92	26
2	Primary	62	17
3	Middle	71	20
4	Matric	66	19
5	Intermediate	36	10
6	Graduation	24	7
7	Masters & Above	5	1
Total		**356**	**100**

The pie chart given below shows the educational level of the respondents.

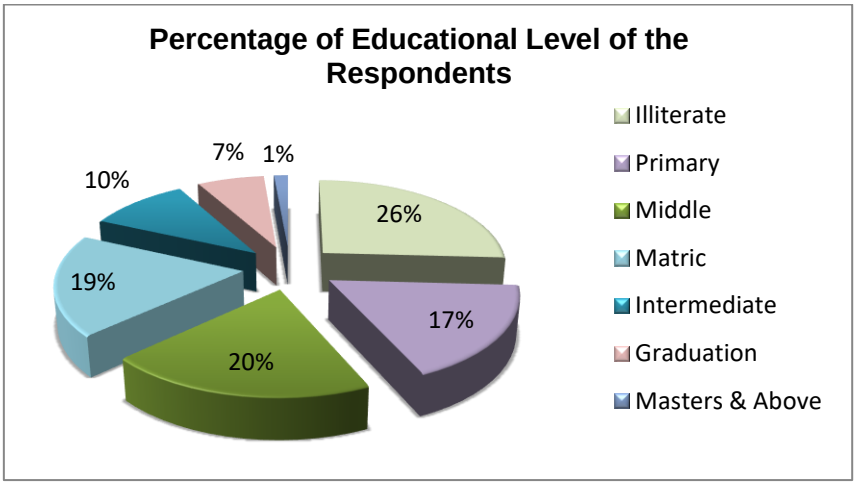


Figure 4.17: Educational Level of the Respondents in the Project Area

iv) Marital Status

The marital status of the sampled respondents was also inquired during the survey. About 79% of the respondents were married and only 21% were unmarried. Details are given in **Table 4.23.**

Table 4.23: Marital Status of the Respondents

Sr. No.	Marital Status	Number	Percentage
1	Married	283	79
2	Un-married	73	21
Total		**356**	**100**

The pie chart given below shows the marital status of the respondents

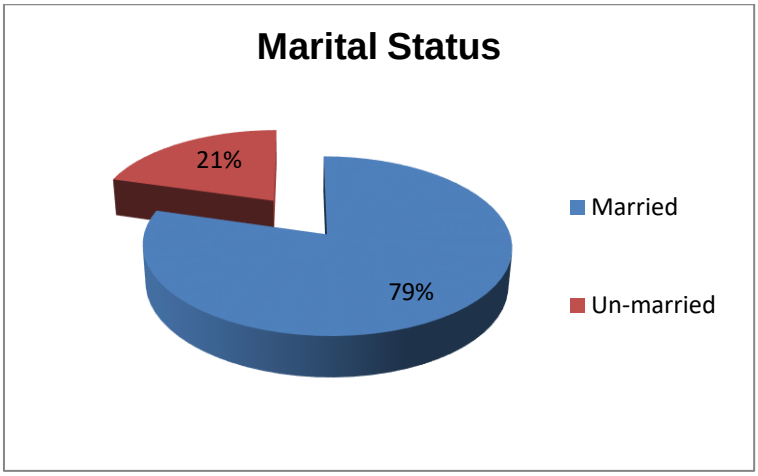


Figure 4.18: Marital Status of the Respondents in the Project Area

v) Languages Spoken in the Area of Influence

Languages spoken in the project area are illustrated in **Table 4.24**. Majority of the respondents (58%) speak Punjabi followed Urdu 1%, accordingly. Those who speak Urdu/Punjabi collectively are 41% percent respectively.

Table 4.24: Languages spoken in the project area

Sr. No.	Language	Numbers	Percentage
1	Punjabi	205	58
2	Urdu	4	1
3	Punjabi, Urdu	147	41
Total		**356**	**100**

The pie chart given below shows the Language of the respondents in the project area

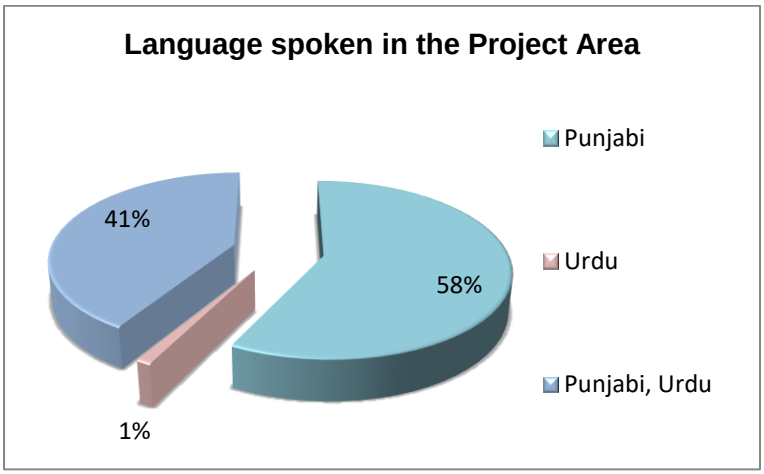


Figure 4.19: Languages Spoken in the Project Area

vi) Household Size

From data presented in the **Table 4.25**, it is clear that the majority of the respondents (61%) fall in family size ranging between 6-10, 32% with family members between 1 to 5, and 5% families were those, who have average household size more than 10 persons, and 3% didn't give any response.

Table 4.25: Household Size of the Respondent

Sr. No.	Family Size	Numbers	Percentage
1	1-5	113	32
2	6-10	216	61
3	>10	17	5
4	No Response	10	3
Total		**356**	**100**

The pie chart given below shows the average household size in the graphical form.

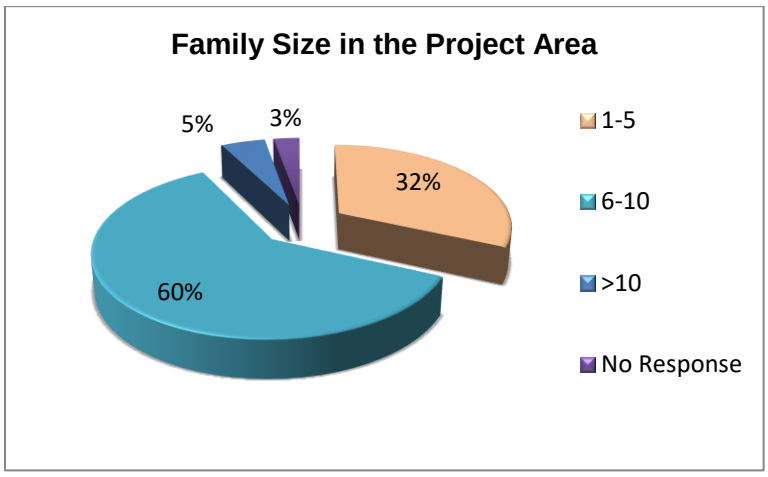


Figure 4.20: Household Size of the Respondents in the Project Area

vi) Religious Composition of Population

The population consists of different religious groups including Muslims, Christians, and Sikhs. The socio-economic baseline survey was carried out with 93% Muslims,7% Christians and 1% Sikhs population. Effort was made to consult a representative sample of all these population groups without discrimination. Religious composition of the respondents is shown in **Table 4.26.**

Table 4.26: Religious composition of the Respondents

Sr. No.	Religion	Numbers	Percentage
1	Islam	330	93
2	Christian	24	7
3	Sikh	2	1
Total		**356**	**100**

The pie chart given below shows the religious composition of the respondents

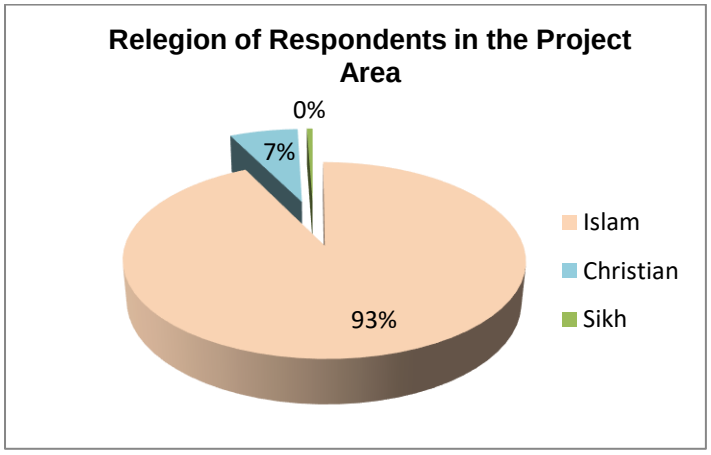


Figure 4.21: Religious Composition in the Project Area

vii) Occupation

About 56% respondents were businessmen/ shopkeepers, 10% of the respondents were office workers/Govt. Employee, 4% were drivers &3% were salesman, 10% were labour/worker, while 10% were Farmers & 2% were students and10% were belong to private Jobs. **(Table 4.27)**

Table 4.27: Occupations of the Respondents

Sr. No.	Profession	Numbers	Percentage
1	Businessmen/ shopkeepers	201	56
2	Drivers	13	4
3	Labour/Workers	37	10
4	Salesman	12	3
5	Govt. Employee	14	4
6	Student	8	2
7	Private Job	36	10
8	Agriculture	35	10
Total		**356**	**100**

The occupational distribution of the respondents is given below in the form of pie chart.

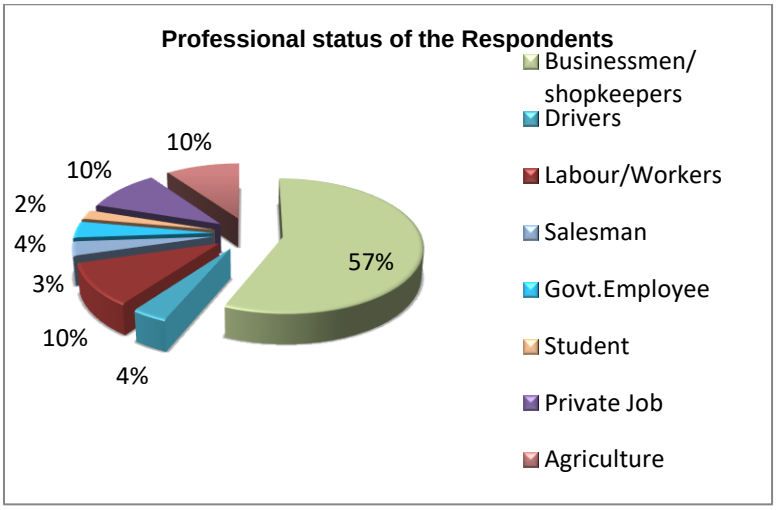


Figure 4.22: Occupations of the Respondents in the Project Area

viii) Average Working Hours of the Respondents

The respondents were associated with various professions such as business/ shop owners, office workers/Govt. job, drivers, students & salesman etc. 21% of the people interviewed were working for 1 to 8 hours daily, 69% for 8 to12 hours while 6% of the respondents were those people who were working more than 12 hours on a routine basis and 3% didn't give any response **(Table 4.28).**

Table 4.28: Average Working Hours of the Respondents

Sr. No.	Working Hours	Numbers	Percentage
1	1-8	74	21
2	8-12	247	69
3	>12	23	6
4	No Response	12	3
Total		**356**	**100**

The graph shows the of the average working hours of the respondents

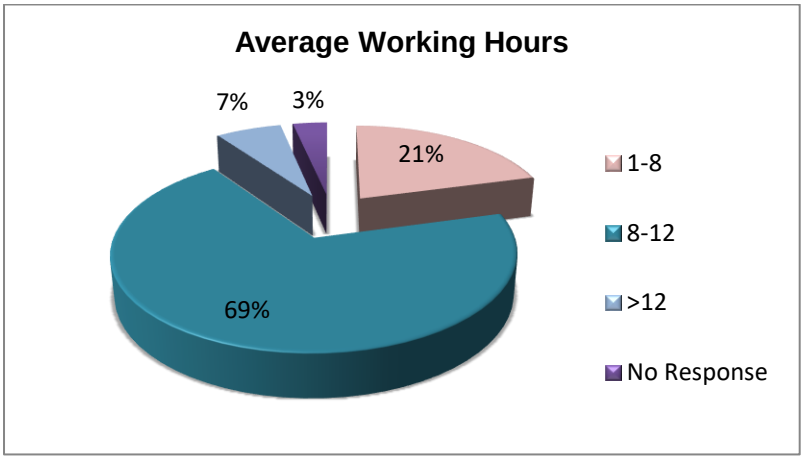


Figure 4.23: Average Working Hours of the Respondents in Project Area

ix) Income Level of the Respondents

From the **Table 4.29**, shows that the 55% of the respondents were earning their monthly income between Rs.10, 000 – 20,000, 24% fall in the income group of 20,000 and above, 14% were earning below Rs.10, 000. 7% respondents did not give any response about their income level.

Table4.29: Average Monthly Income of the Respondents

Sr. No.	Frequency Distribution INCOME	Number	Percentage
1	0-10,000	51	14
2	10,000 – 20,000	195	55
3	20,000 and Above	84	24
4	No Response	26	7
Total		**356**	**100**

In the Pie chart, the income groups of various respondents are shown below:

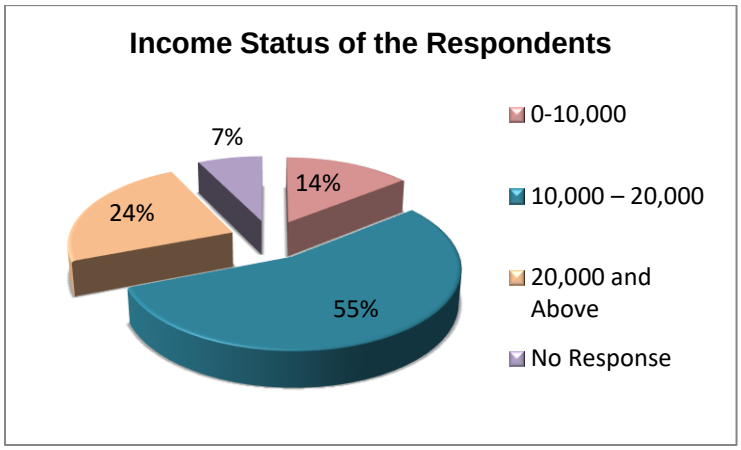


Figure 4.24: Average Monthly Income of the Respondents in Project Area

x) Sources of Domestic Water

Table 4.30 shows the source of water for domestic usage. Majority of the respondents 67% were enjoying Tap water/Govt. water supply scheme and 13% of respondents were depending on bore hole and 20% were using filtration plant as source of water for their domestic usage.

Table 4.30: Sources of Domestic Water Supply

Sr. No.	Water Supply Source	Number	Percentage
1	Tap Water/Govt Water Supply	292	67
2	Bore Water	56	13
3	Filtration Plant	88	20
Total		**436**	**100**

In the pie chart water supply source of respondents in the project area are shown below.

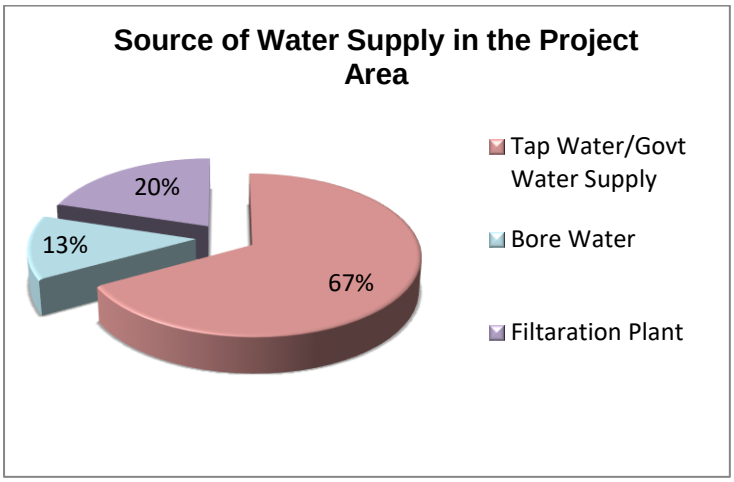


Figure 4.25: Sources of Domestic Water Supply in Project Area

xi) Satisfaction about Quality of Water

Table 4.31shows the current situation of the water quality in the project area. Majority of the respondentsi.e.66% of the respondents were satisfied with the quality of water available in the project area.While 34% respondents were not satisfied with the quality due to hard and brackish water.

Table 4.31: Quality of Water

Sr. No.	Satisfaction with Quality of Water	Number	Percentage
1	Yes	236	66
2	No	120	34
Total		**356**	**100**

In the Pie chart, satisfactions about quality of water of various respondents in the project area are shown below

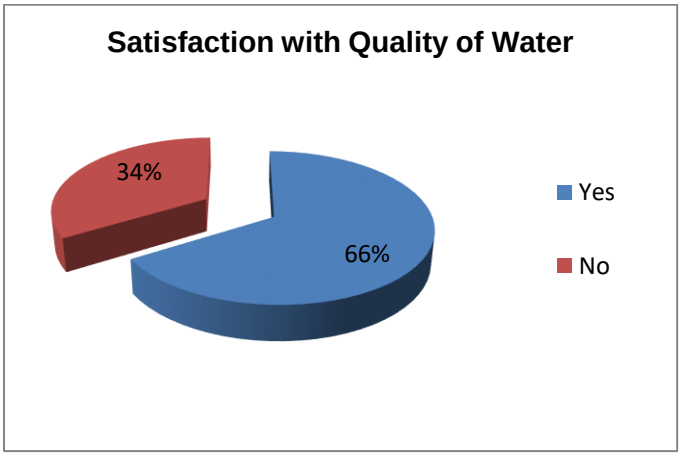


Figure 4.26: Satisfaction of Respondents with Quality of Water

Xii) Housing Pattern

During the Socio-economic survey respondents were also inquired about their house construction type to see the living standard of the respondents. 66% respondents live in pucca houses that are houses constructed with superior materials and workmanship. 21% respondents have Semi pucca houses that are houses made of bricks masonry with mud mortar. 2% of the respondents live in Kacha (Mud) houses that are houses made of mud (Un-burnt bricks) and with traditional beams and baton roofs **Table 4.32**shows the house construction type.

Table 4.32: Housing Characteristic of the Respondents

Sr. No.	Type of House	Number	Percentage
1	Pacca	236	66
2	Semi Pacca	74	21
3	Katcha	8	2
4	No Response	38	11
Total		**356**	**100**

Following pie chart shows the type of houses in the project area

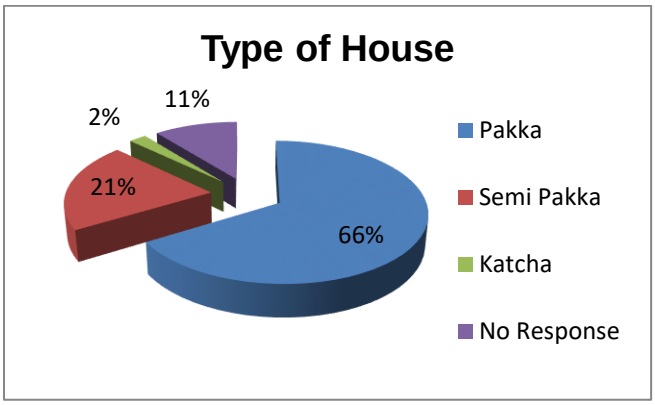


Figure 4.27: Housing Characteristic of the Respondents in Project Area

xiii) Ownership of House

The people have constructed the houses for their own residing purposes. This statement is endorsed by the field investigation, which shows that 30% of the respondents were living in their own houses and 34% of the respondents were found to live in the rented houses. While 36% of the respondents gives no response regarding ownership of houses in the project area are given in **Table 4.33.**

Table 4.33: Ownership of House in the Project Area

Sr. No.	Ownership of House	Number	Percentage
1	Self Owned	106	30
2	Rented	121	34
3	No Response	129	36
Total		**356**	**100**

Following pie chart shows the ownership of houses in the project area

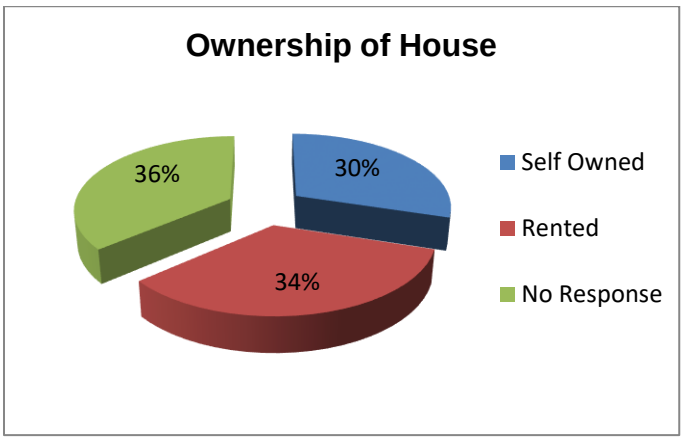


Figure 4.28: Ownership status of House of the Respondents in Project Area

xiv) Source of Energy

Table 4.34shows that majority of respondents (89 percent) were using gas and electricity &1% were using fire wood, 6% were using electricity. 3% of the respondents were found to use electricity/fire wood as source of energy (Cooking, Lightening & Transport).

Table 4.34: Source of Energy in the Project Area

Sr. No.	Source of Energy for Cooking and Lightening in the Project Area	Number	Percentage
1	Electricity	23	6
2	Electricity/Gas	316	89
3	Wood	5	1
4	Electricity/Wood	12	3
Total		**356**	**100**

Following pie chart shows the source of energy in the project area.

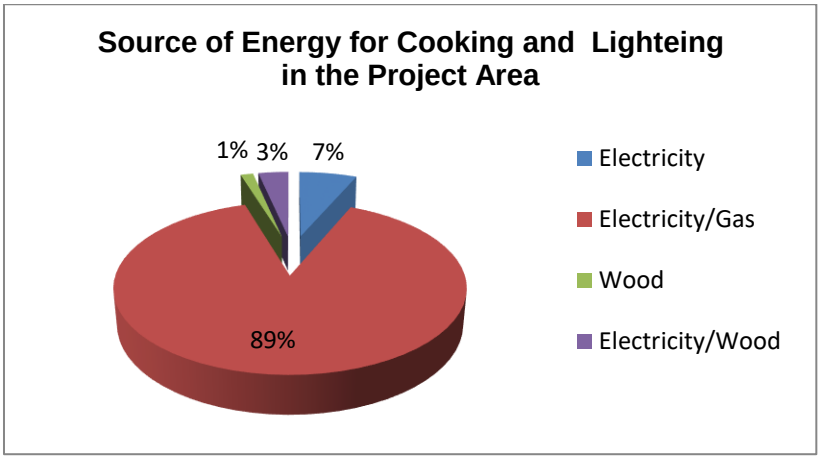


Figure 4.29: Source of Energy for Cooking and Lightening in the Project Area

xvi) Ethnic Composition of Population

Table 4.35 shows that 02% respondents were Syed by caste,14% were Arian, 02%, were Awan, 15% respondents were Jutt, 01% respondents were Balouch, 07% were Bhatti, 04%, were Butt, 03% respondents were Gujjar, 06%, were Pahtan, 19% respondents were Rajput, 01% respondents were Watoo, 04% were Shiekhl, and 05% were christian, 05% were Rehmani, 02% respondents were Mughal, 02% were Mirza, 09%, were Malik.

Table 4.35: Ethnic Groups in the Project Area

Sr. No.	Ethnic Group	Number	Percentage
1	Syed	8	2
2	Arian	50	14
3	Awan	8	2
4	Jutt	55	15
5	Balouch	3	1
6	Bhatti	24	7
7	Butt	16	4
8	Gujjar	9	3
9	Khan	20	6
10	Rajpoot	67	19
11	Watoo	3	1
12	Sheikh	13	4
13	Christian	17	5
14	Rehmani	18	5
15	Mughal	8	2
16	Mirza	6	2
17	Malik	31	9
Total		**356**	**100**

In the Pie chart, different ethnic groups in the project area are shown below

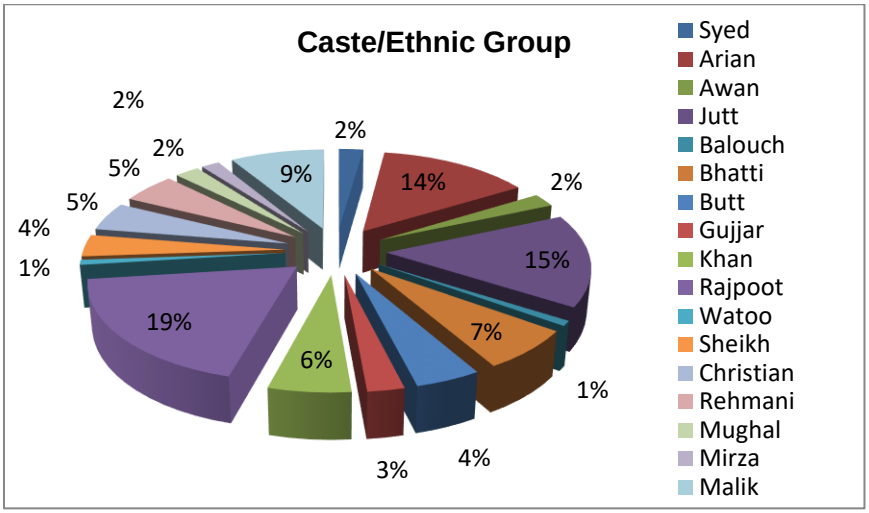


Figure 4.30: Ethnic Groups in the Project Area

xvii) Educational Status

According to Survey conducted in the project Area, 100% respondents confirmed the availability of educational institutes e.g. private school, primary school for boys and girls, Govt. Primary school, Govt. Intermediate School (Boys+Girls) etc. **Table 4.36** shows statistic of educational institutes and frequency of school going children in the surrounding of project area. The respondents were asked about the presence of education institutes in the vicinity of their homes and they were found quite satisfied regarding the availability and environment of educational institutes in their area.

Table 4.36: Educational Facility Available in the Project Area

Sr. No.	Educational Institute	Number	Percentage
1	Yes	356	100
2	No	0	0
Total		**356**	**100**

The graph shows availability of educational institutes in the project area

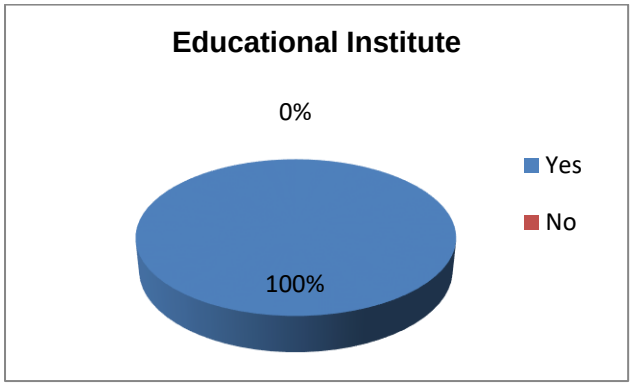


Figure 4.31: Educational Facility Available in the Project Area

xviii) Health

Health condition is one of the major determinants of a society's social development and quality of life. Healthy manpower is imperative for economic growth. Good health is a basic social value of great importance to individual and society.

The over-all health condition of the residents is fair in the project area (100%), and no serious disease was reported by the respondents except the water borne diseases. However, few hepatitis and cholera patients were also reported from the respondents as shown in the **Table 4.37** given below.

Table 4.37: Health Facility Available in the Project Area

Sr. No.	Health Facility	Number	Percentage
1	Yes	355	100
2	No	1	0
Total		**356**	**100**

The graph shows availability of health facilities in the project area

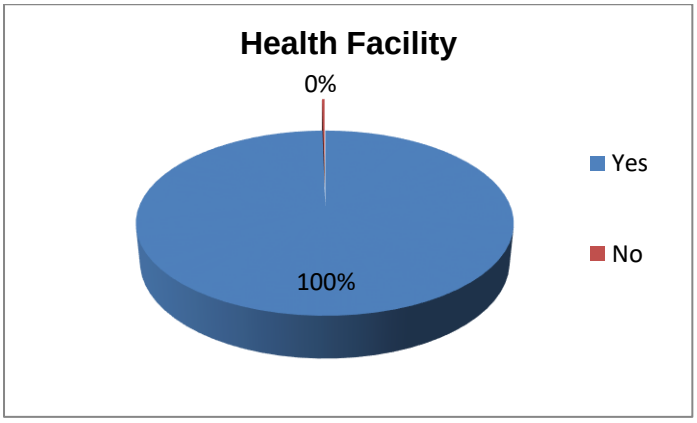


Figure 4.32: Health Facility Available in the Project Area

xix) Common Diseases

Sampled respondents were also inquired regarding the diseases found among men, women and children and the factors responsible for these diseases in their relative area. It is concluded from the survey results that hepatitis, dengue, stomach problem, tensions, diabetes, cholera, diarrhea, skin infection and high blood pressure are the most common diseases among men and women as shown in **Table 4.38**. While 49% of the respondents did not respond on this.

Table 4.38: Commonly Found Diseases in the Project Area

Sr. No.	Diseases	Number	Percentage
1	Allergy	8	2

Sr.	Diseases	Number	Percentage
2	Dengue	15	4
3	Hepatitis	35	9
4	Diarrhea	6	2
5	Ear Disease	9	2
6	Flu	10	3
7	Diabetes	28	7
8	High BP	18	5
9	Malaria	11	3
10	Stomach Problem	17	5
11	Jaundice	9	2
12	HV+ve	11	3
13	Heart Problem	5	1
14	Tension	7	2
15	No-Response	185	49
Total		**374**	**100**

The bar chart given below shows the most common diseases found in the project area.

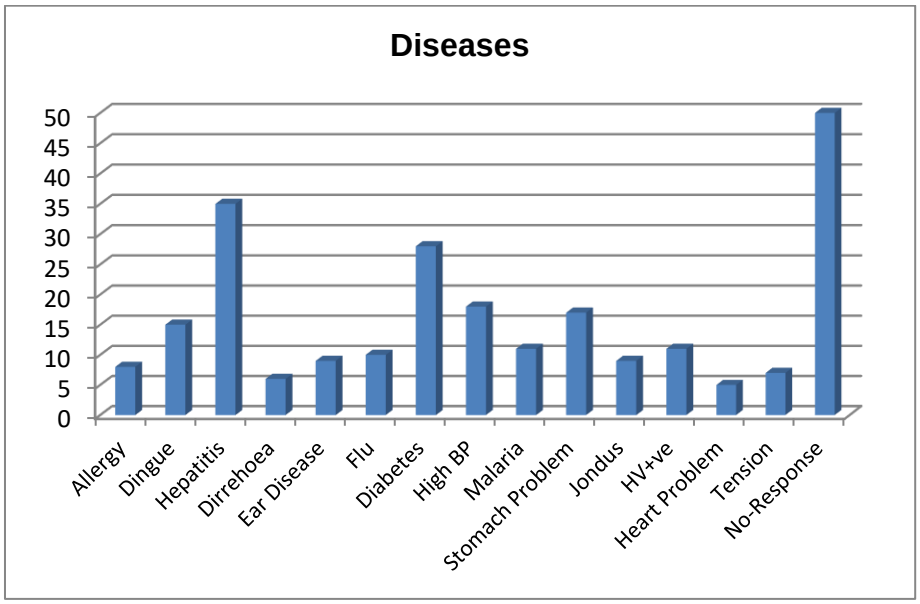


Figure 4.33: Commonly Found Diseases in the Project Area

xx) Modes of Transport in the Project Area

Table 4.39 shows the different modes of travelling in project area. Majority of the respondents i.e. 55% were using public transport including bus, van, rickshaw etc and only 44% respondents have their own vehicle to reach their desired locations. while 1% of the respondents gives no response.

Table 4.39: Modes of Transport in the Project Area

Sr. No.	Modes of Transport in the Project Area	Number	Percentage
1	Public	269	55
2	Private	215	44
3	No-Response	3	1
Total		**487**	**100**

The pie chart given below shows the Mode of Travelling in proposed project area.

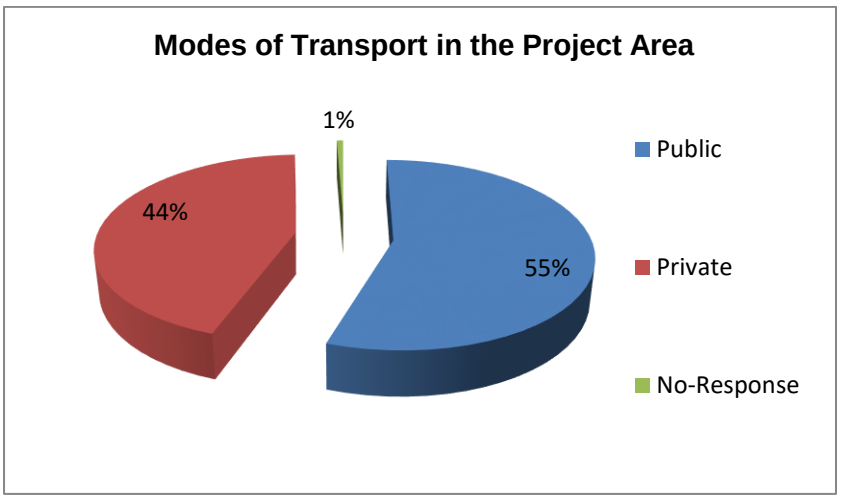


Figure 4.34: Modes of Transport in the Project Area

xxi) Non-Government Organization/Association (NGOs) in Project Area

Survey results indicate that there was only 1% Non-Government Organization/Association (NGOs) working in the project area **(Table 4.40)**

Table 4.40: Presence of NGOs in the Area

Sr. No.	Presence of NGOs in the Area	Number	Percentage
1	Yes	4	1
2	No	197	55
3	No-Response	155	44
Total		**356**	**100**

Pie graph shows the presence of non-government organization/association (NGOs) in project area

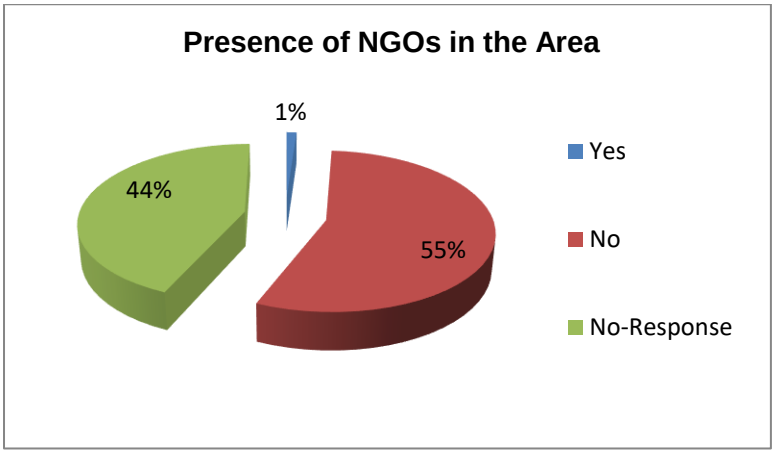


Figure 4.35: Presence of NGOs in the Project Area

xxii) Availability of Sewerage System

Respondents were asked about the availability of sewerage system in the project area as illustrated in **Table 4.41.** A large number of respondents 93% affirmed about availability of sewerage system, while 7% reported having no sewerage system in the area.

Table 4.41: Availability of Sewerage System

Sr. No.	House Connected with Sewerage System	Number	Percentage
1	Yes	330	93
2	No	26	7
Total		**356**	**100**

Pie graph shows the availability of sewerage system in project area

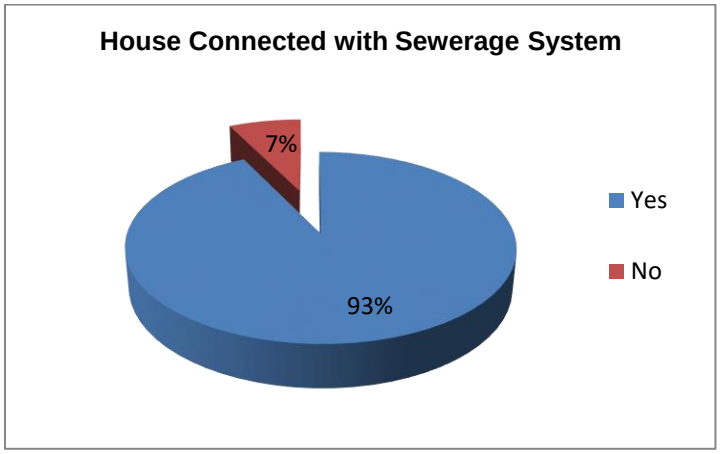


Figure 4.36: Availability of Sewerage System in the Project Area

xxiii) Satisfaction with Sewerage System

Respondents were asked about satisfaction with the present sewerage system, a significant number of respondents (83%) showed satisfaction & 17% were not satisfied and stressed that there should be proper and well-connected sewerage lines in project area. while 1% of the respondents gives no response as shown in **Table 4.42.**

Table 4.42: Satisfaction with Sewerage System

Sr. No.	Satisfaction with Sewerage System	Number	Percentage
1	Yes	294	83
2	No	59	17
3	No-Response	3	1
Total		**356**	**100**

The perceived impacts of the respondents about their satisfaction with sewerage system are shown in the following pie chart given below

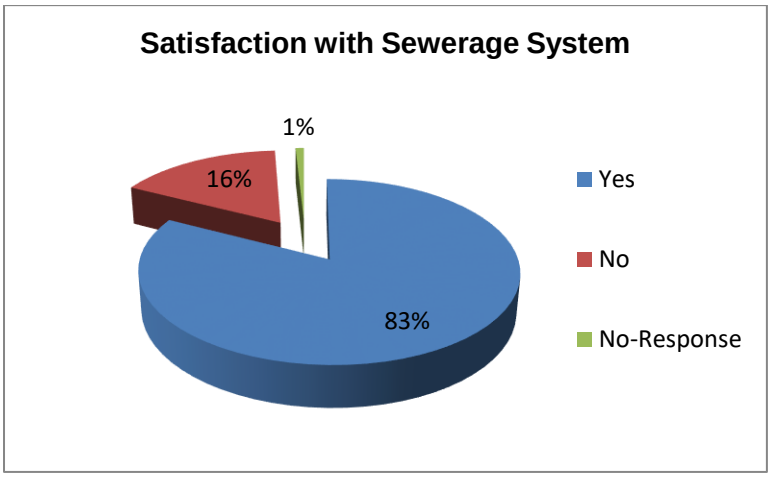


Figure 4.37: Satisfaction with Sewerage System in the Project Area

xxiv) Reasons of Using the Current Location

The data presented below in the **Table 4.43** explain the various reasons of the respondents for using the current locations for their business/ jobs etc. Out of the total, 32% of the respondents were using the subject location for their businesses because of considering it as central commercial area. 57% were the local residence of the subject location. About 93% were coming to the project location because of their jobs. Whereas, 05% respondents opined that it was very easy and main route to approach their desired location, While, 87% were those who remained silent to tell any reason.

Table 4.43: Reasons of using the Current Location

Sr. No.	Reasons of using the subject location	Number	Percentage (%)
1	Central commercial area/Business	114	32

Sr.	Reasons of using the	Number	Percentage
2	Because Residence	57	16
3	Because of job	93	26
4	Main route for travel	5	1
5	No Response	87	24
Total		**356**	**100**

The pie chart given below shows the Reasons of using the Current Location by the Respondents in the graphical form.

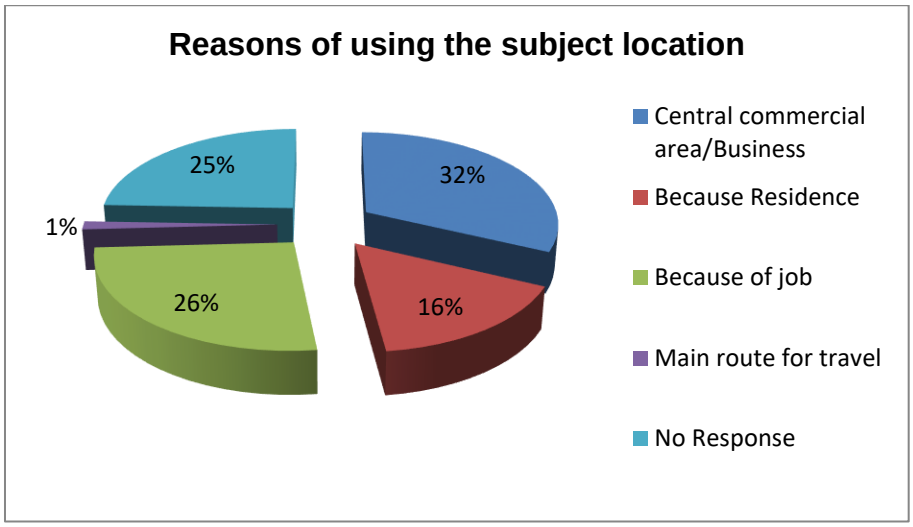


Figure 4.38: Reasons of using the Project Area

xxv) Awareness regarding the proposed Project

Among the respondents 43% were aware of the proposed Project while only 57% were those, who had no prior knowledge of the Project (**Table 4.44**).

Table 4.44: Awareness about the Construction

Sr. No.	Awareness of the Project	Number	Percentage
1	Yes	153	43
2	No	203	57
Total		**356**	**100**

Pie chart shows the awareness level of the respondents about the project implementation.

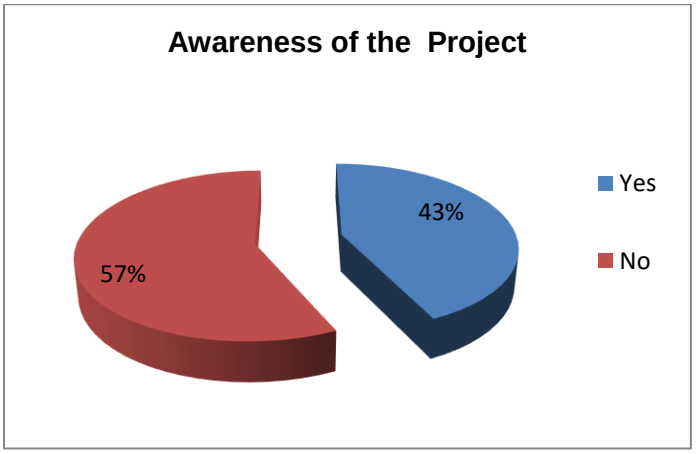


Figure 4.39: Awareness about the Project

xxvi) Implementation of the Proposed Project

Respondent's views were recorded on whether they think the project should be implemented or not. A significant number (96%) of the respondents were in favor of project implementation and only in 4% cases responses were against the construction of the proposed project (**Table 4.45**).

Opinions were also collected regarding the positive and negative impacts of the project implementation. The following impacts were concluded from the data analysis:

- During construction phase, labor opportunities should be provided to the local population of the area.
- Construction activities may cause environmental and noise pollution.
- With the provision of clean drinking water, the health status will be improved and it will have an overall positive effect on their socio-economic wellbeing and productivity.

Table 4.45: Respondents in the Favor of Implementation of the Project

Sr. No.	Implementation of the Project	Number	Percentage
1	Yes	340	96
2	No	16	4
Total		**356**	**100**

Following pie chart shows percentage of population in favor of the project

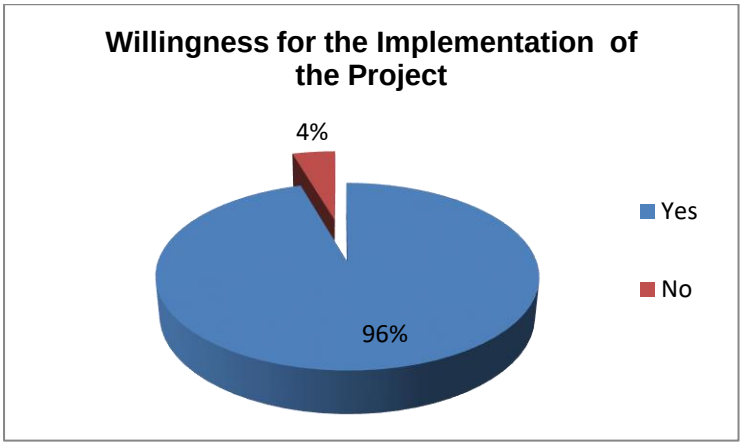


Figure 4.40: Willingness for the Implementation of the Project

xxvii) Perceived Impacts during Construction Phase

Table 4.46 provides us the various perceived impacts of the respondents of the construction of proposed project. 33% responses were that it will increase dust and noise problem during the construction phase of the project. 12% out of total responses were those, who feared traffic jam and traffic route disturbance. 6% think that they will lose whole of their business during the construction phase. 7% out of the total perceived that construction work will increase their travelling time. 7% considered that project will disturb their social life with the construction of sewerage system. 14% think that they have conveyance problem due to construction of elevated MBS. 06% think that project construction gives easy approach to their destination and 7% out of total respondents said that the accident rate will be increased during construction of proposed project. 4% considered that their land will be acquired & they will not be given proper compensation due to construction of proposed project. 9% think that project will have a negative impact on health and property of people in the area. 5% considered that construction work of proposed project will involve tree cutting and 10% out of total respondents gave no response.

Table 4.46: Perceived Impacts During Construction Phase

Sr. No.	Impacts during Construction Phase	Number	Percentage
1	Increase in dust and noise pollution	195	33
2	Decrease in business activities	37	6
3	Land acquisition	24	4
4	Inconvenience to local people during construction stage	41	7
5	Tree cutting	27	5
6	Time delays	44	7
7	Increase in traffic jam	70	12
8	Accident rate will be increased	43	7
9	No Response	62	10
10	Impact on health and property of people	52	9
Total		**595**	**100**

The perceived impacts of the respondents about the construction of sewerage system are shown in the following pie chart given below.

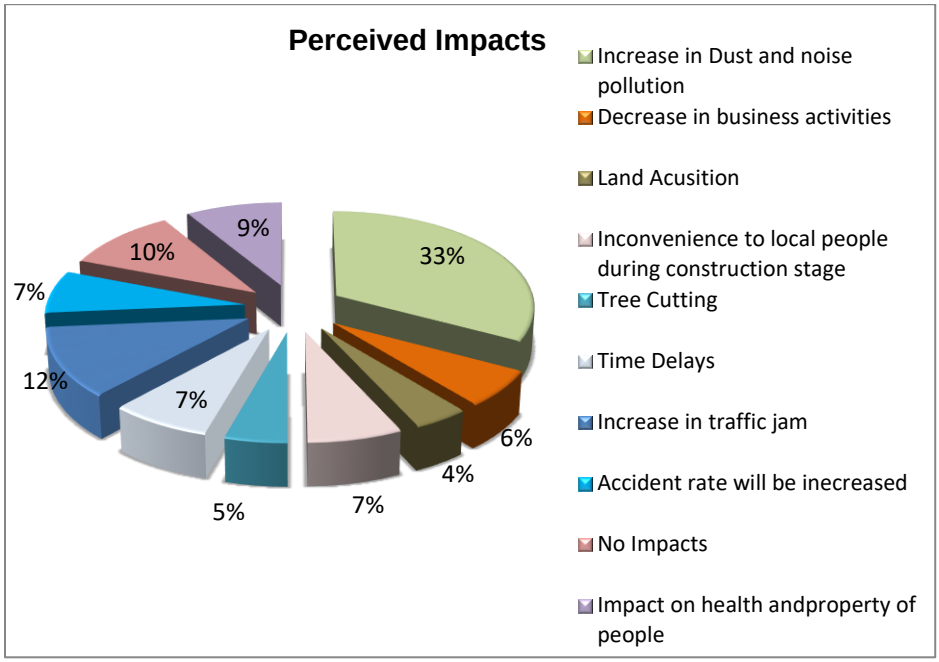


Figure 4.41: Perceived Impacts during Construction Phase of the Project

xxviii) Perceived Impacts during Operation Phase

Table 4.47provides us the various perceived impacts of the respondents during the operational phase of the proposed project, 8% & 17% considered that it will increase their business and job opportunities during the operational phase of the project respectively. 23% considered it will improve the environmental conditions. 4% thinks that the project will be beneficial for the public as well as development of area, while a majority of respondents 45% did not consider any impact regarding the project. 3% out of the total responses were those, who think that traffic movement will be smooth and fast and it reduce the travelling time.

Table 4.47: Perceived Impacts During Operational Phase

Sr. No.	Impacts during Operation Phase	Number	Percentage
1	Increase in business activities	34	8
2	Increase in job opportunities	77	17
3	It will improve the environmental conditions	100	23
4	No Impacts	200	45
5	Beneficial for the public as well as for development of area	18	4
6	Smooth & fast travelling	13	3
Total		**442**	**100**

The Perceived Impacts of the respondents about the construction of Sewerage System from Larech Colony to Gulshan-e-Ravi Lahore are shown below in graphical form work.

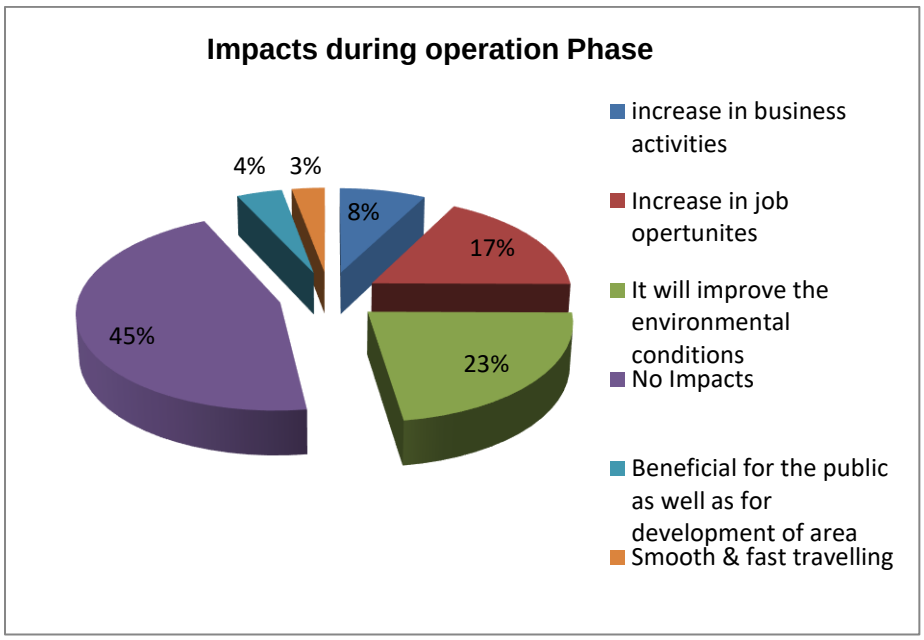


Figure 4.42: Perceived Impacts during Operational Phase of the Project

xxix) Protective Measures Suggested by the Respondents

From the data given in the **Table 4.48**, 32% responses emphasized on the need to provide the proper alternate traffic plan for smooth flow of traffic during construction. 2% were that the construction should be completed in-time without any delay. Again 24% responses were to control the pollution during the construction period. 7% responses for the adopt measure for cleanliness and 11% responses for the better management to facilitate the public& avoidance of disturbance to the customers/public during construction8% of the respondents' responses that save their business during the construction of proposed project. While 8% responses are in favor of to avoid land acquisition.32% responses were that save from dust and noise pollution during the construction phase of the project.

Table 4.48: Perceived Impacts during Operational Phase

Sr. No.	Measures Suggested	Number	Percentage
1	Alternate route provision to control traffic jam	147	32
2	Timely completion of the project	10	2
3	Adopt Measure for cleanliness	34	7
4	Better management to facilitate the public	48	11
5	Save business	38	8
6	Avoid land acquisition	35	8
7	Save from dust and pollution	144	32
Total		**456**	**100**

In the pie chart below the protective measures suggested by the Respondents are shown.

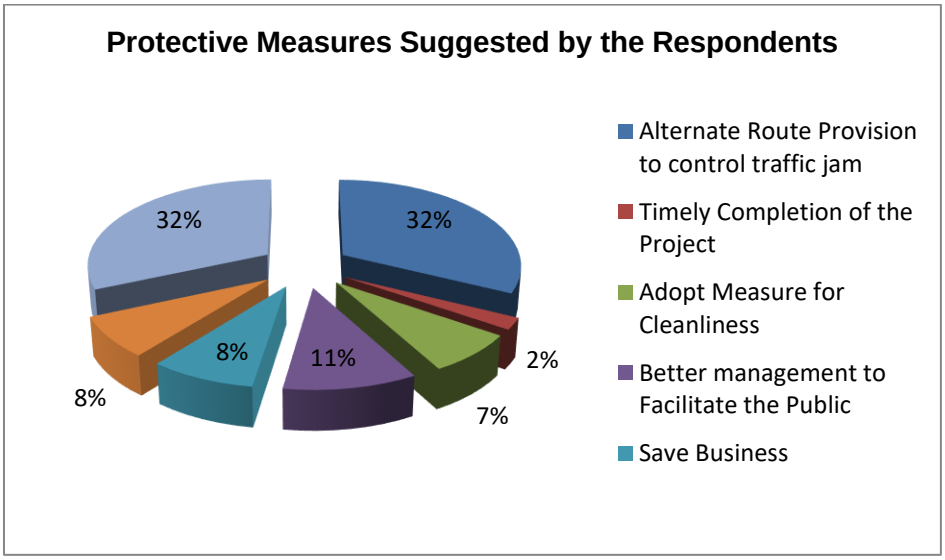


Figure 4.43: Protective Measures Suggested by the Respondents

xxx) Pressing Need of the Area

Survey outcomes showed that the Project area lacks some basic amenities such as water supply, clean drinking water, sui gas, infrastructure, schools and hospitals as depicted in **Table 4.49.** It shows that the water filtration plant was the most desired need by 16% of the total sampled population. Whereas, 7% respondents expressed the need for hospitals, 5% responses for the development of physical infrastructure like roads network Flyover-turn and Underpasses, 13%for schools in the nearest vicinity. Likewise, 16percent respondents were in favor of plantation and 03% asked for the provision of electricity, gas in their respective areas. 11% responses emphasized on the need to provide the proper traffic management plan for smooth flow of traffic. 11% &14% considered the need of playground and parking in the project area respectively.

Table 4.49: Pressing Need of the Area

Sr. No.	Pressing Need of the Area	Number	Percentage
1	Water Filtration Plant	81	16
2	Parking Area	71	14
3	Flyover-turn and Underpasses	27	5
4	Plantation	82	16
5	Hospital	37	7
6	Education	41	8
7	Gas, electricity	49	10
8	Play ground	53	11
9	Proper Traffic management plan	57	11
Total		**498**	**100**

Pie chart given below depicts the graphical representation of pressing need of the project area of influence.

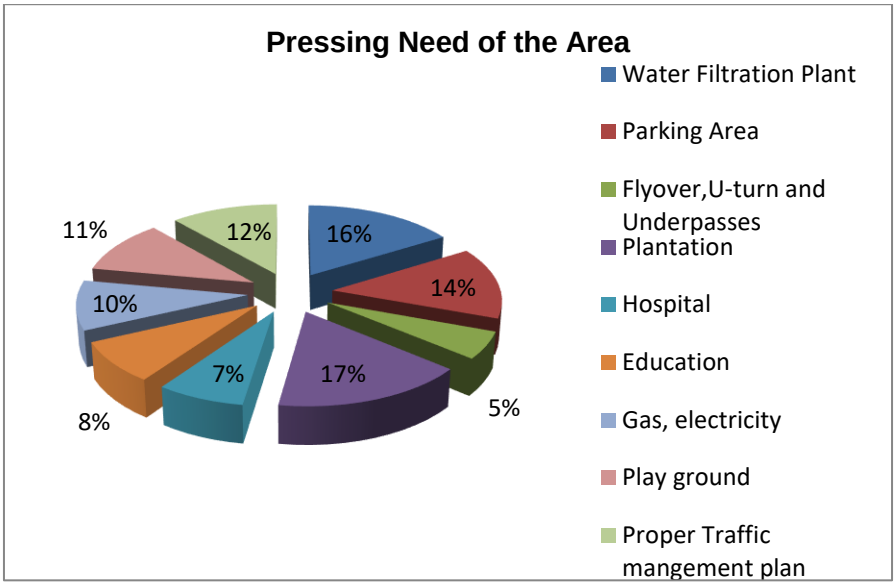


Figure 4.44: Pressing Need of the Area

SECTION 5
PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

5.0 General

This section deals with the information disclosure to the public and consultation sessions held with the different stakeholder groups that are likely to be affected by the implementation of the proposed Project. The consultation process was carried out as per the guidelines of Punjab EPA and AIIB.

This consultation process had the following objectives:

1. Share information with stakeholders on proposed improvement works and expected impacts on the physical, biological and socio-economic environment of the Project corridor;
2. Understand stakeholders' concerns regarding various aspects of the project, including the existing condition of the sewerage, upgrading requirements, and the likely impact of construction related activities and operation of the improved of sewerage system;
3. Provide an opportunity to the public to influence project design in a positive manner;
4. Obtain local and traditional knowledge, before decision making;
5. Increase public confidence about the proponent, reviewers and decision makers;
6. Reduce conflict through the early identification of controversial issues, and work through them to find acceptable solutions;
7. Create a sense of ownership of the proposal in the mind of the stakeholders; and
8. Develop the proposal which is truly sustainable.

5.1 Identification of Main Stakeholders

During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. Different stakeholders identified were the local residents, government officials, shop owners, public representative, NGO's and general public. All those stakeholders had different types of stakes according to their professions.

a) Consultation and Participation Process

For ascertaining the perceptions of different stakeholders about the project (during/ after construction) meetings were held within the project area of influence. These meetings were held in an open atmosphere, in which participants expressed their views freely. Informal group discussions were also held as an additional tool for the assessment of the perceptions of the stakeholders about the project and potential impacts both positive and adverse likely to occur due to its implementation.

b) Methods of Public Consultation

The following methods were used for public consultation with project stakeholders in order to ascertain their stakes regarding project implementation.

- Focused Group Discussions (FGDs)
- Scoping Sessions
- Formal Group Meetings
- Informal Group Meetings

c) Categories of Stakeholders Contacted

Different categories of stakeholders contacted, during consultation is shown in the **Table 5.1**.

Table 5.1: Stakeholders Contacted in the Project Area

Sr. No.	Stakeholder Category
1	Residents
2	Business/ shop owners
3	Office workers
4	Taxi/ Rickshaw drivers
5	Pedestrians
6	Vendors
7	Government Officers
8	Students
9	Passengers

5.2 Scoping Sessions

A series of scoping sessions and focus group discussions were also carried out with local communities and government employees. The meetings were held at various locations.

Generally, people were found to be aware of the need of the sewerage system, and indicated their support for this Project. Local communities demanded that they will be part of a continuous consultation process with other stakeholders at different stages of the Project including the design, construction, and operational periods. **Figure 5.1** shows the pictures of Public consultation meetings.

Public consultation at Fatima Jinah Roaad

Public consultation at Bahawalpur Road

	
Public consultation near Choburji	Formal meeting at Chak Thokar Niaz Baig
	
Discussion with vulnerable people	Discussion with vulnerable people

Plate 5.1: Consultation Meetings with Stakeholders

The scoping sessions were carried out according to the schedule indicated in Table 5.2.

Table 5.2: Schedule of Scoping Sessions

Sr. No.	Date	District	Time	Location	No. of Participants
1	March 22,2016	District Lahore	11:30 am	Shora Koti / Millat colony	13
2	March 28,2016	District Lahore	11:00 am	Gulburg Main Blue Ward	9
3	March 31,2016	District Lahore	10:30 am	Basti Sadan Shah	13
4	April 4,2016	District Lahore	10:00 am	Shadman	10
5	April 4,2016	District Lahore	01:30 pm	Shama Road	11
6	April	District Lahore	10:30 am	Samnabad	13

	12,2016				
7	April 20,2016	District Lahore	02:00 pm	Gulsan Ravi	11
8	April 27,2016	District Lahore	09:30 am	Ghari Sahu	15
9	April 29,2016	District Lahore	10:00 am	Bhawalpur Road	12
10	May 2,2016	District Lahore	10:00 am	Chuburji	10
11	May 3,2016	District Lahore	10:15 am 11:45 am	Shadeywal / Tokher Naiz Bag	10 15

5.3 Public Meetings

Public meetings have many uses in participatory development, including information sharing and group consultation, consensus building, prioritizing and sequencing of interventions and collaborative monitoring and evaluations.

5.4 Major Stakeholders and their Apprehensions

In the project area, all the possible stakeholders were identified during the survey. The commonly Raised Concerns and Views of the Stakeholders and proposed measures for addressing the Stakeholders' concerns are discussed below.

5.4.1 Commonly Raised Concerns and Views of the Stakeholders

The most commonly raised concerns during the meetings are listed below:

- Minimize the effects of noise, dust, vibration, traffic and lightening associated with construction activities on the communities living near the project area that can cause disturbances and emotional stress,
- Solid waste produced due to construction activities should be disposed of properly;
- Avoid dumping of construction material openly;
- Hazardous and non-hazardous waste produced as a result of/during construction should be treated or disposed off properly;
- Sprinkling of water should be regular in the morning, noon and evening on the daily basis;
- Corrugated iron sheets should be used specially near the sensitive receptors (commercial zones, schools/colleges etc.) to control the noise and dust emissions;
- Diversion routes should be clearly defined and appropriate traffic management plan should be adopted on those routes to avoid traffic jams, accidents and dust emissions during construction phase of the project.
- Utilities disturbed at the site should be restored as early as possible;

- Cutting of trees should be avoided at the maximum level; and
- Efforts should be made to transplant the trees according to the available facilities.

5.4.2 Proposed Measures for Addressing the Stakeholders' Concerns

The contractors and design consultants will include the following environmental and safety provisions in the project design and to protect surrounding communities from the expected impact of construction:

- A tree plantation programme to compensate for the anticipated loss of vegetation during the construction activities, and to help abate pollution caused by emissions, dust, and noise during the operation;
- Construction machinery will be placed in an adequate locations away from the sensitive areas to minimize the impacts related to the noise;
- Drainage system will be provided to control surface runoff;
- Project site will be fenced with corrugated iron sheets to minimize the level of noise and dust on the surrounding areas;
- Utilize spray mist to reduce fugitive dust particles from impacting surrounding environment;
- The utilities to be shifted due to the construction of proposed project will be relocated on priority basis to minimize the impact on the stakeholders;
- Project facilities will be located outside the existing residential and commercial areas. In order to avoid restricting the mobility of the local stakeholders, construction vehicles will remain confined within their designated areas of movement;
- Chance of leakage or obnoxious smell from the newly proposed (Trunk sewer System) should be minimized;
- Solid waste generated during construction and at camp sites will be disposed of safely at the waste disposal sites approved by the relevant Government authority; and
- All necessary measures will be taken to ensure the safety of traffic during construction, including barricades (including signs, pavement markings, flags, and lights). All such barricades will be set up to facilitate the local traffic.

Concerns raised during public consultation meetings have been discussed in **Table 5.3**.

Table 5.3: Public Meetings and the Concerns

Sr. No.	Date	Village Name	No of Participant	Main Concerns / Apprehensions	Expectations
1	March 22,2016	Shore Koti / Millat colony	13	• Dust will be generated due to deep excavations • Traffic issues will be exaggerated in the project area • Jobs should be provided to local people during construction stage of the project • Judicious compensation at market price should be given to affected persons if land is acquired. • Indigenous people might be affected	• Drainage system will be improved in the project area • Foul odor will be vanished • Landscape of the area will be improved
2	March 28,2016	Gulburg Main Boulevard	9	• Land should be acquired at market price, if acquired. • Dust emissions due to construction activities. • Vibrations due to use of Tunnel Boring Machine	• Electronics will be saved as the gaseous emissions from the drains will not affect them anymore. • Beauty of area will increase due to covered drains
3	March 31,2016	Basti Sadan Shah .	13	• Avoid use of heavy machinery in residential areas • Indigenous people might be affected	• Chances of falling of children in the open drains will be reduced • Job opportunities for labors during construction. • Water borne diseases will be reduced • Rats will not come out and stay in tunnels

Sr. No.	Date	Village Name	No of Participant	Main Concerns / Apprehensions	Expectations
4	April 4,2016	Shahadman	10	• Accidents chances will be increased during construction. • Safety of old/heritage buildings from the effects of vibration • Jobs should be provided to local people during construction stage of the project. • Business will be disturbed	• Job opportunities for labors during construction. • Landscape of the area will be improved • Land value will increase
5	April 4,2016	Shama Road	11	• Business will be disturbed • Traffic issues will be increased in the project area • Vibrations due to use of Tunnel Boring Machine	• Foul odor will be vanished • Landscape of the area will be improved
6	April 12,2016	Samna Abad	13	• Indigenous people might be affected • Jobs should be provided to local people • Accidents chances will be increased. • Business will be affected during construction phase	• Drainage system will be improved in the project area • Landscape will improve • Land value will increase
7	April 20,2016	Gulsan Ravi	11	• Dust will be generated due to deep excavations • Indigenous people might be affected • Traffic issues will be exaggerated in the project area • Children might fall in the drains or pumping station	• Accidents (i.e. falling children incidents) will reduce • Drainage system will be improved in the project area
8	April 27,2016	Ghari Sahu	15	• Business will be disturbed • Traffic congestion will increase • Dust will be generated due to deep excavations	• Job opportunities for labors during construction. • Landscape of the area will be improved • Land value will increase

Sr. No.	Date	Village Name	No of Participant	Main Concerns / Apprehensions	Expectations
9	April 29,2016	Bhawalpur Road	12	• Sign boards should be provided along the construction site • Proper arrangements should be done to avoid construction hazards.	• Diseases will reduce in the area • Foul odor will be vanished
10	May 2,2016	Chouburji	11	• Traffic issues will be increased in the project area during construction • Vibrations due to use of Tunnel Boring Machine	• Chances of falling of children in the open drains will be reduced • Water related diseases will be reduced
11	May 3,2016	Shadeywal	10	• Dust will be generated due to deep excavations • Indigenous people might be affected	• Landscape will be improved • Smell will be reduced • Land value will be increased
		Thoker Niaz Baig	15		

Concerns raised during institution consultation meetings have been discussed in **Table 5.4**.

Table 5.4 Consultations with Institutions/Departments and their Concerns / Apprehensions & Suggestions

Sr. No.	Agency / Department / Stakeholder	Date	Time	Representative	Apprehensions Raised	Suggestions
1	Education Department DDEO (Tehsil Shalimar)	02-10-2019	11:00 AM	Deputy District Education Officer Tehsil Shalimar (Muhammad Arif)	Educational institutions remain open from 80:00 to 14.00 During these hours maximum mass movement and traffic on the roads of the city has been noted.	Maximum construction work should be done after closing the school and colleges & during the night hours.
2	Government Iqbal Hu High School- Garhi Shahu	02-10-2019	11:30 AM	Head Master (Muhammad Hussain)	The students will face difficulties to reach their educational intuitions well in time.	Awareness among the students should be created about the projects. Traffic should be managed properly.
	Government Post Graduate College (W) Cooper Road Lahore	02-10-2019	13:00 PM	Principle (Dr. Fauzia Naaz) Vice Principle (Farah Hameed Tahir)	• Almost 5000 students have been enrolled in the college they will face difficulties to reach college due to huge pressure of traffic during the construction time. • Building of the college is very old (vulnerable) and there is chance of	• Drilling sites should not be in front of the collage. Effective traffic management plan should be prepared and implement. • Drilling vibration should be minimized to save the vulnerable building structures. • The existing sewerage system should not be disturbed during construction of the trunk sewer system.

Sr. No.	Agency / Department / Stakeholder	Date	Time	Representative	Apprehensions Raised	Suggestions
					collapsing due to the vibrations of drilling. • There is chance damage of the existing sewerage system, due to this risk student and staff of the college face difficulties avail sanitation facilities.	
3	Health Department (Dispensary Garhi Shahu)	02-10-2019	12:00 PM	(Dr. Raina Naseem)	There is chance of to damage of existing sewerage system and sewerage water would mix with the clean drinking water could lead to the water born diseases.	• Existing sewerage system should be protected from the drilling for the new project. • To avoid dust pollution awareness among the people should be created. • Chance of leakage from the newly proposed (Trunk sewer System) should be minimized.
4	Local Residents, Shop keepers, Road Users and UC Officials	02-10-2019	11:00 AM To 17:00 PM	Community (43-Participants)	• Disturbance for the local inhabitants and commercial activities in the area. • The alignment of the proposed project is	• Disturbance of the commercial activities should be avoided & adverse impact on the livelihoods should be minimized. • A proper traffic plan should be

Sr. No.	Agency / Department / Stakeholder	Date	Time	Representative	Apprehensions Raised	Suggestions
					passing through the most congested areas, during construction work there will be traffic problems in the project area.	prepared & implemented
5	CCF Office, Lahore	02-10-2019	11:00 AM	Divisional Forest Officer (DFO)	• Tree Cutting and damage to existing trees and plants.	• The concerned official recommended minimum damage of trees during implementation of the project and to avoid unnecessary damages to the soil and other natural resources. • He recommended proper sprinkling of sites to avoid dusts which leads to slowing the process of photosynthesis. • The official also suggested consultations parks and horticulture authority Lahore.
6	Parks and Horticulture Authority	02-10-2019	2:00 PM	Planning and Development Official	• The consultant Ecologist shed light on the overall project and discussed the proposed route and project details.	• The PHA official with the view that all compensation should be made through proper channel in advance and after that NOC will be issued by the DG PHA through P&D PHA for the

Sr. No.	Agency / Department / Stakeholder	Date	Time	Representative	Apprehensions Raised	Suggestions
					• He discussed their rules of working within their area and shared the details regarding payments to the PHA i.e. PKR 67.5 per feet in green area. • The minimum allowable width for working and payment is 2 feet and depth is 4 feet. • The project area is falling under three different horticulture zones of PHA at this stage of the project.	implementation of the project. • The PHA NOC is subjected to the issuance of certificate from safe city. • All the compensations and correspondence will be made according to rules and proper channel.

In general the representatives of the institutions consider the project beneficial for the population to resolve the issues of the sewerage issues of a big city and to provide the quality of life of people.

View of meeting with representative of Health Department

View of meeting with representative of Education Department

View of meeting Head Master of High School Education Department

View of meetings with Vice Principle Government Post Graduate College (W) Cooper Road Lahore

View of meeting with secretary UC-124

View of meeting with Sub –Engineer WASA at disposal Site

View of meeting with Divisional Forest Officer (DFO)

Plate 5.2: Consultation Meetings with with representatives of Institutions & Departments

5.5 Future Information Disclosure Plan

After suggesting the possible solutions of the stakeholders' concerns, the solutions (final ESIA report) will be disclosed once again before the stake holders and general public. ESIA report will be accessible to interested parties on request and the version of final report will be available in the nearest library and its summary will be available in stakeholders' mother tongue.

SECTION-6
ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

This section deals with the identification and characterization of the impacts at each stage of the project. The identified impacts affect the biophysical and socioeconomic components of the project area either beneficially or adversely. Measures to mitigate or reduce the impacts are also briefly discussed in the section.

6.1 Impact Identification and Characterization

The identification of impacts is done on the basis of literature review, site surveys and expert opinion on prevailing site conditions and sensitive receptors. A comprehensive map shows (**Figure 6.1 a & b**) the environmental sensitive receptor e.g. school, medical center, mosque, factories etc. Characterization is done on the basis of significance, probability and prevalence of the potential impacts in the surrounding environment. To evaluate the impacts, *Environmental Impact Matrices* are used for construction and operation stages. These matrices are given in **Tables 6.1** and **6.2** respectively. The following scale has been used for the evaluation of impacts:

LA = Low Adverse (low/short-term damage to the environment)
MA = Medium Adverse (moderate damage to the environment)
HA = High Adverse (severe damage to the environment)
LB = Low Beneficial (less beneficial to the environment)
MB = Medium Beneficial (moderate beneficial to the environment)
HB = High Beneficial (highly beneficial to the environment)
NA = Not Applicable
O = Insignificant / No Impact

6.1.1 Significance Rating

The overall significance of the impacts was defined based on the result of a combination of the consequence rating and the probability rating. Each identified impact was analyzed in terms of magnitude, extent, duration, and probability of occurrence, the value of the affected environment and likely degree of recovery of the affected area. The results of the assessment of the significance of the residual impacts were then linked to decision making in the following manner

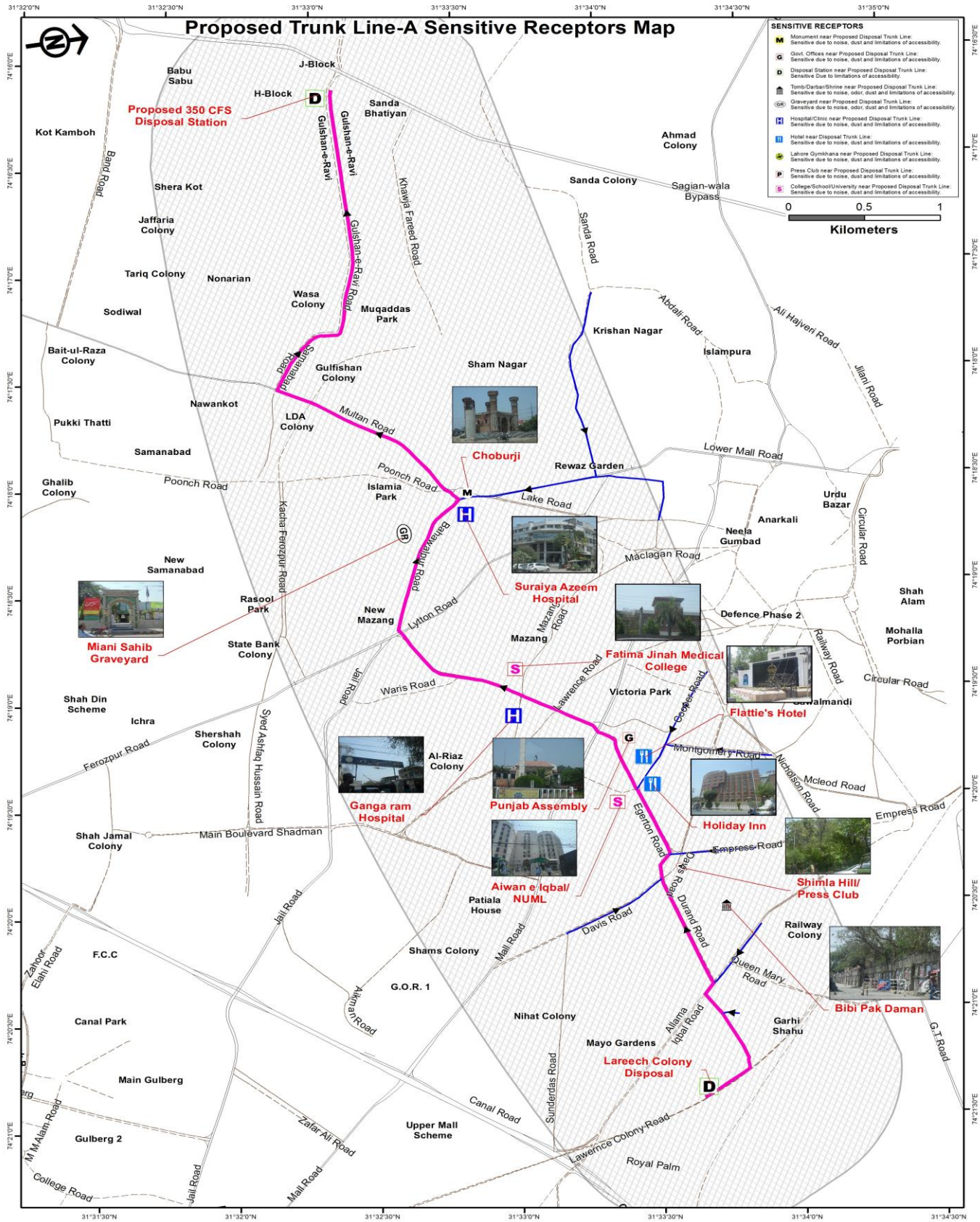


Figure 6.1 (A) Environmental Sensitive Receptors

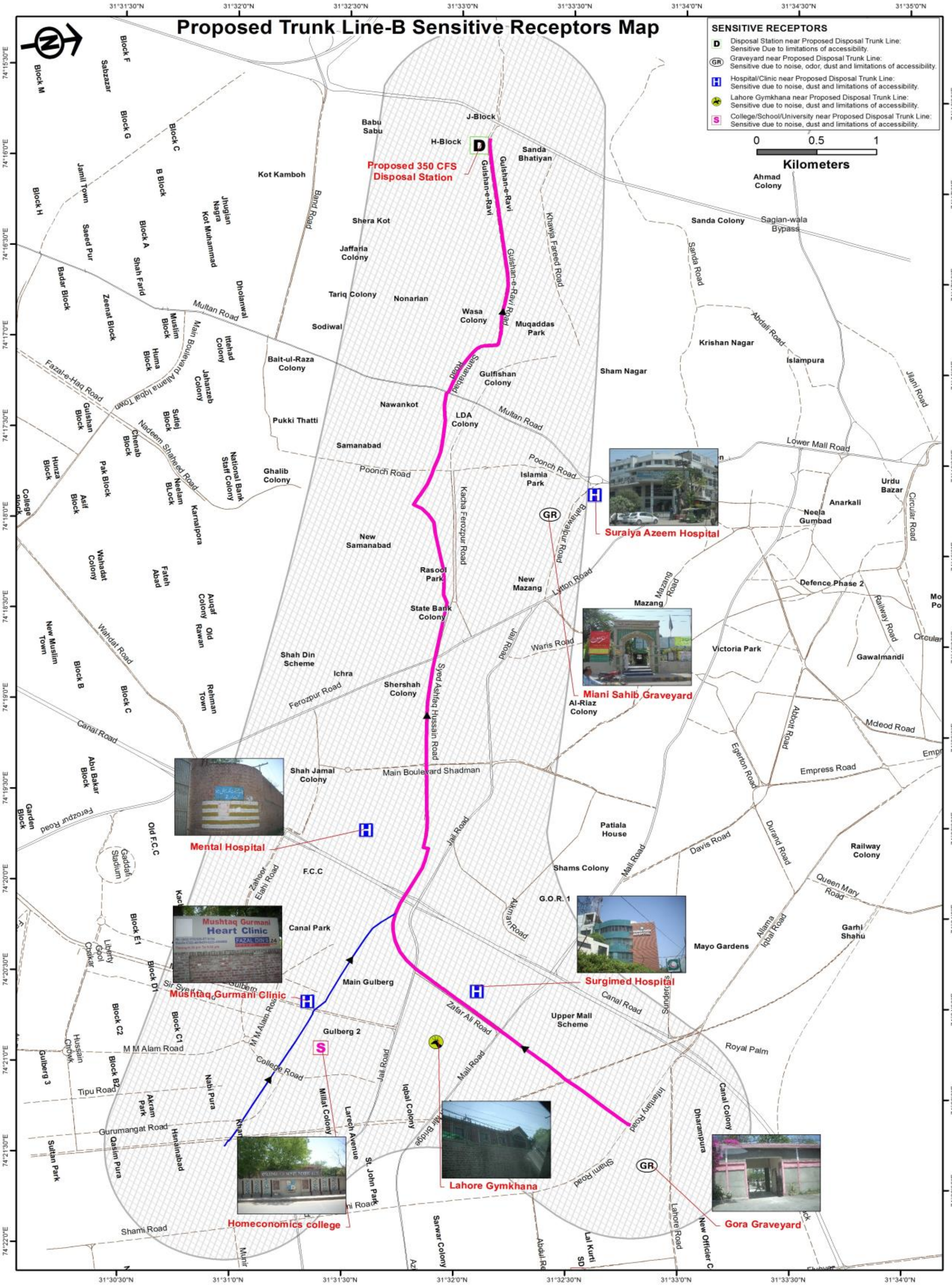


Figure 6.1 (B) Environmental Sensitive Receptors

Significance Rating	Implication
Low	Should not have an influence on the decision to proceed with the proposed project, provided that recommended mitigation measures to mitigate impacts are implemented.
Medium	Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate impacts are implemented.
High	Should strongly influence the decision to proceed with the proposed project regardless of mitigation measures.

6.2 Anticipated Impacts during Planning/Design Phase

Following are the impacts envisaged during planning stage and mitigation measures for this are also suggested.

6.2.1 Selection of Appropriate Technology

The proposed project is aimed to cater the sewage flow of the project area. The conventional cut and cover technology may not be feasible as the project alignment is along thickly populated residential and commercial area. On the other hand, Tunnel Boring Method will significantly reduce potential environmental impacts like noise, dust and visual on sensitive receives and restrict the impacts to the receivers located near the launching and receptor station. Compared with the cut-and-cover approach, disturbance to local traffic and associated environmental impacts would be much reduced; and quantity of spoil generated would also be reduced.

6.2.2 Improved Drainage System

The proposed project will improve the drainage system of the area. Currently the drainage system is uncovered and incapable to cater the sewage and storm water flows and hence during monsoon or heavy rains, the drains overflow. The open drains and stagnant water results in foul odor, serves as breeding ground for disease vector and results in inconvenience to the road users. Hence the project will improve this situation by controlling overflows and proper disposal of wastewater/storm water. This will be a positive and permanent impact.

6.2.3 Topography

The predominant topographical feature of the project area is flat and level plain. Currently open drains are carrying the sewage water. With the execution of the project, the drains will be abandoned and will only carry storm water which will have positive impact by solving the issues of odor, disease vectors, and aesthetic. However, minor excavation and removal of vegetation for the disposal station or excavations for launching and receptor station may have a minor negative impact on the topography of the area. This impact is temporary and minor negative in nature.

Mitigation measures are as follows;

- Due consideration shall be given to aesthetic improvement during the design phase; and
- Excessive excavation and removal of vegetation should be avoided.

6.2.4 Land Acquisition and Resettlement

Most of the alignment is along the main road which is the property of government. Minor acquisition may be required from private property.
Mitigation measures proposed are as follows:

- Due consideration should be given to minimum or no land acquisition.
- Land should be acquired according to Land Acquisition Act (LAA), 1894.
- Compensation should be given as per market rates.

6.2.5 Physical/Cultural Resources

Physical and cultural resources identified in the project area include Choburji, Mianisab graveyard, Tomb of Ghazi Alam Din Shaheed, Allama Iqbal Residence, Mian Mir Tomb and several mosques. People visit the mosques five times a day. Shrines and graveyard are visited occasionally by the surrounding community and devotees. These will not be directly affected but the people may face problem in access to visiting these facilities during the construction phase. This impact is temporary and minor negative in nature. According to law (Antiquities Act), construction should be avoided within 200 feet of any heritage sites and it must not disturb the access pathways. WASA must ensure that the contractor must abide the law.

6.2.6 Tree Cutting

Trees of varying species and sizes, and vegetation exist in the project area. The project does not involve extensive tree cutting however, some plants will be affected specially near the launching and receptor station, construction camps etc. The impact is permanent and minor negative in nature.

The proposed mitigation measures will include:

- Incorporate technical design measures to minimize removal of these trees, as far as possible;
- A plan for transplantation of trees especially fruit tress shall be devised, if required;
- Compensatory planting of six (06) trees against each fallen tree of similar floral function shall be planned; and
- Plantation plan shall prefer the prevalent indigenous species of plants.

6.2.7 Pollutant Load on Receiving Body

The main surface water bodies identified in the project area is River Ravi and Lahore Branch Canal. The quantity of water in River Ravi near Lahore has been greatly reduced due to the construction of The in Dam in India. River Ravi receives huge amount of

untreated wastewater from the city of Lahore and other industrial discharges from different sources especially; Cantonment Drain, AIT Drain, and Hudyara Drain, a natural drain which carries pollution loads from both Pakistan and India. These wastewater discharges, along with reduction in available water naturally in River Ravi for dilution, has greatly deteriorated the quality of river water. The project will increase the direct discharge of untreated wastewater as the collection efficiency will be improved, consequently deteriorating the river water quality. The inorganic pollutants will be reduced whereas the organic pollutants will not be removed thus deteriorating the river water quality and affecting its intended use. The current practice of using water from River Ravi for irrigation will affect the crops and will be taken up in the food chain. The impact is major negative and permanent in nature.

Mitigation measures include the following;

- A treatment plant should be constructed prior to disposal in the River Ravi as a separate project;
- Design must be sufficient to avoid Surface runoff in case of over flow/flooding;
- Alternate arrangements should be suggested in design to cater the sewage flow during construction phase;
- Storm water should be separated from wastewater.

6.2.8 Groundwater

The ground water in the project area is encountered at a depth of around 200 ft. The ground water contamination may occur during construction by the improper handling of construction material (fuel, lubricant, bitumen, asphalt etc.) or sanitary water from construction camps and domestic sewage. During operation probability of seepage through the sewers may also contaminate groundwater. This impact is permanent and moderate negative in nature.

Mitigation measures include the following;

- Selection of materials during the planning stage shall consider efficient seepage control; and
- Alternate arrangements should be suggested in design to cater the sewage flow during construction phase.

6.2.9 Improvement in Public Health, Hygiene and Sanitation

With the improvement in drainage system, improvement in health, hygiene and sanitation will also be observed. The clogged pumping stations, open drains and incapacitated sewers affects the community health and sanitation conditions of the area. Foul odor, breeding grounds for diseases vectors and inconvenience to the road users are some of the negative impacts associated with current status. Thus, the project will improve public health, hygiene and sanitation conditions in the project area. This impact is permanent and major positive in nature.

6.2.10 Public Utilities

Due to the proposed project, public utilities may be affected and create disruption of public services and economics. This impact is however temporary and moderate negative in nature. Mitigation measures will involve careful selection of the design by the designer to minimize disturbance to public utilities. Relocation of the public utilities shall be planned and approved before project commencement if any, to avoid inconvenience to the public. A sanitation plan (**Annex II**) should be adopted in design phase to avoid sanitation related issues.

6.2.11 Seismic Hazard

The project area is located in Seismic Zone 2A, where 2A (lower limit of moderate damage) represents peak horizontal ground acceleration from 0.08 to 0.16g. In this Zone, designing of various types of structures should be done on the basis of Peak Ground Acceleration (PGA). A low to moderate intensity earthquake impacting the project site can adversely impact the development. This factor requires special consideration of the designers keeping in view the recent earthquake of October 08, 2005 and September 25, 2013 and recent tremors within past few months. The proposed project shall be designed and constructed to withstand low to moderate earthquakes.

Mitigation measures will include:

- The structures of the proposed project should be designed and constructed to withstand moderate earthquakes. For seismic hazard analysis, updated structural and seismic evaluations should be consulted.
- To mitigate the seismic hazard, Seismic Building Code of Pakistan 2007 (SBC-07) needs to be adopted. This code specifies minimum requirements for seismic safety of buildings/structures and has to be applied and used by engineers in conjunction with the necessary understanding of the concepts of structural geotechnical and earthquake engineering.

6.2.12 Solid Waste

At operation phase, de-sluddging, and screening will produce solid waste. The waste produced will be of organic and inorganic nature. This impact is moderate negative and permanent in nature but is a concern only during operation. At construction phase however, the impact is temporary.

- Solid waste management plan shall be devised.
- An authorized solid waste collection contractor shall be hired.

6.2.13 Flooding Patterns

Since the proposed site for disposal station is located in the flood plain of River Ravi downstream of the existing flood protection bund. Therefore, it is essential to provide flood protection bund to protect the disposal station. However, any obstruction in the floodplain increases the potential for flooding of adjacent and downstream area and

interferes with natural hydrological processes. The consctruction in the flood plain may alter the volume of water it may hold, thus altering the extent of the area under flood. This will be a major negative impact with a permanent threat.

The mitigation measure includes:

- Dense plantation in the flood plain; and
- Consideration of flood pattern of the area in design.

6.2.14 Soil

Presently, the seepage of waste water through sewer lines and the application of contaminated river water in the agricultural fields are destroying the natural qualities of soil. Several contaminants are affecting it in different ways thus hindering the suitable use of soil. **Table 6.3** below depicts the impacts of several pollutants on soil quality.

Table 6.3: Effects on Soil due to Pollutants

Sr. No.	Parameter	Impacts on Soil
1	Nutrients	Acidification problems provoked by synthetic fertilizers are not observed
2	Organic matter	Improves microbial activity and soil fertility
		Colloidal and suspended organic matter increase moisture and nutritious content, improving structure
		Retains and binds heavy metals
		Depending on its composition and soil consumption, can release salts, nitrogen and metals
		Continuous irrigation and high organic matter contents may clog soil pores and favor an anaerobic population in the root zone
		Organic matter combined with nitrogen and continuous irrigation can cause important nitrogen losses by denitrification
3	Salinity (variable, depending on the water supply content and type of discharges)	No short-term effects observed Long-term salinization occurs at a rate that depends upon the frequency of soil washing and land drainage problems Loss of soil structure and capacity for water and air transport and thus to sustain plants

Sr. No.	Parameter	Impacts on Soil
		Effects depend on conductivity and SAR values, frequency of soil washing and land drainage conditions
4	Alkalinity (carbonates and bicarbonates)	Concentrations above equilibrium conditions in soils precipitate calcium, affecting soil structure
5	Metals	Concentration in soil is increased with time in the first soil layers; depending on pH, organic matter content and irrigation time, metals are either bound to the soil particles or mobile Reduce phosphorus mobility
6	Toxic organic compounds	Long term: some may biodegrade in soils
7	Suspended solids	Clog soils, depending on concentration, composition and soil porosity; >100 mg/l of mineral solids can cause problems If soil is clogged, water infiltration rate diminishes and irrigation becomes less effective.
8	pH	If soil alkalinity is not sufficient to maintain pH above 6.5, metal solubilization can occur; when pH is maintained below 8.5, aluminum can be solubilized and soil deflocculated, and nitrogen can be lost by volatilization

The proposed project will immensely help in eradicating the above mentioned hazards and this will be a major positive impact.

6.2.15 Environmental Enhancement & Reduction in Environmental and Health Hazards of Open Sewerage System

Currently, the sewerage water of WASA, Lahore is going untreated into river Ravi and a plan to install six (6) water treatment plants at different locations to clean the sewerage before it disposes of into Ravi is underway. All the open drains flowing in Lahore are one of the biggest sources of pollution and posing a very serious threat to the humans as well as the environment. Constructed for the purpose of discharging rainwater during the Monsoon season from the city, these drains, for several decades, have been responsible for contamination and pollution of air and water bodies in the provincial capital. These drains were basically constructed for flood and rainwater but with the passage of time they had turned into sewage water drains. Establishment of a Katchi Abadis and encroachments around the drains has also reduced the width of the drains. Besides encroachments, solid waste dumping into the open drains had also aggravated the

situation resulting into chocking off drains.

According to different consultations from various stakeholders, particularly environmentalists, open drains in the city are heavily contributing to increasing air and underground water pollution besides aesthetically damaging the city's beauty. Also, foul odor of these open drains is also very irritating and discourages economic activity around the open drains.

Furthermore, during monsoon season due to inadequate capacity in the storm water drains, the rainfall accumulates in sore points causes flooding in many places and results in degradation of sanitary environment.

Major environmental and health hazards caused by the conveyance of raw sewage in the open drains are briefly discussed below:

Health:

Raw sewage contains disease-causing pathogens, including viruses, bacteria, worms, and protozoa. Diseases resulting from enteric pathogens range from stomach flu and upper respiratory infections to potentially life-threatening illnesses such as cholera, dysentery, Hepatitis B, and cryptosporidiosis. When sewage overflows contaminate public places and waters, people can be put at risk of exposure to the untreated sewage.

Aside from health risks to humans, animals and ecosystems are also put in danger by sewage overflows. A key concern with sewage overflows which enter rivers or streams is their effect on water quality. The environmental impacts of sewage include hypoxia, harmful algal blooms, habitat degradation, floating debris, and impacts to threatened or endangered species.

Environment:

Every element of sewage does damage to the environment, whether it has a direct effect on wildlife, on the ability of the environment to support aquatic life forms, or on our water supply. The raw sewage in the open drains may contain; nutrients (nitrogen and phosphorus); solids (including organic matter); pathogens (including bacteria, viruses and protozoa); helminthes (intestinal worms and worm-like parasites) ; oils and greases; runoff from streets, parking lots and roofs; heavy metals (including mercury, cadmium, lead, chromium, copper) and many toxic chemicals including PCBs, PAHs, dioxins, furans, pesticides, phenols and chlorinated organics.

Increased nutrients may lead to eutrophication which is an excessive growth of marine plant life and decay. Plants such as algae often experience a population increase (called an algal bloom) which limit the sunlight available and cause lack of oxygen in water. When oxygen levels decline, marine animals and other vital habitats may die.

Moreover, unauthorized discharge of domestic wastewater into the system leads to surface water pollution and spreading of pathogens. Solid waste is also commonly disposed of in these open channels.

Advantages of Implementation of the proposed project

The proposed project will provide a socially, environmentally and economically sustainable solution for disposal of sewerage and wastewater. The Project intends to ensure efficiency in safe and quick disposal of sewage/wastewater by laying of Trunk Sewerage System. It will eliminate 12 Intermediate Sewerage Lift Stations which are disposing of the sewerage into the open storm water channels. Moreover, flow from various sore points present in the proximity of project will be catered thereby providing relief to the existing system. This will not only help in eradicating the aforementioned environmental impacts but will also improve the overall health conditions of public residing in the adjacent areas along the project route as the water and air borne diseases will significantly reduce.

Moreover, during monsoon season, the storm water carrying capacity of Central and Cantonment Drain will be enhanced due to elimination of sewage and wastewater flows.

6.3 Potential Impacts & Mitigation Measures during the Construction Phase

6.3.1 Topography

Excavations will be carried out for construction of launching stations. Laying of sewer lines will be done using Tunnel Boring Machine (TBM) which will result in minimum change in topography. The open drains presently being used to carry wastewater will be abandoned and will be used only to carry storm water. This is a permanent and moderate beneficial impact.

6.3.2 Discovery of Heritage Sites/ Structures during Excavation

During excavation, there is a chance of finding artifacts. In case of finding any artifact, the contractor shall immediately report through Supervision Consultant to Directorate General (DG) of Archeological Department, Government of Pakistan to take further suitable action to preserve those antiques or sensitive remains. Chance finds procedure (attached as **Annexure - III**) shall be adopted in case of any accidental discover of cultural heritage.

6.3.3 Soil

The soil would be exposed to erosion due to removal of vegetation, excavations for launching and receptor station, construction camps / workshops etc. The erosion of soil will be greatly reduced by using TBM technology. Erosion may increase in rainy season. Contamination of soil may also be caused by oil and chemical spills or uncontrolled runoff from equipment washing yards. This impact is permanent and minor negative in nature.

Mitigation measures will include:

- Stored excavated material shall be covered and preferably reused, e.g in construction of dykes etc.;
- Sprinkling of water may help in reducing the erosion of soil;
- Use of heavy machinery should be restricted as far as possible to avoid the destruction of soil structure;
- Non-bituminous wastes from construction activities will be dumped in approved sites, in line with the guidelines for dump sites, and shall be covered;
- Washing yards shall be paved to avoid seepage of runoff from the yard;
- Controlling runoff volumes and intercept runoff before it leaves the site;
- Perennial grasses, sod, shrubs, and trees should be planted to control the runoff on the site;
- Excess spoil should be reused where possible and residual spoil can be disposed of at designated site to prevent erosion; and
- Confining excavations to the specified spots as per the approved engineering drawings and unnecessary excavations should be avoided.

6.3.4 Water Quality

The potential sources of water pollution associated with the construction of proposed project have been identified and includes:

1) Construction Site Runoff

Runoff from the construction works area may contain increased loads of sediments, suspended solids and other contaminants. Potential sources of pollution from the site include:

- Runoff and erosion from exposed soil surfaces, earth work areas and stockpiles e.g. grouting and cement material with the rain;
- Wash water from dust suppression sprays;
- Fuel and lubricants from maintenance of construction vehicles and mechanical equipment;
- Spillage of liquids stored on-site such as oil, diesel, and solvents etc. are likely to result in water pollution; and
- Uncontrolled discharge of debris and rubbish such as packaging, construction material and refuse.

2) Wastewater produced by on-site work force

Wastewater would be generated from the workforce during the construction phase. However, wastewater can be adequately treated by interim sewage facilities, such as portable toilets, which can be installed within the construction site.

Construction waste, if left unattended will result in forming leachate that will percolate through the soil strata and will reach underground water table and hence, will end up contaminating groundwater. There is a probability that various materials like fuel,

lubricant oil and other oily products, which are used during the construction phase may contaminate groundwater and channels carrying water.

These impacts are temporary and minor negative in nature.

Mitigation measures will include:

- Protection of groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality;
- Water required for construction may be obtained in a sustainable way that the water availability and supply to nearby communities remain unaffected;
- Stockpiles of cement and other construction materials should be kept covered when not being used;
- Avoid fuel and other chemicals being stored at numerous locations around the site;
- Maintenance of vehicles and plant should be carried out only on impermeable areas where any oil spillages can be contained;
- Oils, fuel and chemicals shall be stored at bunded fuel stores and mobile bunded stores;
- Careful planning of the works to avoid soil excavation works during rainy seasons;
- All kinds of waste shall be stored in covered containers and disposed off safely as soon as possible;
- Temporary sanitary facilities, such as portable chemical toilets, should be employed on-site. A licensed contractor would be responsible for appropriate disposal and maintenance of these facilities; and
- Sand/silt removal facilities such as sand traps, silt traps and sediment basins will be provided to remove the sand/silt particles from run-off. These facilities will be properly and regularly maintained. These facilities will be carefully planned to ensure that they would be installed at appropriate locations to capture all surface water generated on site.

6.3.5 Air Quality

Air quality will be affected by various construction activities. Emissions may be carried over longer distances depending upon the wind speed, direction, temperature of surrounding air and atmospheric stability. In certain climatic condition such as hot summer in the city of Lahore, airborne dust can become a major nuisance if control techniques are not properly employed. The critical sources of air pollution during the construction phase will be:

- Unpaved road surface;
- Transportation of materials;
- Excavation operations
- Construction equipments;

- Vehicular exhaust; and
- Burning of fuel for cooking by workers.

The air emissions may cause health impacts such as dryness and roughness of the throat; eyes, nose, etc. to the workers and staff of the contractor. These emissions may also affect the bio-physical environment. Major air sensitive receivers identified in the project area are, Ganga Ram Hospital, Surayya Azeem Hospital, Bibi Pak Daman, Queen Merry School and Queen Merry College, Home Economics College, NUML University/Aiwan-e-Iqbal, Government Post Graduate Islamia College, Fatima Jinnah Medical College, Punjab Assembly, Press Club, Flatties Hotel, Hospitality Inn and Sergimed Hospital, Punjab Institute of Mental Health, Lahore Gymkhana and Punjab Institute of Cardiology. In addition to these high density settlements, numerous schools and clinics were identified around the project area. The impact is minor negative and temporary in nature.

Mitigation measures for emissions include the following:

- All vehicles, machinery, equipment and generators used during construction activities should be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions;
- Open burning of solid waste from the contractor's camps should be strictly banned;
- Use of fuel with substantially lower sulphur content;
- Proper maintenance and repair of power generators and construction machinery is needed to minimize the hazardous emissions;
- Personal Protective Equipment (PPE) like masks, goggles and gloves etc. shall be provided to workers; and
- NEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during construction works.

Dust problems caused during the construction phase of the project could be effectively mitigated by the implementation of simple procedures by the contractor including but not limited to the following:

- Regular water sprinkling on the site and access roads should be carried out to suppress excessive dust emission(s);
- Preventive measures against dust should be adopted for on-site mixing and unloading operations.;
- Construction workers should be provided with masks for protection against the inhalation of dust;
- The vehicles carrying construction materials and the construction material storage areas should be covered with tarpaulin;
- Vehicle speed in the project area should be prescribed not more than 20 km/ hr and controlled accordingly;

- Tires of all the vehicles leaving the site should be washed. No earth, mud and dust shall be deposited on the public road; and
- Any material dropped on the paved roads will need to be cleaned up immediately to prevent dust nuisance.
- Air emission monitoring program for NO_x, SO_2, CO and PM_{10} should be undertaken by the construction contractor, according to the Programme specified in the Environmental and Social Management and Mitigation Plan (ESMMP).

6.3.6 Noise and vibration

The noise may be produced due to the operation of construction machinery i.e. Tunnel Boring Machine (TBM) and other equipment. Health risks associated with exposure to continuous noise levels includes increase in blood pressure, hypertension, temporary threshold shift etc. Major noise sensitive receivers identified in the project area are, Ganga Ram Hospital, Surayya Azeem Hospital, Bibi Pak Daman, Queen Merry School and Queen Merry College, Home Economics College, NUML University/Aiwan-e-Iqbal, Government Post Graduate Islamia College, Fatima Jinnah Medical College, Punjab Assembly, Press club, Flatties Hotel, Hospitality Inn and Sergimed Hospital, Punjab Institute of Mental Health, Lahore Gymkhana and Punjab Institute of Cardiology. In addition to these High density settlements, numerous schools and clinics were identified around the project area. The impacts of noise would be temporary and highly adverse in nature.

Vibrations will be caused due to tunnel boring operations. The vibrations may affect the foundations of buildings specially the older ones. Miani Sahb Graveyard, Tomb of Ghazi Ilm Din Shaheed, Bibi Pak Daman, Choburji monument, Punjab Assembly, Shimla Hill, Gora Graveyard are some of the structures which are sensitive to the vibrations resulting from tunnel boring machine. The impact of vibration may be reduced due to underground operations.

All mitigation measures mentioned below should be taken in order to minimize the impacts of noise and vibrations in the project area. These measures include, but are not limited to the following:

- Selection of up-to-date and well maintained construction equipments with reduced noise levels ensured by suitable in-built damping techniques or appropriate muffling devices;
- Confining excessively noisy work to normal working hours in the day, as far as possible;
- An effective way of reducing noise is to locate noisy equipment behind purpose-built barriers. The barriers can be constructed on the work site (where excavation operations taking place) along the project route from common construction building material (plywood, block, stacks or spoils) or the barriers can be constructed from commercial panels which are lined with sound absorbing

material to achieve the maximum shielding effect possible. The noise source should not be visible and barrier should be located as close as possible to either the noise source;

- Providing the construction workers with suitable hearing protection like ear cap, or earmuffs and training them in their use;
- Vehicles and equipment used should be fitted, as applicable, with silencers and properly maintained;
- Use of low noise machinery, or machinery with noise shielding and absorption;
- Residents should be notified earlier before commencement of excavation operations;
- Earth retaining walls should be constructed to contain the vibrations; and
- Excavation near old/historical buildings should be avoided. If needed, No Objection certificate (NOC) should be obtained from concerned departments.

6.3.7 Solid Waste (Construction, Municipal and Hazardous Waste)

Due to construction activities municipal and construction waste will be generated from construction activities and contractors' camps. Improper dumping of waste may generate odour and attract mosquitoes and other disease vectors. Empty containers containing the toxic, flammable and corrosive materials may pose hazard to the workers. This may result in health risk to work force and public, if disposal site is improperly selected.

Insecure and unhygienic disposal of solid waste particularly garbage and trash may cause degradation of soil and land. Insecurely disposed of heaps of waste containing kitchen garbage and food waste from construction camps can serve as breeding grounds for the disease spreading vectors and rodents. Throwing away of solid waste into water channels and the wastewater network along the project route can result into choking of the latter.

This impact is temporary and minor negative in nature.

Mitigation measures will include:

- The waste generated from the camp site should be disposed of at LWMC approved sites;
- Burning of waste shall be prohibited;
- Containers with covers shall be provided on site to store waste;
- Proper labeling of waste containers, including the identification and quantity of the contents, hazard contact information should be carried out;
- Training of employees involved in the transportation of hazardous material regarding emergency procedures should be ensured;
- Construction workers and supervisory staff should be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of the waste;

- Waste disposal plan must be reviewed during the entire construction phase in the light of changing weather conditions; and
- The contractor shall ensure implementation of waste management plan.

6.3.8 Flora

Trees serve as lungs to the ecosystem. They absorb CO_2, and produce oxygen and thus purify air. It also serves as noise barrier, cooling effect on earth through transpiration, supply of oxygen through photosynthesis. The project requires tree cutting and removal of vegetation. The cutting of these trees will cause negative and permanent impact on the surroundings. Following impacts are expected on the vegetation in the surrounding of the project area:

- During the construction dust laden polluted air will form a dust film on leaves thus blocking sunshine and stomata consequently hindering photosynthesis processes causing detrimental effect on the plant health;
- Exhaust of noxious gases from movement of heavy machinery will further pollute air which will adversely affect health and vigor of plants;
- Establishment of contractors camps and warehouses for storage of equipment, material etc. shall involve clearing of vegetation from the area, causing a negative impact; and
- During construction activities the contractor's workers may damage the vegetation and trees (for use as fire-wood to fulfill the camps requirements).

To minimize the impacts on flora, following mitigation measures will be adopted during construction stages:

- Efforts shall be made to avoid cutting of trees for the project site and construction camps as far as practically possible;
- Construction vehicles, machinery and equipment will remain confined within their designated areas of movement;
- The contractor's staff and labour will be strictly directed not to damage any vegetation such as trees or bushes;
- Contractor will provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel will not be allowed; and
- The tree plantation program shall be implemented in the project area.

6.3.9 Fauna

The project area is rich in mammals, reptiles and birds. Buffaloes, goats, cats, dogs, and birds etc. were observed in the area. The activities affecting the fauna are discussed below:

- Cutting of trees will adversely affect fauna as trees provide nesting and resting sites to the fauna;

- Animals will avoid the project area due to the construction activities like excavation, channelization, movement of labor, transport of goods and machinery for fear of being persecuted. Some reptiles might be killed during excavation and earth work operations; and
- Refuse of the contractor's camps may attract animals that might be hunted by the workers.

Mitigation measures include:

- Hunting, poaching and harassing of wild animals shall be strictly prohibited;
- The camps will be properly fenced to prevent animals entering the site;
- Staff working on the project should be given clear orders, not to shoot, snare or trap any bird;
- The contractor will make arrangements to minimize the vibration, noise pollution through good engineering practices; and
- The project shall be completed timely to reduce the impacts.

6.3.10 Resource Conservation

The materials used in construction of proposed project would include coarse aggregates (crush), fine aggregates (sand), steel, water, asphalt, reinforcement and cement etc. Almost all the materials to be used in the construction of proposed project are non-renewable and therefore their sustainable use is necessary for the future use.

Fuel will be used to operate construction machinery and asphalt and batching plants. Sustainable use of energy resources is very important not only to continue future use but also to help to reduce air emissions. For conservation of energy, efficiency of the engines and burning processes is very important. The impact is minor negative but is important as these fuels are non-renewable resources of energy.

Following practices shall be adopted to conserve these natural resources.

- Diesel and fuels with low sulphur content should be used to operate construction machinery and equipments.
- The efficient and well maintained equipments and machinery shall be used;
- The equipments and machinery shall be turned off when not in use; and
- Regular maintenance of machinery to avoid fuel leakages.
- Reduction of wastage of water through training of workers involved in water use should be planned;
- Plan for reuse of construction waste materials may be formulated;
- A good camp design and an efficient worksite management plan should be prepared that may help the contractor to reduce the water demand, wastewater and solid waste volumes to the lowest levels.

The Resources Conservation Plan is attached as **Annexure IV.**

6.3.11 Disposal of Slurry

Inevitable earthwork operations during construction will open up scars on the land around the project area. There will be huge heaps of slurry containing bentonite near the launching station of TBM which will require transportation and treatment. This impact is temporary and major negative in nature. This can further be reduced by adopting quarry management plan attached as **Annex V.**

Mitigation measure will include:

- A Slurry management plan shall be devised to treat slurry containing bentonite as required and disposed off to designated site such that it causes minimum environmental damage.
- Slurry should be kept away from the residential areas along the proposed project route;
- Proper landscaping, which should be given due consideration along with re-establishment of the local/indigenous vegetation; and
- The excavated materials that are unsuitable for use will be stored, transported and disposed of appropriately at designated sites.

6.3.12 Construction Camps/Camp Sites

The construction camps may lead to environmental and social impacts in the project area specially arising from camp sites. However, these impacts will be temporary and minor negative in nature. **Table 6.4** summarizes potential impacts and proposed avoidance and mitigation measures associated with construction camps.

Table 6.4: Summary of Worker Camp Impacts & Mitigation Measures

Potential Impact	Proposed Avoidance and Mitigation Measures
Environmental • Temporary habitat loss or disturbance • Temporary visual intrusion • Noise emissions at a single location • Waste generation • Discharge of sanitary effluents and rainwater run-off.	***Environmental*** • Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas. • Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities warrants site-specific landscape restoration measures. • Operate equipment in a manner sympathetic to the ambient noise environment. Do not leave equipment idling unnecessary. • Provide adequate warnings of impeding works to all potential receptors within a 1

	km corridor surrounding the right-of-way via public notices and local news.
Social • Worker camp site: consultation surrounding potential construction camp sites revealed concerns regarding the location of proposed sites for worker camps.	***Social*** Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio-cultural values. Training will be provided to all staff on camp management rules and overall discipline and cultural awareness. This will include, in appropriate languages: • A briefing on camp rules • A community relations orientation to increase awareness about the local area, cultural sensitivities and the project Code of Conduct • Awareness-raising on health considerations, including STDs. The construction contractor is required to develop a Construction Camp Management Plan to address: • Discipline • Community liaison • Ethnic tensions and • Communicable diseases. A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behavior.

6.3.13 Health and Safety

a) Occupational Health and Safety

Workers may be exposed to unsafe and/or unfavorable working environment due to improper storage, handling and transport of hazardous construction material. Workers should be provided with safe and healthy working environment taking into account the following mitigation measures:

- Providing basic medical training to specified work staff and basic medical service and supplies to workers;
- Obligatory insurance against accidents for labourers/workers;
- Layout plan for camp site, indicating safety measures taken by the contractor, e.g. fire fighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents;
- Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for labourers;
- Protection devices (ear muffs) should be provided to the workers doing job in the vicinity of high noise generating machines;
- Provision of adequate sanitation, washing, cooking and dormitory facilities including light up to satisfaction;
- Provision of protective clothing for labourers handling hazardous materials, e.g. helmet, adequate footwear for bituminous pavement works, protective goggles, gloves etc;
- Ensure strict use of wearing these protective clothing during work activities;
- Elaboration of a contingency planning in case of major accidents;
- Ensure that the site is restricted for the entry of irrelevant people particularly children; and
- Adequate lightning devices, barriers, yellow tape and safety signage shall be posted.
- Use of safety signs at the construction site, as shown in below.

b) Community Health and Safety

The construction activities and vehicular movement at construction sites and access service roads may also result in road side accidents particularly inflicting local communities who are not familiar with presence of heavy equipment and machinery.

This is a temporary and minor negative impact. Quality of ground water and surface water resources available in the nearby local communities may get contaminated due to the construction activities, oil spillage and leakage, roadside accidents etc. The labourers work with different transmittable diseases may cause spread out of those diseases in the local residents.

Mitigation measures will include:

- There should be proper control on construction activities and Oil spillage of vehicles;

- The labourers with different transmittable diseases should be restricted within the construction site;
- Efforts will be made to create awareness about road safety among the drivers operating construction vehicles;
- Timely public notification on planned construction works;
- Close consultation with local communities (residential areas along the project alignment) to identify optimal solutions for diversions to maintain community integrity & social links;
- Provision of proper safety signage, particularly at sensitive/accident-prone spots;
- If identified, consider guard rails at accident-prone stretches and sensitive locations;
- The communicable disease of most concern during construction phase, like sexually-transmitted disease (STDs) such as HIV/AIDS, should be prevented by successful initiative typically involving health awareness; education initiatives; training heath workers in disease treatment; immunization program and providing health service;
- Reducing the impacts of vector borne diseases on long-term health effect of workers should be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease, which includes: Prevention of larval and adult propagation of vectors through sanitary improvements and elimination of breeding habitat close to human settlements and by eliminating any unusable impounding of water;
- During construction work pedestrian and vehicular passages should be provided for crossing near settlement;
- Fencing around the camps should be strong enough so that it can not be broken easily by local people for making passages; and
- Use of water should not disturb public water availability and source of water should be selected carefully.

6.3.14 Impacts on Livelihood

The construction activity may disturb the business/ livelihoods of the shopkeepers and workers doing their businesses along the trunk sewer route. As mentioned earlier, the width of the shaft would be 5 meter and its length would be maximum 12 meter. In the congested roads the existing shopkeepers will be affected by the excavation activities at the shaft locations. In this respect, the most critical areas include Larech Colony Road connecting with Allama Iqbal Road, Chuburji Park Road and Mushtaq Ahmed Gurmani Road. The main commercial activities in these areas include vegetables shops, meat shops, grocery stores, hair saloons, furniture shops, beauty parlour, roadside eateries, workshops and electronic shops. At this stage the assessment of livelihood impacts has been carried out on the basis of the approximate location of the shafts. During the

construction phase, these locations will be finalized and on that basis the livelihood impacts will be determined more accurately.

Mitigation measures include:

- Proper compensation will be provided to all the affectees losing their livelihoods along the route;
- Initial assessment of compensation has been carried out for the income loss of the affectees based upon the current approximation of the shaft locations. This assessment will be reviewed and revised on the basis of final shaft locations determined during the construction phase;
- Livelihoods restoration measures have been devised after consultation with the affectees.

6.3.15 Emergency Response

Natural disasters (earthquakes) and accidents such as fire, falls, slips and trips may result in injuries, financial losses and may even lead to deaths. The workers shall be trained and facilitated to cope with such emergencies.

Mitigation measures include the following:

- An Emergency Response Plan for earthquakes and manmade disasters shall be developed by the proponent (WASA) and shall be implemented in close consultation with the RESCUE 1122 Services and other concerned departments;
- Training of the WASA staff/employees regarding the emergency procedures/plans shall be regularly conducted;
- Emergency numbers shall be clearly posted at all disposal stations; and
- Minor incidents and near misses shall be reported and preventive measures shall be formulated accordingly by the WASA Management.

The Emergency Response Plan is attached as **Annexure VI**.

6.3.16 Traffic Disruption

Traffic load on Canal Road, Main Boulevard Gulberg, Gurumanget Road, Allama Iqbal Road, Egerton Road, McLeod Road, Gulshan e Ravi Road and connecting access roads would be increased due to the project activities and movement of heavy machinery especially during construction phase but this will not be a significant concern as the construction will be carried in different packages and traffic can be diverted easily using proper traffic management plan. Thus, the impact is temporary and moderate negative in nature.

The mitigation will include devising a traffic management plan (TMP) in coordination with Lahore Traffic Police Department. The TMP should be devised in order to provide safe passage for pedestrians, cyclists and vehicular traffic around the construction sites with as little inconvenience and delay as possible.

It is strongly recommended that the contractor responsible for the submission of a TMP liaise with Traffic Police Department. It is recommended that the TMP must comprise the following:

- Define scope of area that will be affected by construction activities.
- Provide sequence of construction operations.
- Describe when each phase will commence and finish
- Provide duration of work.
- Note proposed hours of work activity on the site; and
- Describe the truck route(s) that are proposed to be used to and from the site.

6.3.17 Employment

Employment opportunities for skilled and unskilled labour will be generated during all the activities related to construction. This is major positive impact in nature.

6.3.18 Breeding Ground for Disease Vector

The water collected to be used for construction activities may serve as breeding grounds for disease vectors. Disease vectors may also increase in case of unhygienic conditions of the construction camps and the generation of waste from construction activities.

Mitigation measures include the following:

- Workers shall be educated for personal hygiene and the sanitation concerns leading to communicable/non communicable diseases;
- Water shall not be allowed to stagnate even if clean, if unavoidable measures shall be taken to cover the area; and
- Insecticides shall be periodically sprayed.

6.4 Anticipated Impacts during Operation Phase

The anticipated potential environmental impacts related to the proposed project have been studied for the operational stage of the project and are discussed as under.

6.4.1 Water Quality

In the new sewerage scheme the water will be encapsulated in two layers of pipes i.e. the sewer pipe and the tunneling pipe, thus allowing minimum or no seepage of sewage to the groundwater strata, which will be an overall positive impact on the groundwater quality.

The disposal of untreated wastewater through Gulshan e Ravi disposal station will disturb the water quality of River Ravi resulting in reducing its assimilative capacity and limiting its intended use. Sludge from the disposal station if not managed properly will also have a negative impact on the surface water quality.

Following mitigation measures shall be adopted:

- A treatment plant should be constructed before disposal in River Ravi;
- Proper sludge management plan should be devised; and

- Pre-treatment of sludge should be done as it can reduce its associated environmental impacts.

6.4.2 Air Quality and Climate Change Aspects

Climate change is considered to be one of the main challenges to urban wastewater systems. The operation of sewerage scheme and disposal station will result in generation of gases including H_2S and CH_4 (due to anaerobic conditions). H_2S is a foul smelling poisonous gas which might be harmful for the sewer-men and could be fatal sometimes. CH_4 is natural gas also referred to as a greenhouse gas is one of the main greenhouse gas contributors to global warming with a lifespan of about 12 years and a global warming potential of roughly 21–23 times higher than carbon dioxide. Pakistan is signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and adopted Kyoto protocol in 1997. Under the Kyoto Protocol, Pakistan is committed to reduce GHG emissions into the environment to prevent interference with climate change. The GHG emissions for the proposed project are a concern due to the anaerobic conditions in the sewer lines and wet wells of the disposal station. There is always a probability of malfunctioning of the system and uncontrolled leakage of these gases.

Another important impact is the rise in temperature. Warmer temperatures, and especially more extreme temperature ranges, due to increase in greenhouse gas concentrations that will accelerate the degradation of materials and structures in important urban water infrastructures. Warmer air temperatures can lead to biological and chemical degradation of water quality, e.g., by increased solubility and concentrations of contaminants in fresh water or enhanced growth of algae, microbes, parasites, and invasive species. Increased temperatures will result in higher evapotranspiration rates that will increase demands for landscape irrigation and additional human consumption. Warmer temperatures will also result in additional demands for cooling water.

Odour will also be a major issue during the operation phase of the project. It is continuous source of the nuisance. This impact is moderate negative and permanent in nature.

Mitigation measure will be:

- Improved monitoring, planning, and maintenance of the sewerage system by WASA;
- Provision of exhaust gas vents at appropriate locations in the design;
- Sewer-men should cover their faces with mask while entering the sewer for cleaning or maintenance purposes;
- Use gas detector before inspection;
- If possible, use different mechanisms to capture CH_4 and H_2S that can be used commercially; and
- Plan and execute appropriate tree plantation along the disposal station.

6.4.3 Soil

The soil quality will not be affected in the operation phase as the tunnels and pumping station will not allow the seepage to the soil. But the disposal of sludge slurry containing bentonite may deteriorate the soil fertility and make it poisonous. The mitigation will be proper disposal of sludge through sludge management plan and slurry according to the slurry management plan.

6.4.4 Solid Waste

Domestic and hazardous wastes would generate during cleaning and maintenance facilities. The solid waste during operational phase will consist of plastics, metal and organic wastes present in sewer lines. Hazardous waste will be present in form of sludge. Such wastes can cause blockage to drainage systems. Some of these waste materials especially plastics/ polythene which are not biodegradable may cause long term injurious effects on the environment. This will be a temporary and minor negative impact.

Mitigation measures include:

- The sludge removed from the sewers should not be left openly on the roads. It may be recycled as fertilizer;
- Waste will be collected, stored and disposed of according to relevant standards in approved facilities;
- An organized collection system and its implementation through a licensed contractor; and
- Schedule inspection of the sewer lines to keep it clean and to identify any hazardous material.

6.4.5 HSE Considerations

The operation of sewerage scheme and pumping station involves minimum man power. The HSE considerations in this regard shall be addressed. Diseases, fire, trips, slips and falls may occur at operation stage. This impact is minor negative in nature.

The following mitigation measures can be adopted:

- Emergency Response Plan shall be implemented;
- Emergency numbers shall be clearly posted and communicated to the staff;
- Adequate PPE shall be provided especially during maintenance; and
- Fire extinguishing equipment shall be installed at the disposal station.
- Health monitoring plan attached as **Annex VII** should be followed.

6.4.6 Ecology

The trees cut during the construction phase shall be compensated with the ratio of 1:6. The vegetative buffer zone shall be provided. It may provide the following benefits;

- Creates a visual barrier and enhances the appearance of the disposal station;
- Captures and reduces odor concentrations by absorbing gases;

- Dilution and dispersion of the odor concentrations by the mixing and redirection effects of the wind breaks and directing odors up into the lower atmosphere;
- Reduction in wind speeds which means fewer odorous gases and particles will by picked up and conveyed by the wind;
- Collection and storage of chemical odorr constituents on the leaves and surface areas of the plants and trees; and
- Physical interception and absorption of odorous dust particles on the leaves, needles, and branches of the trees.

The impact is positive and permanent in nature.

6.4.7 Maintenance, Monitoring and Related Occupation Safety Hazards

The efficiency of sewerage system may decrease over time if proper maintenance is not carried out. Special provisions in the design must be given for operation and maintenance of sewers and the disposal station. Special stairs should be provided for the sewer men to enter into the tunnel for the purpose of cleaning and maintenance. The mesh size of the screens of disposal station should be efficient enough to remove the desired floating matter. All other facilities should be designed in a way that their operation and maintenance remain simple and easy.

The disposal station shall be monitored and maintained periodically. The site operator should, at the minimum intervals indicate, monitor and record the following:

- Working of pumps;
- Performance of dry/wet wells; and
- A contingency plan is recommended for extreme rainfall, equipment malfunctions, odor complaints.

6.4.7.1 Occupational Hazards of Manhole Inspection

Working near or in a manhole inherits potential dangers which may result in serious accidents. The common ones include falls/slips, fire or explosion, oxygen depletion, gas poisoning, heat stress, drowning, asphyxiation arising from gas, fume, vapor and entrapment by free flowing solid. Amongst which, dangers involving gases are easily overlooked or neglected, leading to serious casualties. This impact is high negative in nature if not given proper consideration.

Mitigation measures include:

- Blank off all pipelines connected to the manhole to prevent any dangerous gas or fume from entering the manhole;
- Remove any sewage or sludge in the manhole beforehand to prevent any toxic or noxious gases that may have accumulated in it from being released and endangering the workers in the manhole in the course of their work;
- Use a ventilating blower to supply fresh air into the manhole to ensure that the air inside is maintained safe for the workers. Ensure a sufficient supply of power outlets for the operation of the ventilation blower(s);

- The responsible person (WASA Engineer/Inspector) shall take all the safety measures, such as erecting fencing, posting of warning notices, implementing necessary personal protective equipment (PPEs) to ensure the safety of relevant personnel working in the manhole;
- The responsible person shall have implemented all the safety measures recommended by the ‘‘competent person of WASA’’ before issuing a work certificate to enter a manhole;
- Before any person enters a manhole, there shall be a sufficient number of persons on standby outside, including those who are appointed to carry out a rescue operation inside the manhole and those responsible for support services outside when such an operation is necessary;
- While working in a manhole, if there are signs indicating that the safety of the workers are under threat, for example, the equipment that continuously monitors the quality of the air gives warning alarms, then evacuation of the workers from the dangerous environment shall be made according to the emergency procedure, and the ‘‘competent person of WASA’’ shall reassess the environment afterwards;
- Should an accident occur, inform the relevant government departments like the RESCUE 1122 Services Department at once for rescue. Only site personnel who have been suitably trained shall use the appropriate rescue equipment so provided to conduct the rescue operation according to the emergency rescue procedure, if possible. Moreover, at any time, especially when an accident has occurred, workers shall not enter a manhole without any rescue equipment and support; and
- The responsible person shall provide and inspect all equipment (like resuscitators) and personal protective equipment (like approved breathing apparatus, safety helmets, protective clothing, safety harnesses and rescue ropes). WASA shall also be responsible for providing training to ensure that the workers understand clearly how such equipment and tools are to be used.

6.4.8 Health Risks to Consumers, Workers and Communities

The primary hazards associated with the exposure to untreated wastewater are pathogens and certain chemicals. The pathogens include excreta related pathogens (Bacteria, Helminthes, Protozoa and Viruses), skin irritants, vector borne and chemicals including heavy metals, halogenated hydrocarbons and pesticides. The impacts related to the pathogens are severe negative. The most common diseases are diarrhea, filariasis, gastro-intestinal, helminthes infection, hookworm infection, dysentery, malaria, and dengue and kidney diseases. WHO has reported malaria as vector borne disease. The affectees are consumer of crops eaten as uncooked, agriculture workers and their families and local communities.

Indirect impacts are related to ground water contamination in shallow aquifers by using it for agricultural purposes. High concentration of nitrates causes blue baby syndrome. Eutrophication favors the growth of toxins producing cyanobacteria and algae causing skin, lever and nervous system impairments.

Mitigation measures include:

- Construction of WWTP prior to disposal, as a separate project; and
- Treated water should meet the international standards for irrigation purpose.

6.4.9 Operational Sustainability

The improvement in sanitation situation is closely linked with reliable collection and disposal of wastewater. The most pressing need is the sustainability of collection system and disposal station and can be assessed on many factors including capacity issues of government departments dealing with municipal services, efficiency of the system & its performance, life cycle analysis and energy requirements.

The three major drivers considered worldwide for ensuring sustainability are the economic considerations, social considerations & environmental protection. Therefore, the municipal services provider i.e. WASA, must consider economic consideration into energy decision and find the best balance between multiple goals, achieving appropriate disposal and optimizing the use of external sources such as electricity.

The operational sustainability can be achieved by:

- Regular O&M of the scheme;
- Capacity building and training of workers;
- Periodic environmental monitoring; and
- High level of commitment in operation.

6.5 Cumulative Impacts

Cumulative impacts are the environmental and social impacts that result from the incremental impacts of one action/activity when added to past, present, and reasonably foreseeable future actions/activities.

One major project namely Lahore Orange Line Metro Train Project is currently in construction stage in Lahore. The proposed project bisects the alignment of this project at few locations. If the proposed project is commenced before the completion of this ongoing project, certain cumulative environmental and social impacts in the form of air and noise pollution and inconvenience to daily commuters may arise and lead to nuisance and chaos, if not managed properly. The main cumulative impacts of the two projects can be:

- Dust pollution due to excavation activities;
- Air pollution due to vehicular emissions in case of traffic jams during the construction phase;

- Increase in noise pollution due to construction activities and traffic jams; and
- Traffic jams leading to time delays for daily commuters.

These impacts are temporary and minor to moderate in nature if not managed properly.

Mitigations measures include:

- The Planning Commission and the major stakeholders of the said project should consult each other for their conflicts and relative construction activities to minimize the cumulative impacts. This may include sharing the scope of work, work/activity schedule, and design details that may help in predicting the extent and duration of possible cumulative impacts. As the route of the proposed project has been diverted due to conflict with orange line train near Choburji similarly, other conflicts should also be managed accordingly;
- Lahore Traffic Police Department should be taken into confidence before the start of the project so that a comprehensive traffic management plan may be prepared and could be effectively implemented during the construction phase;
- WASA should ensure the timely completion of the project along with effective implementation of the proposed Environmental Management & Monitoring Plan (EMMP).

6.6 Induced Impacts

The proposed project will also have certain induced impacts on natural resources as well and other aspects associated with the environment. In case of the proposed project, the induced impact will be on River Ravi whose quality will be declined due to untreated sewage. The water from River Ravi is used for agricultural purposes; hence the pollutants from River Ravi are taken up by the crops and become part of food chain which can ultimately harm the human health (both short-term & long-term health impacts). Moreover, it can also harm the river ecology.

The mitigations for the induced impacts include:

- Construction of waste water treatment plant for safe disposal of waste water;
- Use of river water for restricted crops only; and
- Regular water quality monitoring and management.

Table 6.3

Environmental Impacts Evaluation Matrix During the *Operational Phase*
EIA of Sewerage from Larechs Colony to Gulshan-e-Ravi & Mustafabad to Samanabad More, Lahore

Sr. No	Environmental Components / Project Activities	Physical Environment					Biological Environment		Socioeconomic Environment	
		Soil Quality	Surface Water Quality	Groundwater	Air Quality	Odour	Flora	Fauna	Public Health and Safety	Breeding grounds for disease vector
1	Conveyence of wastewater	LA	LA	LA	LA	LA	O	O	B	O
2	Screening of wastewater	LA	B	LA	O	MA	O	O	B	MA
3	Disposal of wastewater	LA	HA	MA	MA	MA	LA	LA	MA	MA
4	Maintenance of Darinage system	LA	O	B	O	MA	LA	LA	B	MA

Legend

O - Insignificant / no impact
NA - Not Applicable

LA = Low Adverse
B = Beneficial

SECTION - 7
ENVIRONMENTAL AND SOCIAL MONITORING AND MANAGEMENT PLAN

This section aims to address the measures which are needed to be adopted during each phase of the project to avoid, contain, mitigate or compensate the potential impacts identified in **Section 6**. Environmental and Social Mitigation and Monitoring Plan (ESMMP) is the major part of this section and forms the gist of the ESIA study. ESMMP not only includes Best Management Practices (BMPs) but also includes Monitoring Indicators, frequency, responsibility and estimated Environmental Budget. This ensures that mitigation, monitoring and management consideration form a part of the documentation used for decision making and the basic benefit of defining the responsibilities is to make sure that the suggested mitigation measure will be implemented at construction and operation stages of the project. Summary of the mitigation measures for potential impacts have also been given in this section to support ESMMP. Moreover, framework for the implementation of ESMMP has been discussed in this section. Following sub plans are also the part of this section.

- Emergency Response Plan
- Environmental Monitoring Plan

7.1 Environmental and Social Mitigation and Monitoring Plan (ESMMP)

ESMMP is a documents setting out mitigation actions, monitoring actions, responsibility and schedule for mitigation, monitoring, Environmental Monitoring is undertaken during both the construction and operational phases to ensure the effectiveness of the proposed mitigation measures/BMPs. Responsibilities for the collection and analysis of data as well as the reporting requirements have been outlined in the Environmental and Social Management and Monitoring Plan (ESMMP) below in **Table 7.1**. Implementation of environmental mitigation measures during construction is a key to avoiding and reducing short- and long-term potential environmental impacts. Environmental cost has also been given in the ESMMP. Once conditions or mitigation measures have been defined in the environmental review process, they should be included in technical specifications of the contract documents. This incorporation of the environmental consideration into the tender and contract document is a fundamental pre-requisite for effective implementation of the ESMMP. ESMMP provides activities, mitigations, indicators, monitoring frequencies, responsible parties and estimated budget for the implementation of the mitigation measures during the construction and the operation phases respectively.

7.2 Implementation of Environmental and Social Mitigation and Monitoring Plan (ESMMP)

The following staff will be involved in the implementation of ESMMP:

- WASA Environmental Compliance Manger
- Environmental Engineer from Environmental Monitoring Consultant.
- Site Environmental Engineer of the Contractor.
- Environmental Engineer from Supervision Consultant

The Project Director shall be made bound through contractual documents to implement the suggested mitigation measures in the ESMMP. The whole ESMMP will be included as a clause of the contract documents. The organizational setup for implementation of ESMMP is given below in **Figure 7.1.**

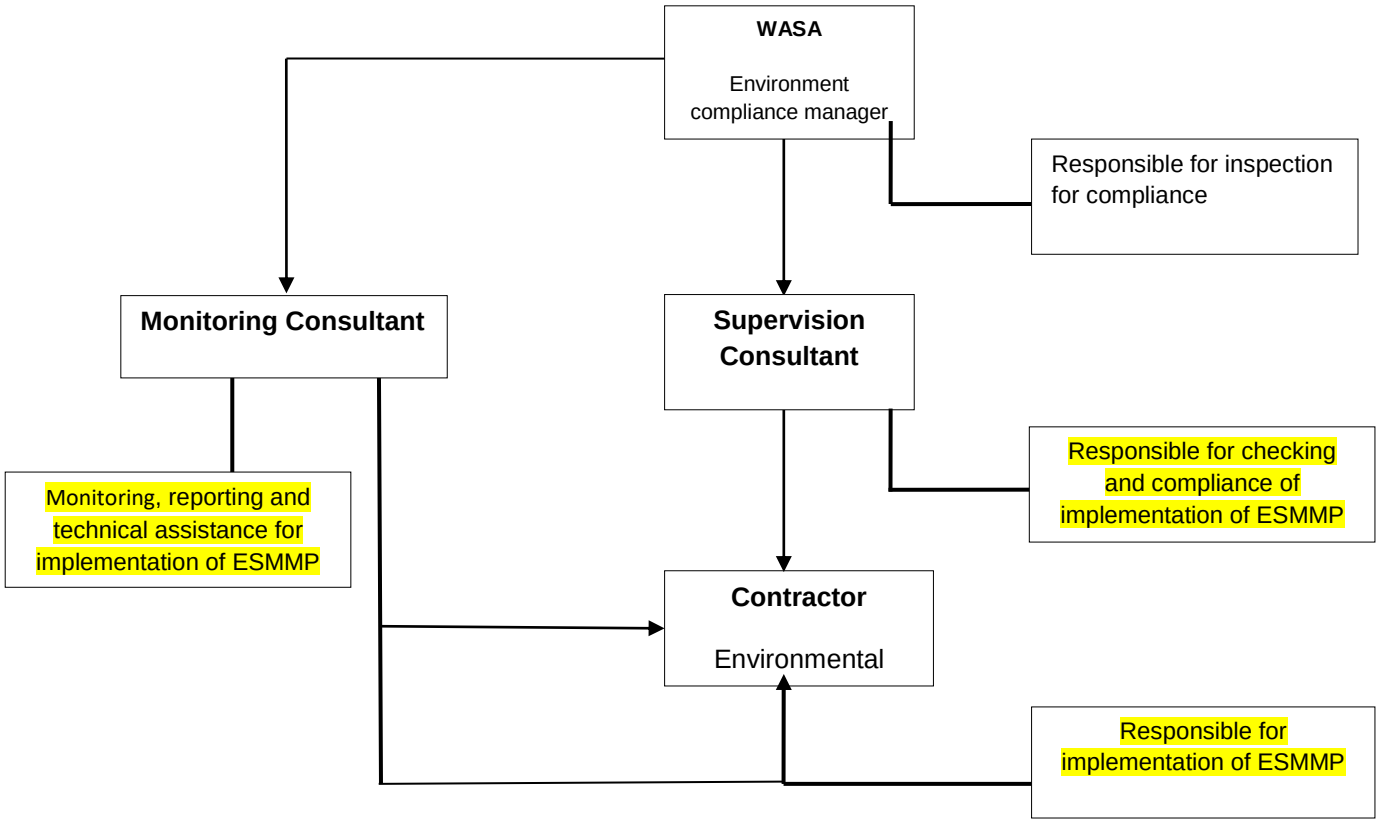


Figure 7.1: Organizational Setup for implementation of ESMMP

7.2.1 Roles and Responsibilities of the Functionaries involved in ESMMP Implementation

a) WASA Environmental Compliance Manager (ECM)

An Environmental Representative of WASA will review the Environmental Monitoring Reports and will direct the Environmental Monitoring Engineer of Monitoring Consultant to provide any necessary information to assure efficient monitoring of the ESMMP.

- **Supervision Consultant: Project Director**

  Supervision Consultant will have responsibility for assuring implementation of EMMP. This includes the following:

- Ensuring that the required environmental training is provided to the staff concerned.
- The Supervision Consultant (SC) will be responsible for carrying out visits to the construction sites to review the environmental performance of the contractors.
- Monitoring the progress of environment related activities.

- Make sure that the contractor is implementing the additional measures suggested by the Monitoring Consultant in monthly environmental monitoring reports.

- **Monitoring Consultant: Environmental Engineer**
  An Environmental Engineer of Monitoring Consultant will supervise, monitor, report and assist technically for the implementation of ESMMP. The Environmental Engineer will also suggest any additional mitigation measures if required.

- **Contractor: Site Environmental Engineer**
  The Site Environmental Engineer of the contractor will carry out the implementation of the mitigation measures at the construction site. The contractor will be bound through contract to take actions against all the special and general provisions of the contract document.

7.3 Reporting Mechanism

Contractor's environmental engineer will be responsible for implementation of mitigation measures and their records while monitoring consultant will determine if the mitigation is in place and its effectiveness or any corrective action is required. Monitoring consultant will prepare a monthly compliance report based on his finding and record provided by the contractor environmental engineer on monthly basis. Monthly compliance report will be submitted to WASA environmental compliance officer. The Environmental Engineer will also be responsible for submitting a monthly ESMMP compliance report for the project to WASA.

7.4 Non-Compliance of the ESMMP

The implementation of the proposed ESMMP involves inputs from various functionaries as discussed earlier. The contractor will be primarily responsible for ensuring implementation of the mitigation measures proposed in the ESMMP, which will be part of the contract documents. The provision of the environmental mitigation cost will be made in the total cost of project, for which the contractor will be Monitoring Consultants on the basis of monthly compliance reports. However, if the contractor fails to comply with the implementation of ESMMP and submission of the monthly compliance reports, deductions will be made from the payments to the Contractor claimed under the heads of environmental components.

Table 7.1: Environmental and Social Management Plan

Sr. No.	Parameters	Target	Mitigation	Responsibility
Design Phase				
1.	Topography	To ensure minimum changes in topography of the project area.	▪ Due consideration shall be given to aesthetic improvement during the design phase; and ▪ Excessive excavation and removal of vegetation should be avoided.	DC and WASA
2.	Land Acquisition and resettlement	To minimize land acquisition	▪ Due consideration should be given to minimum or no land acquisition. ▪ Land should be acquired according to Land Acquisition Act (LAA), 1894 if required. ▪ Compensation should be given as per market rates.	DC and WASA
3.	Physical/Cultural Resources	To avoid any harm to physical or cultural resources of the area.	▪ Avoid construction within 200 feet of any cultural/heritage sites. ▪ Obtain NOC from DG Archeological Department	DC and WASA
4.	Tree Cutting	To minimize the number of trees to be cut for the project.	▪ Incorporate technical design measures to minimize removal of these trees, as far as possible; ▪ Compensatory planting of six (06) trees against each fallen tree of similar floral function shall be planned; ▪ Plantation plan shall prefer the prevalent	DC and WASA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			indigenous species of plants.	
5.	Pollutant load on receiving body	To minimize the pollution in sewage receiving body i.e. River Ravi.	▪ A treatment plant should be constructed prior to disposal in the River Ravi as a separate project. ▪ Design must be sufficient to avoid Surface runoff in case of over flow/flooding; ▪ Alternate arrangements should be suggested in design to cater the sewage flow during construction phase. ▪ Separate storm water from sewage.	DC and WASA
6.	Groundwater Quality	To save the groundwater resources from any kind of pollution due to project.	▪ Selection of liner during the planning stage shall consider seepage control efficiently; and ▪ Alternate arrangements should be suggested in design to cater the sewage flow during construction phase.	DC and WASA
7.	Public Utilities	To avoid disturbance to the public	▪ careful selection of the design by the designer to minimize the impact. ▪ Relocation of the transmission lines shall be planned and approved before project commencement if any, to avoid inconvenience to the consumer.	DC and WASA
9.	Seismic Hazard	To minimize the structural damage due to seismic hazards	▪ The structures of the proposed project should be designed and constructed to withstand moderate earthquakes. For seismic hazard analysis,	DC and WASA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			updated structural and seismic evaluations should be consulted. ▪ To mitigate the seismic hazard, Seismic Building Code of Pakistan 2007 (SBC-07) needs to be adopted. This code specifies minimum requirements for seismic safety of buildings/structures and has to be applied and used by engineers in conjunction with the necessary understanding of the concepts of structural geotechnical and earthquake engineering.	
10.	Solid Waste	To manage (i.e. collect and dispose) the solid waste safely at appropriate sites.	▪ Planning phase shall consider devising solid waste management plan.	DC and WASA
11.	Flooding Pattern	To consider the flooding pattern of the area while designing the scheme to avoid any damage due to flood	▪ Dense plantation in the flood plain; and ▪ Consideration of flood pattern of the area in design.	DC and WASA
Sr. No	***Project Component or Impact***	***Target***	***Mitigation***	***Responsibility***
Construction Phase				
1.	Soil	To minimize soil erosion and contamination.	▪ Stored excavated material shall be covered and preferably reused, e.g. in construction of dykes etc. and stored at approved sites;	CC , SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			▪ Sprinkling of water may help in reducing the erosion of soil; ▪ Use of heavy machinery should be restricted as far as possible to avoid the destruction of soil structure; ▪ Non-bituminous wastes from construction activities will be dumped in approved sites, in line with the guidelines for dump sites, and shall be covered; ▪ Washing yards shall be paved to avoid seepage of runoff from the yard; ▪ Perennial grasses, sod, shrubs, and trees should be planted to control the runoff on the site. ▪ Excess spoil should be reused where possible and residual spoil can be disposed of at designated site to prevent erosion; and ▪ Confining excavations to the specified spots as per the approved engineering drawings and unnecessary excavations should be avoided.	
2.	Water quality	To avoid contamination of surface and groundwater	▪ Protection of groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality; ▪ Water required for construction may be obtained in a sustainable way that the water	CC, SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			availability and supply to nearby communities remain unaffected; ▪ Temporary sanitary facilities, such as portable chemical toilets, should be employed on-site; ▪ Modern techniques should be used to avoid groundwater contamination, if met during tunneling.	
3.	Air Quality	To minimize air pollution	▪ Open burning of solid waste from the contractor's camps should be strictly banned; ▪ Use of fuel with substantially lower sulfur content; ▪ Proper maintenance and repair of power generators and construction machinery is needed to minimize the hazardous emissions; ▪ Personal Protective Equipment (PPE) like masks, goggles and gloves etc. shall be provided to workers; and ▪ Air emission monitoring program for NO_x, SO_2, CO and PM_{10} should be undertaken by the construction contractor, according to the Programme specified in the Environmental and Social Management and Mitigation Plan (ESMMP). ▪ NEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during	CC, SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			construction works.	
4.	Noise and Vibration	To minimize noise pollution and impacts of vibration	▪ Selection of up-to-date and well maintained construction equipment with reduced noise levels ensured by suitable in-built damping techniques or appropriate muffling devices; ▪ Confining excessively noisy work to normal working hours in the day, as far as possible; ▪ Separate vibration study may be conducted if required; ▪ An effective way of reducing noise is to locate noisy equipment behind purpose-built barriers. The barriers can be constructed on the work site (where excavation operations taking place) along the project route from common construction building material (plywood, block, stacks or spoils) or the barriers can be constructed from commercial panels which are lined with sound absorbing material to achieve the maximum shielding effect possible. The noise source should not be visible and barrier should be located as close as possible to either the noise source; ▪ Earth retaining walls should be constructed to contain the vibrations; and ▪ Excavation near old/historical buildings should	CC, SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			be avoided.	
5.	Solid Waste	To minimize the nuisance due to solid waste	▪ The waste generated from the camp site will be disposed of at approved sites; ▪ Burning of waste shall be prohibited; ▪ Proper labeling of waste containers, including the identification and quantity of the contents, hazard contact information should be carried out; ▪ Training of employees involved in the transportation of hazardous material regarding emergency procedures should be ensured; ▪ Construction workers and supervisory staff should be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of the waste; ▪ Waste disposal plan must be reviewed during the entire construction phase in the light of changing weather conditions; and ▪ Containers with covers shall be provided on site to store waste; ▪ General and hazardous waste shall be labelled and segregated; ▪ Solid Waste shall be safely disposed off in demarcated waste disposal sites and ▪ The contractor shall ensure implementation of	CC, SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			waste management plan at construction site.	
6.	Flora	To minimize the impact on flora	▪ Efforts shall be made to avoid cutting of trees for the project site and construction camps as far as practically possible; ▪ Construction vehicles, machinery and equipment will remain confined within their designated areas of movement; ▪ The contractor's staff and labor will be strictly directed not to damage any vegetation such as trees or bushes; ▪ Contractor will provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel will not be allowed; and ▪ The tree plantation program shall be implemented in the project area.	CC, SC, WASA and PHA
7.	Fauna	To minimize the impact on fauna of the project area	▪ Hunting, poaching and harassing of wild animals shall be strictly prohibited; ▪ The camps will be properly fenced to prevent animals entering the site; ▪ Staff working on the project should be given clear orders, not to shoot, snare or trap any bird; ▪ The contractor will make arrangements to minimize the vibration, noise pollution through good engineering practices; and	CC, SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			▪ The project shall be completed timely to reduce the impacts.	
9.	Resource Conservation	Sustainable use of energy resources	▪ The efficient and well maintained equipment and machinery shall be used; ▪ The equipment and machinery shall be turned off when not in use; and ▪ Regular maintenance of machinery to avoid fuel leakages. ▪ Reduction of wastage of water through training of workers involved in water use should be planned; ▪ Plan for reuse of construction waste materials may be formulated; ▪ A good camp design and an efficient worksite management plan should be prepared that may help the contractor to reduce the water demand, wastewater and solid waste volumes to the lowest levels.	CC, SC and EPA
10.	Disposal of Slurry	To minimize the scars on the land in the project area	▪ Slurry management plan should be devised to avoid the nuisance; ▪ Slurry should be kept away from the residential areas and main roads; ▪ Proper landscaping, which should be given due consideration along with re-establishment of the local/indigenous vegetation; and	CC, SC and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			▪ The excavated materials that are unsuitable for use will need to be stored, transported and disposed of appropriately at designated sites.	
11.	Construction Camps/Camp Sites	To minimize the impacts of construction sites	▪ Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas. ▪ A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behavior. ▪ Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio-cultural values.	CC, SC and EPA
12.	Health and safety	To minimize health risks	▪ Providing basic medical training to specified work staff and basic medical service and supplies to workers; ▪ Obligatory insurance against accidents for laborers/workers; ▪ Layout plan for camp site, indicating safety measures taken by the contractor, e.g. firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents;	CC, SC, EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			▪ Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for laborers; ▪ Protection devices (ear muffs) should be provided to the workers doing job in the vicinity of high noise generating machines; ▪ Fencing around the camps should be strong enough so that it cannot be broken easily by local people for making passages; and ▪ Use of water should not disturb public water availability and source of water should be selected carefully.	
13.	Emergency Response	To avoid the accidents	▪ An Emergency Response Plan for earthquakes and manmade disasters shall be developed by the proponent (WASA) and shall be implemented in close consultation with the RESCUE 1122 Services and other concerned departments; ▪ Training of the WASA staff/employees regarding the emergency procedures/plans shall be regularly conducted; ▪ Emergency numbers shall be clearly posted at all disposal stations; and ▪ Minor incidents and near misses shall be reported and preventive measures shall be formulated accordingly by the WASA	WASA and EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			Management.	
14.	Traffic Disruption	To avoid the nuisance due to traffic disruption	▪ The mitigation will include devising a traffic management plan (TMP) in coordination with Lahore Traffic Police Department. The TMP should be devised in order to provide safe passage for pedestrians, cyclists and vehicular traffic around the construction sites with as little inconvenience and delay as possible.	CC, WASA and Traffic Police
15.	Breeding Ground For Disease Vector	To minimize un-hygienic conditions and health risks	▪ Workers shall be educated for personal hygiene and the sanitation concerns leading to communicable/non communicable diseases; ▪ Water shall not be allowed to stagnate even if clean, if unavoidable measures shall be taken to cover the area; and ▪ Insecticides shall be periodically sprayed.	WASA,SC and EPA
Operational Phase				
1.	Water Quality	To avoid the waste water seepage	▪ A treatment plant should be constructed before disposal in River Ravi; ▪ Proper sludge management plan should be devised; and ▪ Pre-treatment of sludge should be done as it can reduce its associated environmental impacts.	WASA, EPA
2.	Air Quality	To minimize air pollution	▪ Improved monitoring, planning, and maintenance of the sewerage system by WASA;	EPD Punjab and WASA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			▪ Provision of exhaust gas vents at appropriate locations in the design. ▪ Sewer-men should cover their faces with mask while entering the sewer for cleaning or maintenance purposes. ▪ Use gas detector before inspection. ▪ Plan massive tree plantation along the disposal station.	
3.	Solid waste	Proper handling of the Solid waste to avoid the odor.	▪ The sludge removed from the sewers should not be left openly on the roads. It may be recycled as fertilizer; ▪ Waste will be collected, stored and disposed of according to relevant standards in approved facilities; ▪ A strong collection system and its implementation through a licensed contractor; and ▪ Schedule inspection of the sewer lines to keep it clean and to identify any hazardous material.	LWMC and WASA
4.	HSE Considerations	To avoid the accidents	▪ Emergency Response Plan shall be implemented; ▪ Emergency numbers shall be clearly posted and communicated to the staff; ▪ Adequate PPE shall be provided especially during maintenance; and	WASA, EPA

Sr. No.	Parameters	Target	Mitigation	Responsibility
			▪ Fire extinguishing equipment shall be installed at the treatment plant or the treated effluents of the plant will be used in case of fire.	
5.	Health Risks to Consumers, Workers and Communities	To avoid risks to health of consumers/workers/communities	▪ Construction of WWTP prior to disposal, as a separate project; and ▪ Treated water should meet the international standards for irrigation purpose.	

KEY

DC	Design Consultant	CC	Construction Contractor
PHA	Parks and Horticulture Authority	WASA	Water and Sanitation Agency
SC	Supervision Consultant	LWMC	Lahore Waste Management Company
EPA	Environment Protection Agency		

7.5 Environmental Monitoring

Environmental Monitoring is undertaken during both the construction and operational phases to ensure the effectiveness of the proposed mitigation measures. Certain environmental parameters are selected and quantitative analysis is carried out. The results of analysis are compared with the guidelines; standards and pre-project condition to investigate whether the ESMP and its implementation are effective for the mitigation of impacts or not. Parameters to be analyzed during construction and operation of the project and responsibilities for monitoring and reporting have been discussed below. A cost estimate for this measurement of parameters is given in **Table 7.2.**

7.5.1 Construction Phase

a) Air Quality

Air quality monitoring will be carried out monthly basis during the construction phase at the representative locations.

The following parameters will be monitored:

- CO
- NOx
- SOx
- PM_{10}

b) Groundwater Quality

Groundwater quality monitoring will be done quarterly during the construction phase at the representative locations. The parameters mentioned in PEQS, 2016 (given in Section 2) will be monitored to assess groundwater quality.

c) Surface Water Quality

Surface water quality monitoring will be done monthly during the construction phase at the representative locations. The parameters mentioned in PEQS for disposal in inland waters (given in Section 2) will be monitored to assess surface water quality.

d) Noise Levels

The noise levels monitoring will be carried out on quarterly basis at representative locations in the project area.

7.5.2 Operational Phase

a) Air Quality

Air quality monitoring will be done quarterly during the operational phase at the representative locations. The following parameters will be monitored:

- CO
- NO_X
- SO_2
- PM_{10}

b) Ground Water Quality

Groundwater quality monitoring will be done quarterly during the operation phase at the representative locations. The parameters mentioned in PEQS, 2016 (given in Section 2) will be monitored to assess groundwater quality.

c) Surface Water Quality

Surface water quality monitoring will be done quarterly during the operation phase at the representative locations. The parameters mentioned in PEQS, 2016for disposal in inland waters (given in Section 2) will be monitored to assess surface water quality.

d) Noise Levels

The noise level monitoring will be carried out quarterly at representative locations in the project area.

7.5.3 Responsibilities for Monitoring and Reporting

The Construction Contractor (CC) will be responsible for environmental monitoring and reporting throughout the construction phase under the supervision of Environmental Engineer of Supervision Consultant (SC). While implementing agency will be responsible for monitoring at operation phase. Contractor will submit the monthly report to SC. SC will review the report and will give its observations. Monthly report will be submitted to EPA through client.

This should be included in general clauses of the contract and contractor should be paid separately.

Table 7.2: Budget Estimate for Environmental Monitoring & Compliance during the Construction and Operation Phase

Components	Parameters	No. of Samples (No. of Samples x Frequency x Year)	Frequency	Responsibility	Duration	Cost (Rs.)
Construction Phase (1 year)						
Air Quality	CO, NOx, SOx, PM_{10}	1x12x4 = 48	Monthly	Contractor/ WASA	24 hours	1,440,000/-
Ground Water Quality	Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium	1x12x4 = 48	Monthly	Contractor/ WASA	-	1,440,000/-
Surface Water Quality	pH, Dissolved Oxygen, TSS, TDS, Alkalinity, BOD_5, COD, Turbidity	1x12x4 = 48	Monthly	Contractor/ WASA	-	1,440,000/-
Noise Level	-	1x12x4 = 48	Monthly	Contractor/ WASA	24 hours	480,000/-
					TOTAL	**4,800,000/-**
Operation Phase (1 year)						
Air Quality	CO, NOx, SOx, PM_{10}	1x4x5 = 20	Quarterly	WASA	24 hours	240,000/-
Ground Water Quality	Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium	1x4x5 = 20	Quarterly	WASA	-	240,000/-
Surface Water Quality	pH, Dissolved Oxygen, TSS, Alkalinity, BOD_5,	1x4x5 = 20	Quarterly	WASA	-	600,000/-

Components	**Parameters**	**No. of Samples** (No. of Samples x Frequency x Year)	**Frequency**	**Responsibility**	**Duration**	**Cost (Rs.)**
	COD, Turbidity					
Noise Level	-	1x4x5 = 20	Quarterly	EPD Punjab	24 hours	80,000/-
TOTAL						**1,160,000/-**
GRAND TOTAL						**5,960,000/-**

KEY

EC – Environmental Committee

WASA - Water and Sanitation Agency

7.6 Environmental and Social Technical Assistance and Training Plan

In order to raise the level of professional and managerial staff, there is a need to upgrade their knowledge in the related areas. The CC and WASA should play a key role in this respect and arrange the trainings.

An environmental and social training and Technical Assistance (TA) program is to be carried out before the implementation of the project. Contractor's environmental awareness and appropriate knowledge of environmental protection is critical to the successful implementation of the ESMP because without appropriate environmental awareness, knowledge and skills required for the implementation of the mitigation measures, it would be difficult for the contractor(s) workforce to implement effective environmental protection measures. A suitable training program is proposed to train the contractor(s) staff who will be involved in the construction phase and the professional staff from the client involved at the operational stage of the project.

WASA will engage TA consultant to manage the environmental training program. The objective of the TA will be, to help in establishment of appropriate systems, and to train senior WASA staff responsible for managing environment, operations, and planning, who can then impart training at a broader level within and outside the WASA Department (i.e. the training of trainers). The TA consultant will organize training courses for WASA Department and contractor staff to train them in specialized areas such as air and noise pollution monitoring; develop environment operation manuals in consultation with the EPA Punjab. The details of this training program are presented in **Table 7.3**

Table 7.3: Personnel Training Program/ TA Services

Provided by	Contents	Trainees/Events	Duration
TA consultants/ organizations specializing in environmental management and monitoring	Short seminars and courses on: Environmental laws and regulations, daily monitoring and supervision	Three seminars for WASA and Contractor project staff	3 days
TA consultants/ organizations specializing in social management and monitoring	Short seminars and courses on: Social awareness	Three seminars for project staff dealing in Social/lands matters	3 days
TA consultants/ organizations specializing in Occupational, health and safety issues	Short lectures relating to Occupational Safety and Health	Two seminars for contractor's staff	4 days

7.7 Environmental and Social Monitoring, Mitigation and Training Cost

The cost required to effectively implement the mitigation measures is important for the sustainability of the Project both in the construction and operation stages of the Project.

These costs are summarized as below:

1.	Environmental Monitoring / Compliance Cost	=	5,960,000/-
2.	Environmental and Social Mitigation Cost (including PPEs, Medical, Tarpaulins, Drinking water facilities, Sanitation, Waste management etc.)	=	5,000,000/- (lump sum)
3.	Environmental and Social Training Cost	=	1,000,000/- (lump sum)
	Total	**=**	11,960,000/-
	Say	**=**	**11.96 Million**

7.8 Grievance Redress Mechanism (GRM)

The Grievance Redress Mechanism discussed in this section has been developed for the LWWMP and the same would be followed for the proposed project. The typical grievances associated with the environmental and social aspects of the proposed project are likely to include but not limited the following:

- Dust, noise and air pollution from construction activities
- Intensive schedule of construction activities
- Inappropriate timing of construction vehicle/machinery flow
- Traffic movement
- Water pollution
- Air pollution
- Noise pollution
- Waste disposal
- Tree cutting
- Open dumping of construction material
- Spillages from construction machinery

7.8.1 Regulatory Framework for Grievance Redressal Mechanism

The Land Acquisition Act 1894 contains provisions pertaining to objections and hearings of affected persons of land and associated assets. The Act is limited to address grievances pertaining to compensation and there is no provision in the legal framework for a continuous grievance redressal mechanism on the concerns and grievance of the affected persons and other stakeholders other than land acquisition, compensation and related matters.

Under the Punjab Environment Protection Act 1997 (Amended 2012), the Environment Protection Department (EPD), Punjab created Environment Protection Agency (EPA) which is responsible for the protection, conservation, rehabilitation and improvement of the environment; the prevention and control of pollution; and promotion of sustainable development in the province. EPA sustains qualitative and quantitative standards for the discharge of effluents, wastes, air emissions or noise

either for general applicability or for a particular area or from a particular source in the form of Punjab Environmental Quality Standards (PEQS) and other standards established under the laws, rules and regulations.

7.8.2 AIIB Requirements

The AIIB requires establishment of a suitable project level grievance redress mechanism in accordance with AIIB's Environment and Social Policy and applicable standards for the project affected persons and to address the concerns and grievances of the stakeholders. This mechanism can receive and facilitate resolution of the concerns or grievance of people who believe they have been adversely affected by the LWWM Project's environmental or social impacts or the people who believe that their interest are at risk due to the Project including construction and operations activities. There is also provision for protection of complainants from retaliation and the right to remain anonymous, if requested, to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's social, resettlement and environment performance.

Measures have been identified to mitigate environment, social and resettlement impacts to be caused due to implementation of the LWWM Project works. However, in spite of best efforts, there is a high chance that the individuals / households affected by the project or other stakeholders are dissatisfied with measures adopted to address adverse environment and social impacts of the Project. To address such situation, an effective Grievance Redress Mechanism (GRM) will be established to ensure timely and successful implementation of the project. It will also provide a public forum to the aggrieved to raise their concerns and address them adequately. It will receive, evaluate and facilitate the resolution of affected People's concerns, complaints and grievances about the environmental and social performance at the level of the Project.

7.8.3 The Aims and Objectives of GRM

The GRM will aim to investigate charges of irregularities and complaints and grievances received from the affected people and other stakeholders and provide a time-bound early, transparent and fair resolution to voice and resolve environmental and social concerns and grievances linked to the project. The objectives of the grievance redressal mechanism are:

- to provide APs and other stakeholders with a clear process for providing comment and raising grievances;
- to allow APs and other stakeholders the opportunity to raise concerns, complaints and grievances anonymously through using the several intake locations and modes;
- to structure and manage the handling of concerns and grievances, and allow monitoring of effectiveness of the mechanism; and
- to ensure that concerns and grievances are handled in a fair and transparent manner, in line with provincial laws and regulation, AIIB environment and social policy framework and standards, and international best practices.

7.8.4 Nature of Complaints to be Redressed

It is anticipated that during the Project implementation and operational phase, the nature of such complaints will relate to compensation and resettlement and rehabilitation assistance; income and livelihood restoration matters; damages, mobility and access issues of general public or disruptions of services/utilities during civil works will be related to the project functionaries. Examples of grievances that may arise are listed below:

- Name of a AP(s) may be missing from the eligible AP's list;
- Losses (such as damage to assets or loss of income) may not identified correctly during detailed design stage;
- Improper distribution of compensation and/or resettlement assistance
- Delays in the payment of compensation and resettlement assistance,
- Any disruption by the civil works contractors;
- Non-observance of project principles, by different parties, as laid down in the RP
- Environmental issues;
- Any other issue arising during the project implementation

The ES staff of PMU with the assistance of ES staff of PMC and EPC/DBO Contractor shall make the public aware of the GRM, particularly the APs, through public awareness campaigns, information dissemination material and face-to-face meetings, with both literate and illiterate APs. The GRM shall be publicized through the notice boards at their VICs, site offices of contractors and sub-contractors, construction camps, and at accessible and visible locations of villages, SWTP site and along the corridor of raw water intake channel, transmission main, feeding mains and distribution system. The information about GRM shall be disseminated to the APs and other concerned stakeholders through face-to-face meetings with illiterate male and female APs, information dissemination material and workshops. The illiterate men and women will be facilitated in documenting their verbal complaints by the ES staff of PMU, PMC or the Contractor staff and subsequent follow ups until their resolution. The names of the ES staff of PMU, PMC and EPC/DBO Contractor, their addresses, contact numbers and the 24/7 Universal Access Number (UAN) or complaint registration number of LWASA will serve as hotlines for registering verbal and written concerns, complaints and grievances The project information brochure will include provision of GRM, but a dedicated brochure on GRM will be prepared in Urdu language and shall be widely disseminated throughout the SWTP site and corridor of water transmission pipelines by the ESS of PMU, PMC and EPC/DBO Contractors. Grievances may be reported verbally, can be placed in the complaint boxes or filed in writing in the form of a letter, via web based GRM at LWASA website, the LWWMP website or by phone through designated staff of the PMU, PMC, EPC/DBO Contractor or UAN of LWASA.

7.8.5 Three Tier Grievance Redressal Mechanism

A three-tier GRM has been designed to provide a time-bound, early, transparent and fair resolution for APs and other stakeholder grievances (Figure 8.1). The ES staff of PMU will undertake public awareness campaigns on the GRM with the assistance of

ES staff of PMC and EPC/DBO Contractor. All complaints received verbally or in writing will be properly documented and recorded in the Complaint Management Register(s). In addition, an easy-to-access web-based GRM will be implemented.

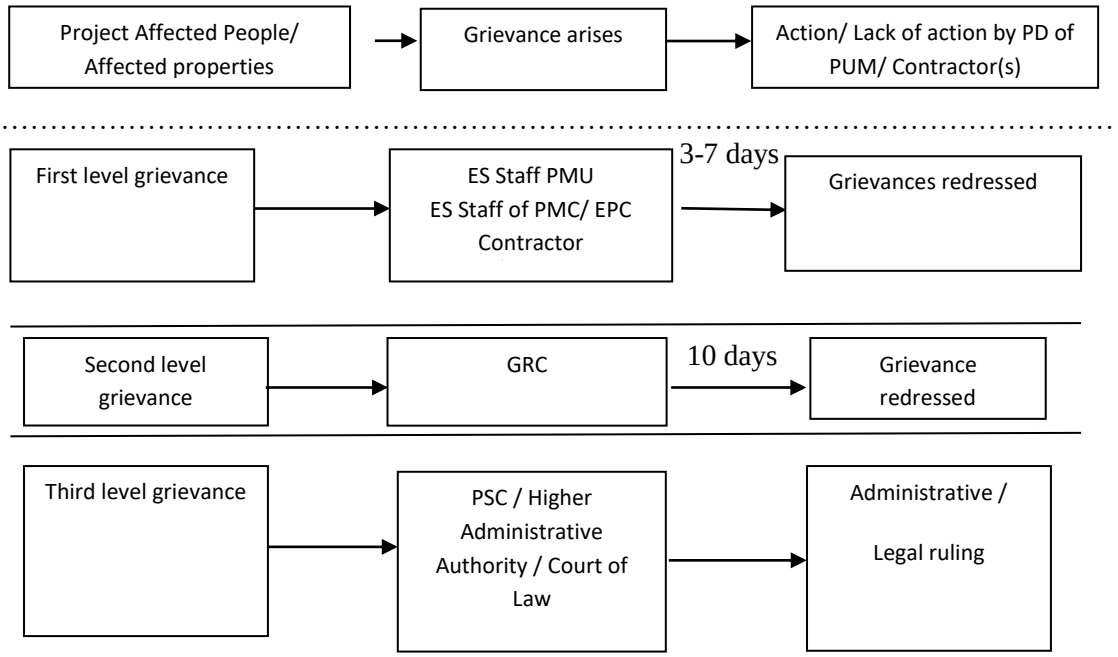


Figure 7.2: Grievance Redress Mechanism

7.8.5.1 First Tier of GRM

The PMU will be the first tier of GRM which will offer the fastest and most accessible mechanism for resolution of grievances. The ES staff of PMU shall be designated as the key personnel for grievance redress. Resolution of complaints will be completed within three (3) to seven (7) working days, depending on the nature of grievance. First, concerns and grievance resolution will be attempted at village or local level by the ES or any other staff of PMU, PMC and EPC/DBO Contractor or through the involvement of the representatives of APs Committee and informal mediators. At this stage, ES staff of PMU and PMC may ask LWASA for additional support and guidance in grievance redressal matters. Investigation of grievances will involve site visits and consultations with relevant parties (e.g. affected people, DC office staff, contractors, traffic police, general public, utilities companies etc.). Grievances will be documented and personal details (name, address, date of complaint, nature of complaint etc.) will be included unless anonymity is requested. A tracking number shall be assigned for each grievance, including the following elements:

- Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered either verbally or in writing;
- Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures);

- Closure sheet, one copy of which will be handed over to the complainant after s/he agrees to the resolution and signed-off.

7.8.5.2 Second Tier of GRM

The ES staff in PMU will refer the unresolved issues or grievances (with written documentation) to the second tier of GRM, the Grievance Redress Committee (GRC). The GRC shall be established by LWASA at the designing stage of the Project prior to the approval of ESIA and RP reports so that the APs and other stakeholders have recourse to refer their concerns and grievances. The GRC will consist of the following persons: (i) MD-LWASA as head of GRC; (ii) Deputy Managing Director; (iii) Project Director-PMU; (iii) representative of DC office; (iv) representative of PMC; (v) representative of EPC/DBO Contractor (on call); (vi) representative of relevant government offices (on call); (vi) two to three representative of the Affected Persons. The ES staff of PMU shall organize training on GRC for the LWASA, PMU, EPC/DBO Contractor, sub-contractors and service providers with the assistance of ES staff of PMC to orient about the GRM, grievance registration and handling procedures as laid down in the ESIA and RP.

A hearing can be called with the GRC, if necessary, where the AP(s) can present details of his/her/their concern/grievance. The process will facilitate resolution through mediation. The GRC will meet as necessary when there are grievances to be addressed. The GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within ten (10) working days, depending on the nature of grievance. The ES staff of PMC and EPC/DBO Contractor will have observer status on the committee, if required. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the government's administrative or judicial remedies.

The functions of the GRC are as follows: (i) resolve problems and provide support to affected persons arising from various social, resettlement and environmental issues such as land acquisition (temporary or permanent, as applicable), asset acquisition, eligibility for entitlements, compensation and resettlement assistance as well as environment issues including dust, noise, utilities (electric power, gas, telephone optical fiber, water supply), waste disposal, traffic interference, access and public safety, etc.; (ii) reconfirm grievances of APs, categorize and prioritize them and aim to provide solutions maximum within 2 to 20 working days; and (iii) report to the aggrieved parties about developments regarding their grievances and decision(s) of the GRC. The ES staff of PMU will be responsible for processing and presenting all relevant documents, field enquiries and evidences/proofs to the GRC, maintaining a database of complaints, recording decisions, issuing minutes of meetings and monitoring to see that formal orders are issued and to ensure that required actions against decisions are being carried out. The PMC and EPC Contractor ES staff will assist PMU in these tasks as and when required.

7.8.5.3 Third Tier of GRM

In the event that a grievance cannot be resolved directly by the PMUs (first tier) or GRC (second tier), the affected people can seek alternative redress through the district administration, the Secretary HUD&PHED or higher level administrative authorities and the court of law or as appropriate. The PMU or GRC will be kept informed by the district or local administration, or any other authorities. The grievance redress mechanism and procedures are depicted in Figure 8.1. The monitoring reports of the RP and ESMP implementation shall include the following aspects pertaining to progress on grievances: (i) number of cases registered, level of jurisdiction (first, second, third tiers), number of hearings held, decisions made, status of pending cases; and (ii) lists of cases in process and already decided upon, may be prepared with details such as name with copy of NIC, complaint number, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, pending, closed).

7.8.6 Purpose of the Grievance Redressal Committee

The purpose of this grievance redressal committee (GRC) is to provide means to seek investigation and effective resolution of grievances related to any of the issues on social, resettlement and environment performance of the project. And the purpose of LAR Coordination Committee (LCC) is to provide means to seek effective redressal of issues related to land acquisition and compensation.

Table 7.4: Composition-Project Level GRC

1	Managing Director-Lahore WASA	Chair of the Committee
2	DMD Engineering-Lahore WASA	Deputy Chair, will preside over meetings when Chair is unable to attend
3	Director LWASA relevant section	Member
	Land Acquisition Collector of LWASA/LDA	Member
4	Assistant Land Acquisition Collector of LWASA	Member
5	Project Director-LWWMP	Member (also act as secretary of the committee)
6	Environment and Social Staff-PMU	Member
7	Environment and Social Staff-PMC	Observer
8	Environment and Social Staff-PMC	Observer
9	Team Leader-PMC	Member (on call)
10	Chief Resident Engineer-EPC/DBO Contractor	Member (on call)

7.8.7 Role of Land Acquisition and Resettlement Coordination Committee

LAR Coordination Committee (LCC) will play the role of Grievance Redress Committee to redress the grievances related to land acquisition and compensation issues. The ES staff of PIU, with the assistance of ES staff of PMC and EPC Contractor will fully inform the APs of their rights and of the procedures under the LAA for addressing complaints both verbally or in writing during the process of land acquisition and compensation. Care will always be taken to prevent grievances rather

than going through a redress process. This can only be obtained through careful implementation of the ESMP and RP, by ensuring full participation and consultation of the APs, and by establishing extensive communication and coordination between the affected people, the PMU, the LAC and local government.

Table 7.5: Composition- LAR Coordination Committee

1	Deputy Commissioner (District Land Acquisition Collector)	Chair of the Committee
2	Additional Deputy Commissioner Revenue (land acquisition)	Deputy Chair, will preside over meetings when Chair is unable to attend
3	Managing Director-Lahore WASA	Member
4	Land Acquisition Collector of LWASA/LDA	Member (also act as secretary of the committee)
5	Tehsildar Acquisition (Shalimar Tehsil)	Member
6	Assistant Land Acquisition Collector of LWASA	Member
7	Environment and Social Staff-PMU	Member
8	Chief Resident Engineer-Design and Supervision Consultants	Member (on-call)
9	Staff of concerned departments	Member (on-call)

The LCC will serve a due diligence function on land acquisition. It will meet once in a month and will review the progress of the land acquisition and compensation process of the Project, seek reports from the LAC, the Project Director and APCs, take cognizance of delays and anomalies in the process, suggest remedial measures and, if necessary, bring them to the notice of the DC Lahore and Punjab Board of Revenue.

7.8.8 Functions of GRC and LAR Coordination Committee

The GRC and GRM will perform following functions:

- Ensure effective implementation of the Grievance Redressal Mechanism on the issues that fall under their jurisdiction;
- Ensure an easy access to GRM having provision to file grievances verbally or by phone, in writing or via web based provision including the option of submitting grievances anonymously;
- GRC and LCC will look into all referred grievances and effectively address and resolve them within 15 days from the receipt of the grievances, in a timely and impartial manner;
- The GRC and LCC will deal promptly with any issues relating to land acquisition, resettlement, compensation or resettlement assistance that is brought before it;
- The GRC and LCC will take decisions on the basis of consensus or majority of votes;
- When required, the GRC and LCC would seek the assistance of other persons/institutions;
- Speaking orders/decisions of the committee on the grievances shall be recorded and replied to aggrieved parties/persons with a copy kept as record;

- In case aggrieved is not satisfied by the decision of the GRC and LCC, s/he can prefer an appeal within 10 days of the receipt of decision, the GRC could refer the case to the appropriate forum after examining the appeal;
- In the event that a grievance cannot be resolved by GRC, the affected person can seek alternative redress through the higher administrative authority or court of law or as appropriate.

7.8.9 Complaint System of Environment Protection Agency

The district level staff of EPA is responsible for supervision of PEQS and handling of public complaints.

7.8.10 Provisions of Grievance Redressal Mechanism under Legal Framework of Government of Punjab

7.8.10.1 Environment Protection Agency Complaint Section

A Complaint Cell is already functional in EPA for addressing public complaints regarding environmental pollution. This section of EPA is responsible for:

- Maintaining the record of public complaints received by the Office of the Director General, EPA Punjab and subsequent actions, taken to find solutions to these issues
- Processing all grievances regarding environment received at online petition cell of the Chief Secretary, Punjab

Punjab Information Technology Board has designed an effective Complaint Management System (CMS) for the assistance of Environment Protection Department (EPD) for recording and processing of complaints and take further necessary actions to deliver the services and take steps to eradicate the problems of pollution recorded. All the complaints lodged by the citizens through applications are recorded in the CMS. Different labs are operating under EPD for the testing of different materials affecting the environment, and their results are also recorded in this system.

Complaints lodged are categorized according to the industry and pollution type, district name along with the violation type, and the violation is defined under different laws. . Furthermore, status of the complaint, to whom the complaint will be sent, is also selected within the system. This information system provides summary of reports to the users of EPA in graphical representation under different categories i.e. district wise, year wise, violation type etc. After the lab testing of materials taken from different areas or districts which are thought to be affecting the environment, further necessary actions are taken. Either the case is discarded, depending on the results, or the case is further processed. Documents related to the complaints are recorded in the system and complaint is further transferred to different levels of hearing of case at district level or at courts. The complaints recorded can be searched, edited, saved and there is a unique feature of advance search added to the system. The salient features of the system are:

- Recording of complaints;

- Different types of reports on basis of districts, violations, industry and pollution type;
- Recording of Lab tests results;
- Record of all complaints lodged at one glance;
- Record of current complaints;
- Summary of reports under different categories.

7.8.10.2 Grievance Redressal Mechanism under Land Acquisition Act

A grievance mechanism is also available under the Land Acquisition Act 1894 (LAA) to allow the AP appealing regarding the land acquisition and compensation. The LAA contains provisions pertaining to objections and hearings of affected people of land and associated assets. The objections are heard by the Land Acquisition Collector at different stages. The persons interested are also entitled to file reference before the Civil Court. Against the decision of the Civil Court, affected people can seek their remedy before the High Court and then the Supreme Court. Further, right to writ petition under Article 199 of the Constitution exists which empowers the interested person to challenge the acquisition itself on several grounds.

As finances will move differently for land and other affected assets associated with land and the resettlement and rehabilitation assistance (in the first case funds will move from LWASA through the LAC Office to the APs, while in the second case funds will go directly from LWASA to the APs through the Project Director of the LWWM Project), Complaint & Grievances will be addressed through two different processes (i) project level GRM; (ii) as per provision in the LAA, described in Table 8.3 If the Land Acquisition Collector fails to satisfy the AP(s), he/she/they can further submit their case to the higher administrative authority or the appropriate court of law.

Table 7.6: Right to objections and hearing under Land Acquisition Act

Land Acquisition and Compensation Issues- Hearing of objections
Section 5-A. (1) Any person interested in any land which has been notified under section 5 as being needed for a public purpose or for a Company may, within thirty days after the issue of the notification, object to the acquisition of the land or of any land in the locality, as the case may be. (2) Every objection under sub-section (1) shall be made to the Collector in writing, and the Collector shall give the objector an opportunity of being heard either in person or by pleader and shall, after hearing all such objections and after making such further inquiry, if any, as he thinks necessary, submit the case for the decision to the Commissioner together with the record of the proceedings held by him/her and a report containing his recommendations on the objections. The decision of the Commissioner on the objections shall be final; (3) Where land is needed for a Company, the Collector shall, after making such enquiries

as he deems necessary, also make his recommendations to the Commissioner with regard to the area that in his opinion is reasonable for the purpose;

(4) For the purpose of this section, a person shall be deemed to be interested in land that would be entitled to claim an interest in compensation if the land were acquired under this Act.

Section 9. Notice to persons interested:

(1) The Collector shall then cause public notice to be given at convenient places on or near the land to be taken; stating that the Government intends to take possession of the land, and that claims to compensation for all interests in such land may be made to him/her.

(2) Such notice shall state the particulars of the land so needed, and shall require all persons interested in the land to appear personally or by agent before the Collector at a time and place therein mentioned (such time not being earlier than fifteen days after the date of publication of the notice), and to state the nature of their respective interests in the land and the amount and particulars of their claims to compensation for such interests and their objections (if any) to the measurements made under section 8. The Collector may in any case require such statement to be made in writing and signed by the party or his agent.

(3) The Collector shall also serve notice to the same effect on the occupier (if any) of such land and on all such persons known or believed to be interested therein, or to be entitled to act for persons so interested, as reside or have agents authorized to receive service on their behalf, within the revenue district in which the land is situated.

(4) In case any person so interested resides elsewhere, and has no such agent, the notice shall be sent to him/her by post in a letter addressed to him/her at their last known residence, address or place of business and registered under Part III of the Indian Post Office Act, 1866.

(5) The Collector shall also serve notice of the enquiry to be held under section 11 (such notice not being less than fifteen days prior to the date fixed under sub-section (2) for determination of claims and objections) on the Department of Government, local authority or Company, as the case may be, for which land is being acquired, and require it to depute a duly authorized representative to attend the enquiry on its behalf for the purpose of making objections (if any) to the measurement of the land, claims to any interest in the land or the amount of any compensation. Such authorized representative shall be a party to the proceedings.

Section 11. Enquiry and award by Collector:

On the day so fixed, or on any other day to which the enquiry has been adjourned, the Collector shall proceed to enquire into the objections (if any) which any person interested [and a Department of Government, a local authority, or a Company, as the case may be], has stated pursuant to a notice given under section 9 to the measurements made under section 8, and into the value of the land [at the date of the publication of the notification under section 4, sub-section (1)], and into the respective interests of the persons claiming the compensation and shall make an award under his hand of–the true area of the land;

The compensation which in his opinion should be allowed for the land; and the apportionment of the said compensation among all the persons known or believed to be interested in the land, of whom, or of whose claims, he has information, whether or not they have respectively appeared before him/her.

Post Award:

In cases where LAC announces the award and AHH/AP has received the compensation amount for loss of assets, LAC cannot make any decisions or revise its previous decisions. Such cases will be decided as per Section-18 of the LAA by the Court under Section-20 of the LAA, if AHH/AP has filed the appeal within due date/time, as given below for the awareness of the APs

Reference to Court and Procedure Thereon:

Section 18. Reference to Court:

(1) Any person interested who has not accepted the award may submit written application to the Collector, require that the matter be referred by the Collector for the determination of the Court, whether his objection be to the measurement of the land, the amount of the compensation, the persons to whom it is payable, or the apportionment of the compensation among the persons interested; amount or costs allowed'.

(2) The application shall state grounds on which objection to the award is taken: Provided that every such application shall be made, -

(a) if the person making it was present or represented before the Collector at the time when he made his award, within six weeks from the date of the Collector's award;

(b) in other cases, within six weeks of the receipt of the notice from the Collector under Section 12, sub-section (2) or within six months from the date of the Collector's award, whichever period shall first expire.

(3) Notwithstanding anything to the contrary contained in section 21, the Provincial Government may, if it has not accepted the award, refer the matter to the Court within a period of six months from the date of announcement of the award; provided that the Court shall not entertain the reference unless in its opinion there is a prima facie case for inquiry into and determination of the objection against the award].

Section 19. Collector's statement to the Court.–

(1) In making the reference, the Collector shall state for the information of the Court, in writing under his hand,

(a) the situation and extent of the land, with particulars of any trees, building or standing crops thereon;
(b) the names of the persons whom he has reason to think interested in such land;
(c) the amount awarded for damages and paid or tendered under sections 5 and 17, or either of them and the amount of compensation awarded under section 11; and
(d) if the objection was to the amount of the compensation, the ground on which the amount of compensation was determined.

(2) To the said statement shall be attached a schedule giving the particulars of the notices served upon, and of the statements in writing made or delivered by the parties interested respectively.

Section 20. Service of notice:

The Court shall thereupon cause a notice specifying the day on which the Court will proceed to determine the objection, and directing their appearance before the Court on that day, to be served on the following persons, namely: -

(a) the applicant:
(b) all persons interested in the objection, except such (if any) of them as have consented without protest to receive payment of the compensation awarded; and
(c) if the objection is in regard to the area of the land or to the amount of the compensation, the Collector [and the Department of Government, local authority or Company, as the case may be, for which land is being acquired].

Section 21. Restriction on scope of proceedings.–
The scope of the inquiry in every such proceeding shall be restricted to a consideration of the interests of the persons affected by the objection.

Section 22. Proceedings in open Court.–
Every such proceeding shall take place in open Court, and all persons entitled to practice in any Civil Court in the province shall be entitled to appear, plead and act (as the case may be) in such proceeding.

[**22-A.** Cross objection.– The Provincial Government, or a local authority or a Company for which land is being acquired, may lodge a cross objection to the objection made by any person interested and the Court may reduce the amount awarded by the Collector if it considers it just and proper.

Annexures

Annex I

Monitoring Results

Annex II

Sanitation Plan

Sanitation Plan

1. Introduction

This plan outlines the measures that can improveconditions of sanitation at construction sites during construction and operation phase.

2. Purpose of the plan

The plan intends to ensure sanitation includingthe control of water supplies, excrete and wastewater disposal, refusedisposal, vectors of diseases, housing conditions, food supplies and handling,atmospheric conditions, and the safety of the working environment.

3. Management of Sanitation During Construction Phase:

i) Responsibility:

The Health and safety Inspector designated by construction contractor shall also inspect sanitation conditions and ensure safe working environment for workers.

ii) Location of Camp Sites

The construction camps shall be located at least 500 m away from residential community. Theaccommodation and ancillary facilities for labor shall be constructedand maintained to standards and scales approved by the Resident Engineer.

The camps must be located such that the drainage from and through the camps shall notendanger any domestic or public water supply.

All sites must be managed to avoid ditches/depressions to minimize nuisance due to stagnant water.

iii) Water Supply

An adequate and convenient water supply, approved by the appropriate health authority, mustbe provided in each camp for drinking, cooking, bathing and laundry purposes.

Potable water supply systems for labor camps occupants shall meet the drinking water quality standards of Pakistan. In addition, the design of water systemfacilities shall be

based on the suppliers Engineer's estimates of water demands.The drinking water must be monitored regularly for drinking water quality parameters.

At all construction camps and other workplaces, good and sufficient water supply shall bemaintained to eliminate chances of waterborne/water-related/water-based diseases to ensurethe health and hygiene of the workers.

iv) Toilet Facilities and Hygiene

According to health and safety guidelines OR-OSHA number of toilets required at construction site is as 1 toilet for 20 workers. Table 1 shows the number of toilets required in accordance with the number of employees at construction site. The total numbers of employees at construction site are estimated to be 141 persons.

Table-1: No. of Toilets Required for Employees at Construction Site:

No. of Employees	No. of Toilets and Urinals by OSHA	Total No. Toilets and Urinals Required at Construction Site
Up to 20	1 toilet	7 toilets
Up to 40 employees	1 urinal	4 urinals

Within the premises of every workplace, toilets and urinals shall be provided in anaccessible place, and the accommodation, separately for each of these, as per standards prevailing in the country.

Toilet facilities adequate for the capacity of the camp must be provided. Each toilet roommust be located so as to be accessible.

A toilet room must be located within 200 feet of the camp. No toiletmay be closer than 100 feet to kitchen and sleeping area.

These toilets must bedistinctly marked by signs printed in nativelanguage of the persons occupying the camp, or marked with easily understood pictures orsymbols.

Urinals troughs in privies must drain freely into the pit or vault, and the construction of thisdrain must be such as to exclude flies and rodents from the pit.

Proper facility for hand washing and other cleaning activities to be provided, e.g

- Provide individual hand towels from a sanitary dispenser and receptacles for disposing of waste towels;
- Providing hand soap and industrial hand cleaner for removing paints and other contaminants;
- Prohibited use of gasoline or solvent for hand washing; and
- Keep the floor of facilities dry to prevent spills and falls.

v) Waste Disposal

The sewage system for the camp must be designed, built and operated in compliance with the relevant legislationso that no health hazard occurs and no pollution to the air, ground or adjacent watercourse takes place.

Garbage bins must be provided in the camps and regularly emptied and the garbage disposedof in a hygienic manner.

Unless otherwise arranged for by the local sanitary authority, arrangement for disposal ofexcreta should be done in the already existing sewerage system in the area.

On completion of the works, all such temporary structures shall be cleared away, all rubbishburnt, excreta tank and other disposal pits or trenches filled in and effectively sealed off andthe outline site left clean and tidy, at the Contractor's expense, to the entire satisfaction of theengineer.

vi) Maintenance of Sanitary Facility

Proper maintenance of toilets and other sanitary facilities should assure by health and safety inspector. Toilets and other sanitary facilities shall be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles shall be tarred inside and outside at least once a year.

All buildings, rooms and equipment and the grounds surrounding them shall be maintained ina clean and operable condition and be protected from rubbish accumulation.

All necessary means shall be employed to eliminate and control any infestations of insectsand rodents within all parts of any labor camp.

4. Management of Sanitation During Operational phase:

A proper sanitation plan is to be adopted formaintaining the hygienic conditions during the operational phase of the project. These includes

- Site Clearance;
- Storm Water Clearance;
- Sewage/Drainage Clearing and
- Solid Waste Management

i) Site Clearance:

The construction contractor shall assure the clearance of construction machinery, vehicle and other equipment used during the construction period after the completion of the project.

ii) Storm Water/Sewage Clearance:

One of the main issue that may arise during construction and operational phase is the clogging of drainage/sewer pipelines as a result of construction material, oil spillage from vehicles, throwing of solid waste by the road users due to lack of bins into the nearby drainage/sewer pipes, etc. the blockage of these drainage pipes will cause over flow of water on road, which will have negative impacts on the road in form of deterioration of road surface as well as standing water acts as a source of water-through disease in the area.

Responsible Authorities:

In case of storm water drains/sewer pipes clogging the concerned department Capital Development Authority (CDA) are responsible for un-clogging of these sewer and drainage pipelines.

iii) Solid Waste Management:

Municipal solid waste produced as a result of commercial activities, by road users and from nearby residential community should be collected and managed properly by the concerned department. Waste bins should be placed along the road/bridges, regular cleaning of the road should be carried out using mechanical sweepers twice a day and at least one sweeper should be deputed for the whole stretch of project site to assure regular cleaning.

iv) Awareness and Training:

A training and awareness sessions shall be conducted for workers before commencement of the project.The implementation of sanitation plan would be more effective if the importance of hygiene; sanitation and safety are known to the workers.

Annex III

Chance Find Procedures

CHANCE FIND PROCEDURES

Project mayinvolve deep excavation.Therefore,the possibility of chance find is not ignorable.In case of any chance find, the contractor will immediately report through Supervision Consultant to Directorate General (DG) of Archeological Department, Government of Pakistan to take further suitable action to preserve those antique or sensitive remains. Representative of the DG will visit the site and observed the significance of the antique, artifact and Cultural (religious) properties and significance of the project. The report will be prepared by representative and will be given to the DG. The documentation will be completed and if required suitable action will be taken to preservethose antiques and sensitive remains.

In case any artifact, antiques and sensitive remains are discovered, chance find procedures should be adopted by contractor workers as follows:

- Stop the construction activities in the areas of chance find;
- Delineate the discovered site or area;
- Consult with the local community and provincial Archeological Department
- The suggestion of the local communities and the concerned authorities will be suitably incorporated during taking the preventive measures to conserve the antique, artifact and cultural (religious) properties
- Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remain, a night guard shall be arranged until the responsible local authorities take over;
- After stopping work, the contractor must immediately report the discovery to the Supervision Engineer.

The contact Address of Archeology Department is given below:

Archeology Department
1st Floor Auqaf Department,
Shahrah-e-Qaid-e-Azam,Lahore

Tel: 042-99231526
042-99231527

Annex IV

Resource Conservation Plan

Resource Conservation Plan

1. Introduction:

The resources in this world are not infinite. We are completely dependent on the resources of the earth to fulfill all our day to day requirements.Sustainable development calls for the need to conserve resources, especially the non-renewable resources.

2. Objective of the plan:

The Resource Conservation Plan is intended to make an effort towards achieving sustainable development. The objective of the resource conservation plan is to:

- Minimize the use of natural resources; and
- Mitigate/ prevent pollution contaminating the natural resources.

3. Planning:

Careful estimations of quantities of material, fuel, water and energy required directly or indirectly shall be done to avoid excessive or unnecessary wastage of these materials. In addition to this, pollution prevention strategies shall also be devised to prevent contamination of resources.

- The estimations include the following:
    1. Estimation of construction material required for the project
    2. Estimation of fuel consumption for construction machinery, construction vehicles and generators etc.
    3. Estimations of the energy requirements during all the stages of the project
    4. Estimations of water consumption for construction activities and construction camp sites.
- Strategies shall be planned to reduce loads on the identified resources to be consumed;
- Best management practices shall be devised to control or reduce pollution resulting from the activities during different stages of the project; and
- An inspectorshall be assigned responsibility to oversee the ongoing activities to check the compliance of the planned strategies.

4. Execution of the plan:

The planned strategies shall be implemented to conserve the natural resources including but not limited to the following:

Material

- Material supplied shall be in conformance with the estimated quantities and excess material shall be returned to the supplier;
- Material wastage shall be avoided by using best management practices;
- Waste produced during the project execution shall be disposed off safely to the designated disposal sites through approved contractors; and
- Reuse of the materials shall be appreciated.

Fuel/Energy

- Reduce trips and optimize routes to and from the construction site for all kinds of activities;
- Regular maintenance of equipment and vehicles to avoid leaks and sustain efficient fuel consumption;
- Switch off/plug offidle equipment and vehicles to avoid wastage of fuel;
- Minimize warm up time, unnecessary acceleration and deceleration of the construction equipment and vehicles;
- Avoid unnecessary burning of fuel for cooking in construction camps;
- Avoid unnecessary heating/cooling systems during extreme weathers;
- Construction shall start in early hours of the day to avoid heat in summers and utilization of day light; and
- Alternate energy sources shall be considered for electricity generations during construction and operation to conserve fossil fuel as it is non-renewable resource.

Water

- Avoid using potable water for sprinkling, curing and washing of equipment/vehicles. Surface water or treated effluent can be used instead;
- Wastage of water should be controlled through providing proper valves and through controlling pressure of the water;
- Unnecessary equipment washings should be avoided;
- Awareness amongst workers shall be raised to conserve water and immediately report for any leaks detected; and
- Ensure protection of canal water from contamination resulting from construction activities.

Pollution:

- Emissions shall be reduced/controlled as far as possible and direct discharges to air shall be avoided by strictly adhering to the mitigation measures outlined in EIA report;
- Waste water shall not be discharged directly into the canal and must be managed as per the recommendations presented in EIA; and
- Construction& demolition waste and municipal solid waste shall not be dumped/burnt openlyand shall be handled according to the preventative measure given in EIA study.

5. Checking and Corrective Actions

The proponent shall bind the construction contractor through contract agreement to comply with the strategies outlined in the Resource Conservation Plan. The proponent shall also appoint an Inspector who shall monitor the daily onsite activities and shall report any issues/ concerns raised in relation to Resource Conservation Plan. The inspector shall recommend adequate corrective actions to mitigate the issues raised.

Annex V

Quarry Management plan

QUARRY MANAGEMENT PLAN

The contractor is responsible for extraction of resources for the construction aggregate from quarry area is required to prepare and implement a Quarry Management Plan (QMP). The overall objective of the QMP is to manage the extraction and processing of a valuable aggregate resource while avoiding, remedying or mitigating adverse effects on the environment and enhancing environmental performance wherever practicable.

The activities conducted in quarry areas are carried out under license or a mining lease under the Punjab Mining Concession, Rule 2002. The lease is issued based on open bidding. The lease is granted for a period not exceeding five years.The leased area may be re-auctioned within three months before its expiry but if the auction or the grant of lease is delayed due to the certain reason, the licensing authority may extend the period of previous lease upto the date of next grant.

The Licensing Authority of the Mine and Mineral Department shall inspect the lessee during the operation.If on inspection or otherwise, the licensing authority is of the opinion that lessee is working in a manner contrary to the conservation of mineral property or safety of workers and other people, the licensing Authority require the lessee, in writing, to remove the defects or amend the method of mining within the period, not exceeding two months, as is determined by the Licensing Authority. If thelessee fails to comply withthe instruction within the specified period, the licensing authority shall have the power to stop the work of extraction of mineral in whole or in any part of the area demised under lease till such time that the defects are removed to the satisfaction of the Licensing Authority and if the defects are not removedor the method of mining are not amended to the satisfaction of the licensing authority within two months from the date of stoppage of work the lease shall be cancelled and bid money already paid shall be forfeited. Inspectorate of mines will ensure the safe mining practices, authorized mining and worker health and safety. Environmental Protection Department (EPD) also plays vital role in environmental monitoring of the criteria pollutant at the Quarry area.

1.1 Key Quarry Activities

The Key activities identified in extraction of material from quarry are discussed as under:

A) Pre Operation

Pre Operation includes Land clearing and Overburden stripping

B) Quarry Operation

Quarry Operation includes:

- Excavation of rock
- Loading and transportation of rock
- Crushing and stockpiling
- Asphalt manufacturing
- Water supply
- Transportation to the construction site.

C) Rehabilitation

- Reclamation activities are conducted after the completion of quarrying activities to restore or rehabilitate the site.

1.2 Environmental Considerations

Quarrying has the potential to have a range of adverse environmental effects. This QMP identifies these effects and suggests measures to mitigate or minimize these impacts.

1.2.1 Vegetation Removal

During land clearance and vegetation removal the following shall be considered:

- Minimize the amount of vegetation removal; and
- Allow timber and other useful resources to go to the localcommunities.

1.2.2 Overburden Clearance

During overburden clearance the following shall be considered:

- No direct discharge of sediment laden water withouttreatment.
- Earthworks and land clearance should be minimized andphased.
- Provide treatment to achieve a reduction in suspended solidsprior to discharge to a natural water course.
- Any discharges to rivers should occur during high flow to dilute the unavoidable discharges;
- Stockpiling should be at least 10m from a water course;
- Waste rock or overburden should be placed in properlydesigned dumpsites, which are located and shaped to blend inwith the surrounding landscape;
- Compaction and re-vegetation of exposed areas as soon aspracticable;
- Earthwork control measures should be inspected andmaintained in efficient operating condition;
- Existing drainage channels should be kept free ofoverburden.
- Wherever possible, stripped topsoil should be placed directlyonto an area being rehabilitated. This avoids stockpiling anddouble handling of the soil.

1.2.3 Noise

To keep noise generated due to the different activities to an acceptable level, the following measures shall be adopted:

- Managing the time and location of particularly noisy operations around the site to ensure minimum disturbance to the localities;
- The majority of fixed processing plant, excluding conveyors will be housed within structures that reduce the noise level at the boundary of the quarry;
- Machinery shall be regularly maintained to ensure that noise produced from machinery is kept minimal;and
- Monitoring of noise levels shall be done.

1.2.4 Excavation and Blasting

To keep vibration and air overpressure due to excavation and blasting to an acceptable level, the following practices shall be adopted:

- Removing rock, where practicable, with an excavator by free digging or ripping instead of blasting.
- A comprehensive blasting management plan shall be prepared and implemented addressing the following concerns:
    i. Control of blasting area
    ii. Time schedule
    iii. Training of personnel
    iv. Announcement/ Communication
    v. Traffic management
    vi. Hazardous material handling and storage
    vii. Waste disposal
    viii. Post blast re entry
    ix. Health and safety of worker

1.2.5 Traffic

To avoid, remedy or mitigate the adverse effects associated with quarry traffic following measures shall be adopted:

- All the vehicles used shall be regularly maintained and checked to ensure that appropriate noise suppression devices are installed and being operated effectively.
- All trucks leaving the quarry shall be checked for overloading to avoid risk of quarry products being spilled on public roads.
- Loader drivers shall be appropriately trained to help ensure that container/trucks are loaded securely.
- A wheel wash shall be used to spray truck wheels as they leave the quarry site. This will help reduce the risk of dust being carried onto public roads by trucks.
- To ensure the safety and convenience of local traffic, a Traffic Control Plan is required to be communicated that ensures minimized traffic stoppage times.

1.2.6Dust (Air quality)

Dust emissionshave the greatest potential for off-site effects. However, provided the operation site is well controlled and the activities well managed, dust emissions can be reduced by adopting the following measures:

- Locating the fixed processing plant away from quarry boundaries;
- The fixed processing plant is covered in areas where dust generation could become a nuisance;
- Potential dust generating conveyors are covered where practicable to contain dust;
- Water sprays to suppress dust emissions wherever practicable;
- Blasting will be restricted if windy conditions are likely to carry visible dust emissions beyond the quarry boundary where they could create a nuisance;

- Minimizing dust emissions from blasting by sequential firing and using minimum force;
- Revegetating areas that will not be further disturbed as soon as possible;
- Proper maintenance and tuning of the vehicles and equipment also shall also be considered in avoiding any off-site effects;and
- Good blasting practice, including using waterproof explosives in areas where groundwater levels are high, to avoid the degradation of the explosive, will minimize incomplete combustion and any associated NOx emissions.

1.2.7 Altering Water Flow

Quarries and pits can affect ground-water and surface-water systems by lowering of local ground-water and surface-water levels from mining operations andmine dewatering, changes in turbidity levels in ground water due to blasting and quarry operations, interruption of ground-water conduit flow paths by rock removal andtemperature change (thermal impacts) in springs and surface-water streams.To avoid reduced water flow from springs to water ways andirrigation/drinking water schemes, changes in water flowdirection and increased storm waterrunoff, following mitigation measures shall be adopted:

- Create temporary ponds to treat sediment and reduce runoffspeed of surface water flow especially during high rainfall.
- Create a channel from the settling ponds to the nearest river.
- Create a special water channel for citizens to source cleanwater from springs.
- Divert groundwater and surface water around the quarry area.

1.2.8 Landscape

Following shall be considered in order to minimize impacts to the landscape;

- Vegetation and landscape plan for the site shall be devised and followed by the contractor that gives a comprehensive description of all measures that will be taken on site to protect the landscape and visual characteristics of the site;
- Provide earth mounding and vegetation screening to mitigate visual effects of quarry operations and on-site truck routes where practical.

1.2.9 Hazardous Substances

To deal with issues relating to the release of hazardous substances from storage facilities or during their use, transport or disposal within the quarry site, the following shall be considered:

- Ensure that only the imminent operational requirements are stored on the site.
- Explosives and detonators shall not be stored for long time on site.
- Fuel, lubricant and waste oil storage, dispensing and operating facilities are designed and operated in such a way that contamination of soil and water is avoided as far as practicable.
- Rain runoff carrying fuel, lubricant and waste oil shall be directed to an oil separator before entering the storm water drainage system. Oil separators are cleaned out on a regular basis.
- All transport, storage and operating conditions meet the requirements of licenses under theSection 14 of PEPA 1997, Handling of Hazardous Substances.

1.2.10 Rehabilitation of the site

Restoration of the former quarry areas may be done using the overburden and fertilizers to restore soil stability and soil fertility.

- Remove all stockpiles.
- The use of imported fill shall be minimized.
- Plant local plant species and productive vegetation as part ofthe restoration plan.
- Stabilize all slopes and unstable areas.

1.2.11 Worker Health and Safety

To ensure worker health and safety the following shall be adopted on or near the project site:

- Restrict the access to the quarry areas for unconcerned persons;
- All personnel shall be provided (and wear) Personal ProtectiveEquipment (PPE), such as safetyhelmets, safety shoes, vests, dust masks, goggles, and a high visibility vest;
- Providing radio communications equipment to facilitate coordination in the field;
- Conducting periodic monitoring of heavy vehicles and equipment for safety risks;
- Limiting the hours of operation of heavy vehicles and equipment, to minimize risks relating tostaff fatigue;
- Conduct inspections of the access point to the location of transport because of thesteepness of the route;
- In case of accidents or emergencies, basic medical facility shall be provided;
- The team shall be able to handle emergency situations and the possible emergency services shall be notified in advance;and
- No damage occurs to people, property, livestock or power lines.

1.2.12 General Prohibitions

The following General prohibitions shall be adopted in and around the quarry area:

- Cutting of trees for any reason outside the quarry;
- Hunting, fishing, wildlife capture and poaching, or plant collection;
- Buying of wild animals or their meat for food or any other purposes;
- Disturbance to anything with architectural or historical value;
- Use of firearms (except authorized security guards);
- Washing car or machinery in streams or creeks;
- Doing maintenance (change of oils and filters) of equipment outside authorized areas;
- Littering of the site and disposing trash in unauthorized places;
- Workers driving motorbikes without wearing helmets;
- Control construction plants or vehicles by unauthorized person;
- Driving at speeds exceeding limits;
- Having caged wild animals (especially birds) in camps;
- Working without safety equipment (including gloves, boots and masks);
- Creating nuisances and disturbances in or near communities;
- Disrespecting local customs and traditions;
- The use of welding equipment, oxy-acetylene torches and other bare flames where firesconstitute a hazard;
- Indiscriminate disposal of rubbish or construction wastes or rubble;

- Spillage of potential pollutants, such as petroleum products;
- The storage and use of explosives;
- Collection of firewood;and
- Burning of wastes and/or cleared vegetation.

Annex VI

Emergency response plan

Emergency Response Plan

1. Introduction

Emergency management can be defined as the organization, coordination and implementation of a range of measures to prevent, mitigate, respond to, overcome and recover from the consequences of emergency events affecting the community, its assets and the environment.

2. Purpose of Plan

This plan intends to provide a framework for safety and security to infrastructure, people and vehicles. It assigns responsibility to organizations and individuals for carrying out specific actions at projected times and places in an emergency situation that exceeds the capability or routine responsibility of any one agency.

The emergency response plan provides guidance to:

- Prevent any potential sources causing hazard to the resources during all stages of the project;
- Coordinatebetweenvarious organizations to take actions in case of emergencies;
- Protect people and property in emergencies and disasters;
- Develop procedures to respond to the emergencies efficiently;
- Identify and ensure availability of personnel, equipment, facilities, supplies, and other resources for use in order to provide timely and efficient response and recovery operations; and
- Confirm that measures taken in an incident are adequate to recover the affected resources or furtherimprovements are needed.

3. Planning

i. <u>Emergency Response Team</u>

A group/team shall be dedicated to identify and control potential emergencies during the construction and operation of the project. The roles and responsibilities of the group members shall be clearlydefined.

The primary responsibilities of the group are described below:

- Identify the potential hazard or risk sources that can lead to emergency situations; Ensure availability of adequate resources, procedures and communication system to deal with the identified emergency situations;

- Ensure awareness and training of the staff to facilitate implementation of the emergency response plan;
- Maintaining the records of any previous incidents; and
- Post-event analysis to bridge the gaps of the existing risk prevention procedures.
- The emergency response team shall include but not limited to the following;
    1. Team Leader
    2. Safety Engineer
    3. Reporting officer/Inspector

Team Leader

- Approve/ modify devised measures to prevent or mitigate the risks associated with the identified risk sources
- Arrange resources for dealing with potential emergencies including, financial, equipment and personnel required to deal with emergencies.
- Assure that the Emergency Response plan is adequate, effective and can be implemented practically.

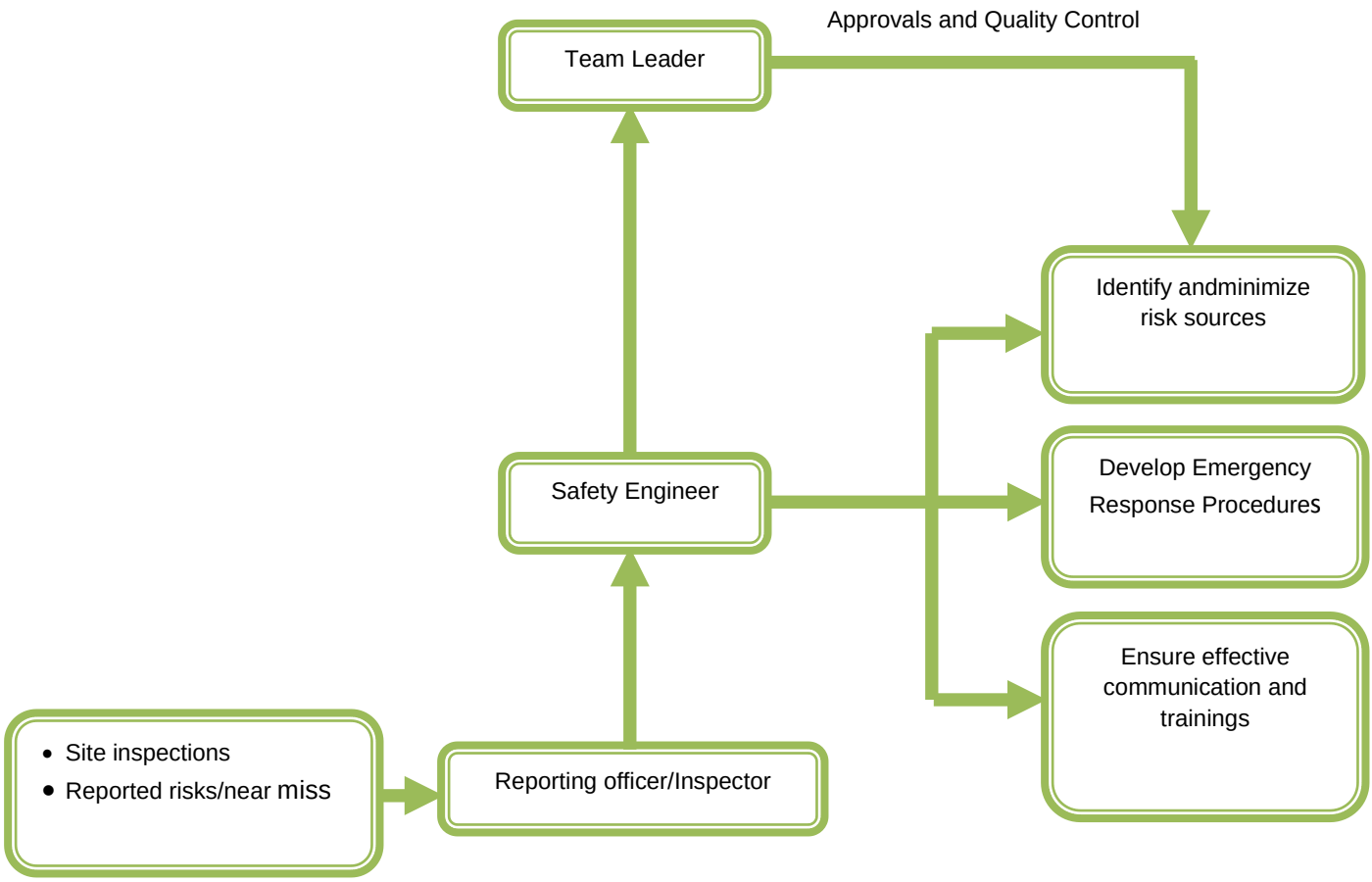
Safety Engineer

- Analyze the Identified risk sources and devise measures to prevent or mitigate the risks in close consultation with the Team Leader;
- Develop and implement the Emergency Response Procedures, in case of the possible emergencies arise;
- Ensure effective internal and external communication; and
- Provide regular trainings and arrange drills to make people aware of dealing with emergencies.

Reporting officer/Inspector

- Regular inspections of the site, to identify potential risks associated with equipment, materials and work practices;
- Anybody from the site can notify the reporting officer about potential risk and/or near misses on the site;
- Record any identified risks and mitigation measures to control the identified risk; and
- Notify the issue and control measures takenthereby to the safety engineer.

The designation, roles and responsibilities of each member shall be clearly defined and communicated to the employees.An outline of the framework of responsibilities is presented in the following organizational chart:



ii. <u>Hazard Identification</u>

A comprehensive identification and evaluation of the hazards/risks likely to cause an emergency shall be done by Emergency Response Team (ERT). Major potential emergencies identified in road projects are as follows:

- Structural failure
- Disruption of Utility (Power, Water, Telecommunications, Gas, etc)
- Accidents
- Vehicle accident
- Fog
- Smoke

- Power/equipment failure or Vandalism
- Fire
- Earthquake
- Terrorism including bombing
- Disease Outbreak

iii. Prevention and Mitigation

The ERT shall work to eliminate or reduce the impact of identified emergencies and increasing the resilience of an affected community to recover from the consequences of such events. These activities include:

- Design considerations to control flooding, earthquakes and adequate lightening for fog etc.;
- Regular inspection and maintenance of construction machinery and the structural integrity;
- Review of work schedules based on weather updates; and
- Security controls based onpolitical situations.

4. Emergency Preparedness

The ERT shall be prepared withall necessary resourcesand the personnel's shall be trained regularly

i. Resources

Finance and administration

The financial resources shall be reserved for dealing with any emergencies arising on site during construction and operation. Responsibilities of the person managing the resources in case of emergencies shall be clearly defined and the required resources shall be adequate and updated regularly.

Equipments

All the necessary equipments needed in an event of emergencies shall be madeavailable, as a minimum, the equipments needed include;

- Personal Protective Equipments
- Alarms/ Warnings
- Fire extinguishers
- Crowd control, flashlights, signs, barricades

- First Aid Facility
- Detection instruments, e.g; personal alarm kits; smoke detection instruments
- Tools to fix minor vandalism

Communication

All external and internal communication systemsshall be made available. Local emergency numbers shall be clearly posted and communicated to the personnel involved in construction and during operation.

The local emergency numbers are given below, which shall be regularly updated.

Emergency Numbers

	Service	Lahore (042)
1	EdhiAmbulance	440159/444460
2	Emergency Police	15
3	Bomb Disposal	7352825
4	Rescue	1122
5	Fire Brigade Center	16
6	Hospital Civil(casualties)	7310130-9

Trainings

Personnel shall be made aware of the importance of safety, potential emergencies and how to respond in case of emergencies.One day training and mock exercise shall be done to prepare, the personnel to deal with emergencies.

5. Emergency Response

Response includes actions taken to reduce the impacts of an emergency event, and to limit the threat to life, property and the environment.

The emergencies can be dealt with:

- On-Site Management of the situation
- Off-site coordination to arrange necessary resources to support the on-site management
- Providing advice and reports of the situation to stakeholders

i. Emergency Response Procedure:

Any person can report about an emergency, anon-site worker, an outside agency, or the public. Circumstances change during the course of an emergency in different events,

thus,the procedure will vary as per the specific situation on ground. However, a basic action plan to be followed in an emergency is discussed below. This order ofresponse is applicable to almost any emergency and should be followed in sequence.

Assess the situation:

The most important thing to do in case of emergency is to stay calm and avoid panic. Assess the situation, the cause and most immediate requirement to control, limit and/or manage the immediate, ongoing, or further damage.

Immediate control:

The most senior person on the scene should take control and contact, or delegate someone to contact emergency services as posted and communicated by ERT and inform the reporting officer of ERT and explain the situation. The area of emergency shall be restricted by barricades, tapes and adequate signage, if and as required.

Protection from further losses:

1. Once the site is restricted, to provideprotection and reducefurther losses, the source causing the emergency shall be controlled including equipments, materials, environmentand accident scene from continuing damage or further hazardsto the area and people.e.g: suppress fire, prevent objects from falling, shut down equipment or utilities, and take other necessary measures as required depending upon the type of emergency
2. Provide first aid if required or in doing so.
3. Designate people to emergency duties. e.g: assignpersonnel to guide emergency services on arrival.
4. Headcount People/personnel to identify any missing persons.
5. People/ personnel shall be directed to safe location.
6. Arrange diversions for the traffic to reduce disturbance to the flow of traffic, if and as far as possible.
7. Preserve the accident scene until experts mark it safe; only disturb what is essential to maintain life or relieve human suffering and prevent immediate or further losses.

ii. Communication:

Emergency service providers:

The emergency service providers'needs to be kept informed of the situation. On site, personnel from the emergency services shall be guided towards the emergency scene, brief about the event, ongoing and potential hazards and cause(s), if known.

Emergency Response Team and Management:

Members of ERT shall be immediately informed and the management shall also be kept informed.

Public:

Timely notifications to public shall be disseminated through electronic and print media depending upon the requirement and urgency of the emergency so that they can adopt alternate routes and avoid the hazards associated with the emergency encountered.

Utilities:

In case of disruption of utilities, the utility control authorities shall be immediately contacted to control the situation.

6. Recovery:

Emergency affected individuals, communities and infrastructure shall be restoredin terms of emotional, economic, and physical well being including the following as a minimum:

- A detailed analysis and assessment of causes of emergency , extent of damage and gaps if any, in managing the emergency;
- Recovery/replacement of the assets and infrastructure;
- Reinstatement of disrupted services;
- Road and bridge repairs;
- Updationof safety arrangements and Emergency response procedures to ensure better safety and security in any other arising emergencies.

Annex VII

Health Monitoring Plan

Health Monitoring Plan

1. Introduction

The health risks associated with the use of wastewater for irrigation include Helminth infections, bacterial/ virus infections, and protozoa infections. Children are at greater risk for infections related to wastewater. The diseases associated with the use of wastewater reuse include: cholera, typhoid, diarrhea, shigellosis outbreak, saalmonila infections, Giardia intestine infections. Four groups of people are anticipated to bear potential risk from the agricultural use of treated wastewater. These include:

- Farm workers and their families;
- Crop handlers;
- Consumers (of crops, meat and milk);
- Communities living nearby

Agricultural field workers are at high potential risk, especially of parasitic infections. Exposure to hookworm infection can be reduced, and even eliminated, by the continuous in field use of appropriate footwear, but persuading workers to adopt this precaution may be difficult. A rigorous health education program is needed.

A similar approach may be taken with crop handlers; the risk to them is somewhat less than that to field workers, but it can be reduced by thorough personal hygiene and the wearing of gloves.

Immunization is not feasible against helminthes infections or against most diarrheal diseases. However, for highly exposed groups, immunization against typhoid and administration of immunoglobulin to protect from hepatitis A may be worth considering.

Additional protection may be provided by the availability of adequate medical facilities to treat diarrheal disease, and by regular chemotherapy. This might include chemotherapeutic control of intense nematode infections in children and control of anemia.

Chemotherapy must be reapplied at regular intervals to be effective. The frequency required to keep worm burdens at a low level (for example, as low as in the rest of the population) depends on the intensity of transmission, but will not normally be less than once a year. The drugs involved normally cost about US $ .50 for each complete treatment. One to three doses are required, depending on which drug is used.

Chemotherapy and immunization cannot normally be considered as an adequate strategy to protect farm workers and their families who are exposed to raw wastewater or excrete.

Risks to consumers can be reduced by the thorough cooking of vegetables and meat, by boiling milk, and by maintaining high standards of personal and kitchen hygiene. Food hygiene should be included in health education campaigns.

Any risk of tapeworm transmission can be controlled by meat inspection provided that animals are slaughtered only in recognized abattoirs where all carcasses are inspected and all infected carcasses are rejected.

2. Measures to protect human health and environment

Human health and environment could be protected through four groups of measures:

- Wastewater treatment level
- Restriction of the crops grown
- Irrigation methods and
- Control human exposure to the waste, and hygiene.

i. Wastewater Treatment Level

Partial treatment of wastewater (to 10^5thermo tolerant coliforms per 100 ml) reduces the effects in adults but not children and treatment may need to be below 10^4thermo tolerant coliforms where children have high amount of contact or if this is not possible effective measures to reduce contact of children should be introduced. Studies by WHO shown that increased risk of infection by sprinkler irrigation at 10^6thermo tolerant coliforms per 100 ml but no increased risk at 10^4 -10^5thermo tolerant coliforms per 100 ml. Full treatment prevents excreted pathogens from reaching the field. However, the farmers in most of the cases have to cope with wastewater of a certain quality. Because of this, for the farming crop restriction, irrigation system and human exposure control which act later in the pathway, are more important. A combination of agro-technical measures to be selected, depending on the local socio-cultural, institutional and economic conditions may provide health protection.

ii. Crop selection for health protection

Vegetables should not be allowed to be irrigated by treated wastewater in order to minimize health risk. According to WHO here are three groups of crops to be considered for health protection as follow:

a). Category A: Protection needed only for field workers according to WHO

Crops not for human consumption (cotton, sisal)

- Crops normally processed by heat or drying before human consumption (grains, oilseeds, sugar beet)
- Vegetables and fruits grown absolutely for canning or other processing that effectively destroys pathogens
- Fodder crops sun-dried and harvested before consumption by animals
- Landscape irrigation in fenced areas without public access (nurseries, forests, and greenbelts).

b). Category B: Further measures may be needed

- Pasturelands, green fodder crops
- Crops for human consumption that do not come into direct contact with wastewater, on condition that none must be picked off the ground and that spray irrigation must not be used (tree crops, vineyards, etc.)
- Crops for human consumption normally eaten only after cooking (potatoes, eggplant, beetroots)
- Crops for human consumption, the peel of which is not eaten (melons, watermelons, citrus, bananas, nuts, groundnuts)
- Any crop if sprinkler irrigation is used.

c). Category C: Treatment to WHO "unrestricted" guidelines is essential

- Any crops often eaten uncooked and grown in close contact with wastewater effluent (fresh vegetables such as lettuce or carrots, or spray-irrigated fruit)
- Landscape irrigation with public access (parks, lawns, golf courses)
- Control of human exposure to the wastes and hygiene .Controlling the risk of public health from waterborne diseases when treated sewage wastewater is used for irrigation is of high importance. In this respect, the groups of persons running such a risk and the ways such groups are exposed to the risk should be identified and examined.

The following groups may be recognized:

i). Farm workers

The probability for them of wetting their hands, clothes, or other parts of their body from leaks or otherwise is certainly the highest risk of exposure. Therefore, farmers should be aware about the risk and handle wastewater with care.

- Workers handling or packing polluted crops. If proper care was not taken at the treatment stage and proper irrigation practice were not followed by the farmers, pathogens may be present on the crops at such concentrations, as to pollute the hands, or clothes of such workers.
- Farmers: provide information through interactive learning methods on health risks associated with wastewater use, information and technical assistance on proper crop selection in relation to wastewater quality, irrigation techniques, protective clothing (boots), personal hygiene, washing crops before marketing, group organization for on field sanitation and washing facilities; preventing damage to soils and ground water.

Farmers should take the following precautions:

- It is highly recommended to prefer drip irrigation over others
- All farmers should have a standard Polio-diphtheria-tetanus vaccination.
- All farmers should wear boots and gloves, they shouldn't work barefoot.
- They should not touch their face or smoke, drink or eat during and after working with treated wastewater until they wash their hands and face with soap and water.
- All exposed wounds, however small, should be cleaned and covered with a sterile dressing.
- Farmers should contact their doctor in any case of change in their health such as persistent stomach symptoms of worm infection, a flu-like fever, chest problem and regular checkup.

ii). Consumers

This group is actually the general public, comprising children, elderly people and others of low resistance to pathogens, being the most sensitive group. Farmers should feel responsible for this group and manage wastewater in such a way to avoid crop contamination. Crops polluted with pathogens, particularly those consumed raw wastewater, allow the chance for consumers to be infected by pathogens, if not properly washed and cleaned. Risks to consumers can be reduced by thorough cooking and by high standards of hygiene. Local residents should be kept fully informed about the location of all fields where wastewater is used. In this way, they may avoid entering them and also prevent their children from doing so. Programs should be

conducted to inform them on proper washing; cooking or blanching of vegetables; and sufficient cooking time for fish raised with wastewater; necessity of paying for treatment of household wastewater as they are the generators.

Protection of consumers can be avoided by:

- Selecting the most appropriate crop to be irrigated by TWW.
- Using drip irrigation and plastic mulch
- Pesticides should not be diluted or mixed with wastewater
- Avoiding contact between crops and wastewater after harvesting.
- Processing of crops.
- A strict state monitoring system for crops irrigated with wastewater

Other general measures include:

- The irrigation system should be checked regularly for spraying or broken emitters and pipes leaks
- Produce that has fallen on the ground or the black mulch should not be marketed.
- Produce hanging on the ground should not be marketed
- Irrigation should be stopped two weeks before harvesting if possible

iii). Surrounding residence

In order to protect them and minimize their health risks, signs should be available to all of them in order to inform them of the presence of wastewater; in addition, they should be informed about the project, site, and impact, as well as their children. This can be done by campaigns in schools, mosques, markets and health clinic. Fencing around the treatment facility projects is a useful tool to minimize the health risks of the people living in the surrounding area and the treatment plant, usually the safe distance is 100 m. In addition, animals should not be allowed to graze from these fields using treated wastewater or drink this water.

Annex VIII

General Clauses of Contract

Contract Document for Environmental and Social Compliance of ESMMP

1. GENERAL

The Contractor shall be solely responsible for the remedy and/or mitigating measure(s) required by the Authority in relation to the effect on the environment of his construction plant/equipment and/or his construction related activities. In case of an environmental problem, the Contractor shall immediately notify the Engineer (Monitoring Consultant) who will instruct him of any course of action to be taken. Among the situations which may require such steps, are complaints or legal action by third parties on matters such as environmental damage to property and natural resources, ground subsidence, interruption of groundwater flow, and surface and groundwater contamination.

The Contractor shall insure that all related environmental legislation framework in Pakistan be observed at all times in the project site. Some of these legislations, but not limited to these, are mentioned below:

a) Constitution

- The Constitution of the Islamic Republic of Pakistan (1947)

b) Environmental Impact Assessment

- Pakistan Environmental Protection Agency (review of IEE and EIA) Regulations (2000)

c) Land Acquisition

- Land Acquisition Act (1894)

d) Water Quality

- National Environmental Quality Standards (Revised 2001)
- National Environmental Quality Standards (2010)

e) Air Quality

- The Motor Vehicles Ordinance (1965) and Rules (1969)
- National Environmental Quality Standards (Revised 2001)
- National Environmental Quality Standards (2010)

f) Noise

- National Environmental Quality Standards (Revised 2001)

- National Environmental Quality Standards (2010)

g) Toxic or Hazardous Substances

- The explosives Act (1884)
- National Environmental Quality Standards (Revised 2001)
- National Environmental Quality Standards (2010)
- Hazardous Waste Rules (2002)

h) Solid Wastes and Effluents

- National Environmental Quality Standards (Revised 2001)
- National Environmental Quality Standards (2010)

2. GENERAL PROVISIONS (GP)

GP-1 The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private right of way as a result of its operations, including any deposits arising from the movement of Construction Plant or vehicles. The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exists from the site whence excavated material is hauled, to the consent of the Engineer.

GP-2 The Contractor shall at all times ensure that all existing stream courses and drains within and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in the watercourses.

GP-3 All water and waste products arising on the site shall be collected, removed from the site through a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance.

GP-4 The Contractor shall construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage by flooding and silt washed down from the Works. It shall also provide adequate precautions to ensure that no spoil or debris of any kind are allowed to be pushed, washed down, fallen or deposited on land adjacent to the site.

GP-5 In the event of any spoil or debris from construction works being deposited on adjacent land or any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.

3. SPECIFIC PROVISIONS (SP)

SP-1 Implementation of EMMP

Summary of mitigation measures and Environmental Mitigation and Monitoring Plan (EMMP) are to be followed as given under Table 7.1and Table 7.2

SP-2 SIGN BOARDS

a) Scope

The work shall consist of procurement, erection, maintenance and removal of signboards that gives brief details of the construction. The signboards will be installed within forty five (45) days after Commencement Date and removed within thirty (30) days after issuance of the final Taking over Certificate.

b) Design of Sign Board

The signboards with an approximate size of 3 m wide x 2 m high shall be mounted at a height above 2 m on the ground. It is supported by a steel pipe frame that is strong enough to withstand the prevailing wind. The board shall be fabricated with flats bars and steel angle frames. The wording, style and size of lettering colors, etc. shall be subject to the approval of the Engineer (Monitoring Consultant).

c) Location of Erection

The signboards will be erected at the beginning and end of the project site and at the camp yard.

d) Maintenance of Sign Boards

The Contractor shall maintain the installed signboards in a satisfactory manner until the issuance of the Taking Over Certificate. The maintenance work shall include periodic inspection, repainting, cleaning and other repair works.

e) Measurement and Payment

Measurement for the payment of signboards shall be the number of signboards installed. This work shall be paid for at the contract price per sum for the BOQ item listed below:

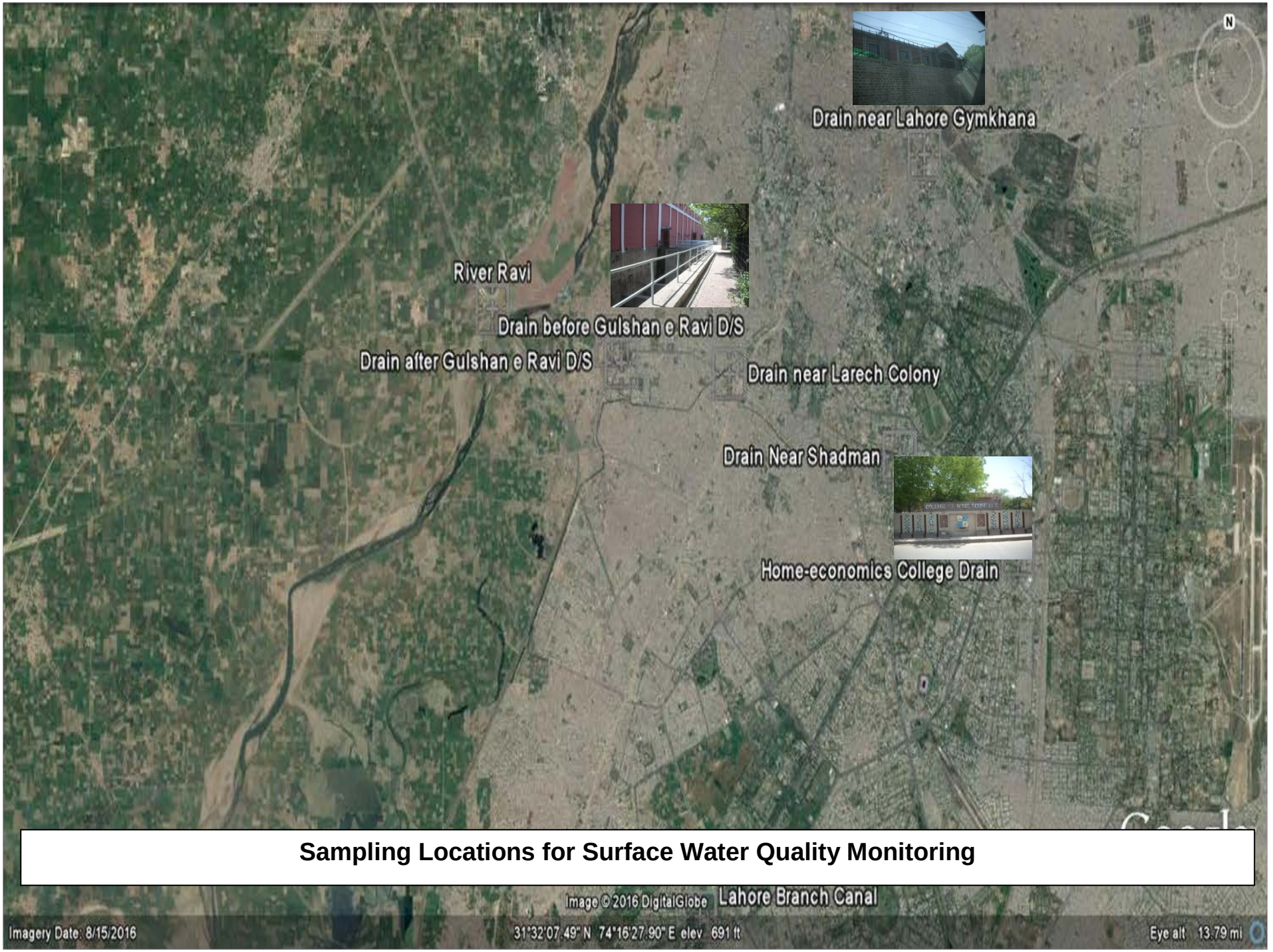
The payment shall be considered to be full compensation for all cost involved with the procurement, installation, maintenance and removal of the sign boards as specified including all labor, materials, equipment, disposal and incidentals necessary to complete the work.

The items of work payable under this provision along with their units shall be as follows:

Payment Item No.	Description	Unit of Measurement
SP 2	Erections of Signboards	Each

Annex IX

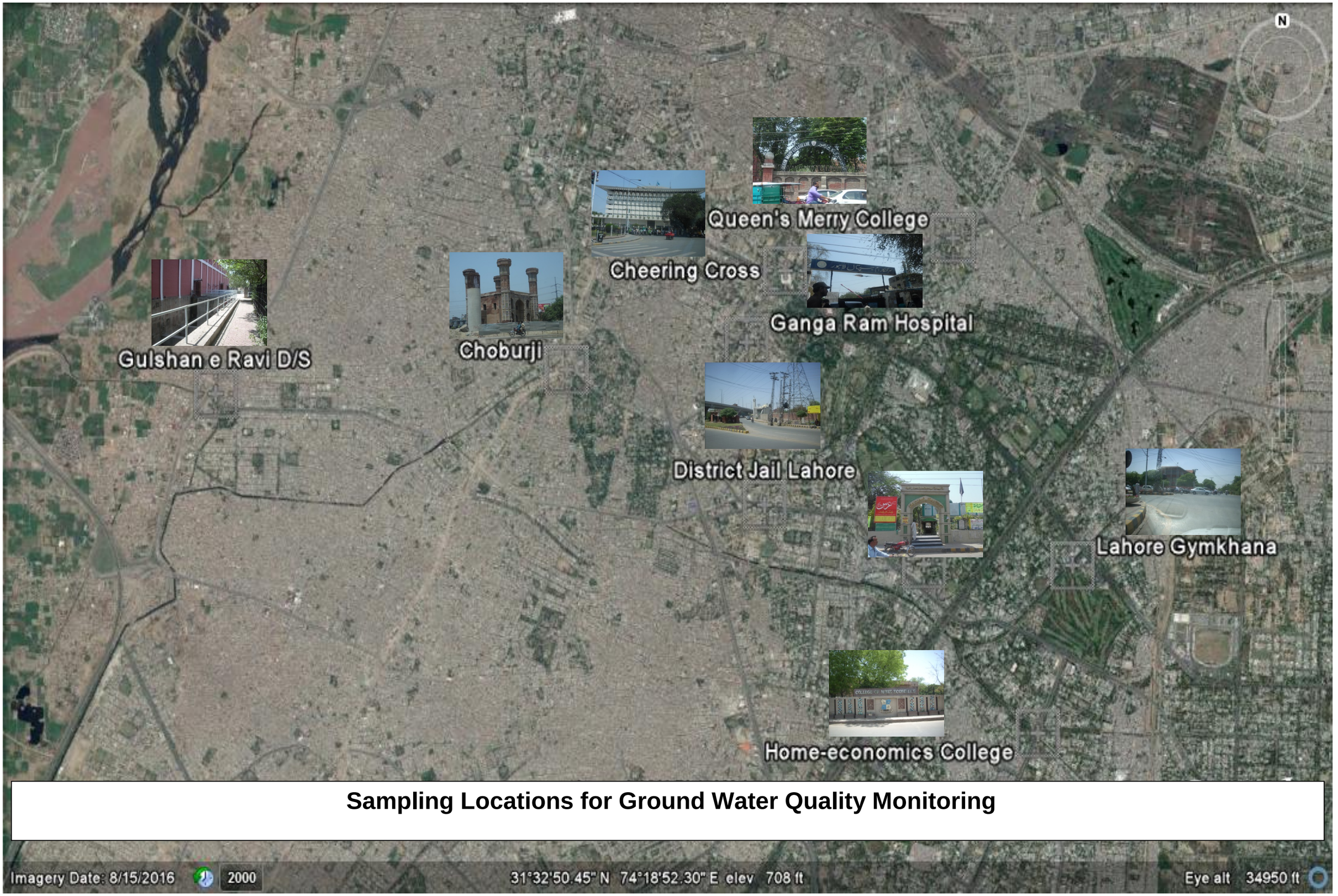
Sampling Locations – Surface Water



Sampling Locations for Surface Water Quality Monitoring

Annex X

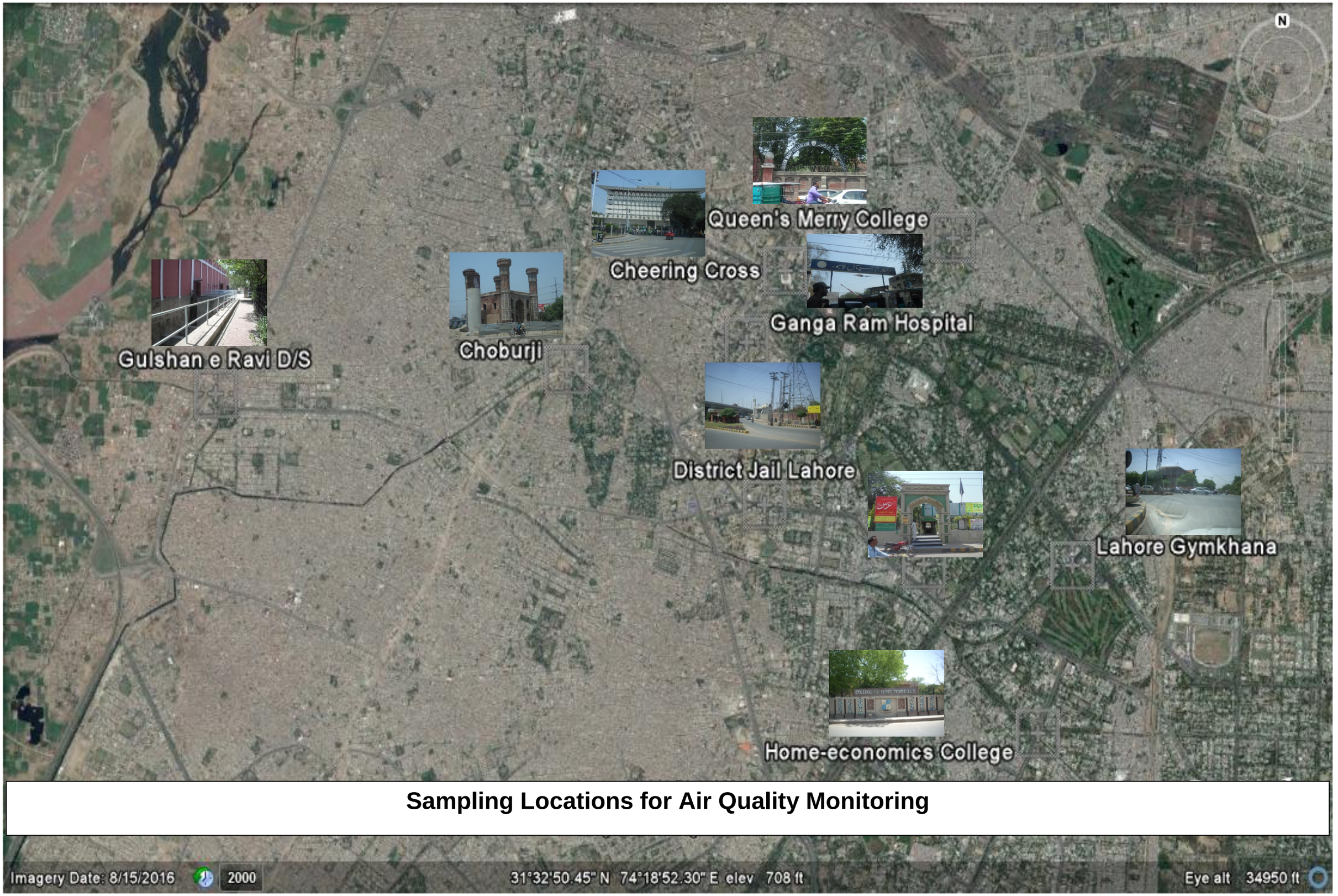
Sampling Locations – Ground Water



Sampling Locations for Ground Water Quality Monitoring

Annex XI

Sampling Locations – Air/Noise



Sampling Locations for Air Quality Monitoring

Annex XII

Terms of Reference

APPENDIX-A

DESCRIPTION OF THE SERVICES

Description of the services shall be as provided:

The work under this consultancy will mainly consist of (a) carry out requisite surveys, investigation and studies for Tunneling Method for laying of RCC sewer pipes.(b)Detail Engineering Design with parameters / standards, Preparation of Detail Construction Drawings. c) Preparation of Detail Engineering Cost Estimates for TS, d) Bidding documents, Technical Specifications, Bill of Quantities (BOQ) and comprehensive criteria for selection of contractor(e) evaluation/vetting of Bid proposals of contractors (f) construction supervision and contract monitoring, (g) supervision of installation commissioning of pumping machinery(h) facilitate contract management (i)preparation of manuals and other related unforeseen tasks.

Scope of Work

The duties and responsibilities of the Supervision Consultant (Consultant) shall include, but not limited to:

Part-I*:* **Design Services**

a. Collection and Review of available data

The consultancy shall include collection of requisite data (primary and secondary) and related.

b. Topographical and site survey

The survey work shall comprise topographic and other necessary surveying, leveling and establishing bench marks with respect to GTS bench mark, drawing cross-sections where required and other related works required for Tunneling Boring Method to lay the RCC sewer pipes. Design of Disposal Station. The consultant shall also carry out site survey from STP proposed site route, fix the benchmarks and prepare L-Section/profile, Rout plan showing project boundaries, existing services, relocation plan, Diversion plan for existing sewer line, drain and for Disposal station.

c. Soil/Geotechnical Investigations

The Consultant will carry out soil/geotechnical and other investigations of the site. Necessary field and laboratory testing will be carried out to assess the engineering properties of the soil strata for detailed design to lay the pipe with TBM /Pipe jacking method. Laboratory testing will be conducted from reputed laboratories. The result of the sub soil investigations will be submitted in the form of report. The Consultant will examine the chances of permeability of soil and penetration of waste water and danger of any water penetration to working area from existing utilities services.

d. Review / validate the design prepared at master planning stage

The Consultant will Review / Validate the design prepared at Master Planning stage by NESPAK for this section and contributory flows. The Consultant will also carry out a critical review of the detailed design prior to the physical commencement of works to identify defects or omissions that compromise the completeness or consistency of the design. This design / review of design will be carried out immediately after the commencement of services. On completion of the review, the consultant will prepare a report, setting out all findings and recommendations for correcting any defects or omissions identified during the review stage. Notwithstanding these, the Consultant will also immediately inform the employer of any defect or omission that may have a substantial impact on the Project at the time the defect or omission is uncovered. The Consultant will submit four copies of the review report(s) to the employer. During execution stage, the suggested improvement(s), if any, shall be designed and prepared by the Consultant after approval from the Client so that work progress does not suffer.

e. Detailed Design to lay sewer pipe with TBM/Pipe Jacking Method

The Consultant shall review the hydraulic design of sewerage system prepared at the stage of Master Planning for Central Lahore prepared by M/S NESPAK and carried out the detailed designing for laying of sewer pipe with tunneling Boring Method / Pipe Jacking technology along the proposed route up to Disposal Station. The consultant will examine the all factors in detailed design for laying of trunk sewer line by using the TBM machines for successful completion of the project. The consultant will also design the launch shaft and manhole chambers etc. with respect to site and working environment.

f. Detailed Design of Disposal Station

The Consultant will prepare the detail design of sewerage system by using the methodology of TBM/Pipe Jacking along the proposed route. Detailed design of disposal station shall include the configuration and detail structural design of the pumping station including various civil, electrical and mechanical components in accordance with international standards. General arrangement drawings, pumps, motors, electrical panelslayouts, power requirement calculations, Phase wise implementation schedule for installing the pumps motors etc. shall be prepared by the consultant.

g. Detailed Design for R.C.C Sewer Pipe

Consultant shall prepare the detail design of vertically casted R.C.C sewer pipe to withstand the jacking load/force based on international standards.

h. Technical Specifications and Construction Drawings

The consultants will prepare technical specifications of the proposed equipment/material for the project for specified items not covered in the General Specifications. The Consultant will prepare tender and construction drawings in a clear, concise and uniform manner in digital format using

AutoCAD and will submit final copy of complete drawings after approval to client in soft DWG format as well as the consultant will submit hard copies of the drawings.

i. Bill of Quantities and Engineers Cost Estimate

The Consultant will prepare Engineers Cost Estimate of the project based on MRS and latest market rates. The Consultant shall prepare detail Engineering design, architectural design, drawings, specifications Manual, Engineer's Cost Estimate for T.S, bidding documents, Bill of Quantities (BOQ) Tender Drawings for the components where required. The Consultant will also assist the WASA in evaluation/vetting of Bid proposals of contractors. They shall also recommend remedies, alterations, omissions and corrections with supporting documents to the client / EA before or during implementation / execution. The consultant will provide the soft and hard copies of all above to WASA.

j. EIA / IEE

Consultant shall be responsible for preparation of EIA/IEE reports and its approval from concerned department including all expense/Fee.

k. Integrated Design

Consultant shall be responsible for an integrated design keeping in view the future infrastructure development works in the vicinity of the proposed route of the trunk sewer lines like Orange Line Metro Project etc. TheConsultant will liaison with other department / Consultant to integrate the project with other development works in the area.

Part-II:Resident Supervision and Contract Monitoring

The Consulting service for construction supervision is to assist the WASA to implement the project for laying of sewer pipes with Tunneling Boring / Pipe Jacking Machine at proposed route in Lahore. The Construction Supervision services shall include but not be limited to the following tasks:

a. The Consultant shall be responsible for Resident Supervision of the work i/c casting of sewer pipe through qualified and graduate engineers and other supervisory technical staff having sufficient experience in the relevant field. The Consultant's team shall perform its duties with due diligence and efficiency, in accordance with the best engineering practices, standards &Consultants technical / professional approach to:

(i.) Ensure standards of quality in executing the works,
(ii.) Ensure completion of the work within the stipulated time limit.

b. Ensure that the Technical Specifications in the Tender Documents have been duly accounted for in the detailed engineering design and construction drawings.

c. The Consultant shall supervise contractor's job and all work related matters and shall ensure that measures taken by contractor for safety of the public, properties and staff working at site are adequate and in accordance to the international standards / practices. If found any deficiency, the Consultant shall give advice to the contractor for remedial measures informing concerned Director Construction /Sr Construction Engineer WASA.

d. The Consultant shall examine the work schedule prepared by the contractor; recommend any change / modification / alteration, if required. Consultant shall also monitor progress carefully and certify that the work executed at site is strictly according to the schedule approved by the client. The Consultant shall submit fortnightly inspection and progress reports to the Engineer. In case if the contractor is lagging behind from the schedule the Consultant will point out and propose remedial measures to meet the target.

e. The Consultant shall prepare QA & QC manuals and assure its implementation and certify that the construction material brought by the contractor at site to be used in the execution of work is strictly in accordance to the standards & specifications and certify that the laboratory test reports meet the standards.

f. The Consultant will assure quality of the works during construction, continuously inspects the soils and materials, construction operations and the works with regard to workmanship and compliance with the specifications. Assure the proper testing of all construction material prior to its utilization in construction work and supervise all field / laboratory tests of material and works as per methods described in the specifications and will submit a copy of all field / laboratory test reports to WASA immediately as well as along with payment certificate. The field equipment required will be provided by the contractor whereas the consultant would arrange technician / supervisory staff to carry out /supervise the tests as per standard procedure / requirement laid in the specifications. The Consultant will advice the requisite tests of materials / structure and ensure adherence to specifications, and approve the sources of construction materials. For laboratory test sampling will be carried out by the consultant and laboratory fee will be paid by the contractor. The consultant will certified the results of test Reports " approve /disapproved"

g. The Consultant shall be fully responsible and certify that the executed works are as per approved design, drawings, standard specifications / quality, technically sanctioned estimates and within the provision of contract agreement.

h. The Consultant shall certify under his seal, the contractor's bills / payments, clearly indicating /certification that the quality of work executed at site is in accordance to the specifications, design, drawings, technically sanctioned estimate and contract agreement within the 48 hours of submission of bill to the consultant. The Consultant shall certify the quantity of work executed at site and make recommendations regarding payment to the contractor along with Test Reports.

i. The Consultant is also responsible for encountered site problems during the implementation stage where revised detailing/ design review for a particular location is required due to the encountered site problem including investigation, monitoring of design and drawings etc complete till the approval by the Employer.

j. The Consultant while supervising construction works will make all necessary measurements and control the quality of works and implementation of the works. The Consultant in consultation with the Director Construction WASA, will make all engineering decisions required for the successful and timely implementation of the construction contracts, and have necessary powers.

k. The Consultant's authorized representative and other staff will implement the work contracts and ensure that the Works are constructed in accordance with its provisions. The Consultant will have all the powers defined in the Conditions of Contract as being the supervisor, except the following, which will be retained and exercised by the employer, generally on the advice of the Consultant:

a. Issuing the order to commence the works,

b. Approving variation orders that have financial implications,

c. Approving significant variations in quantities,

d. Approving subletting of any part of the works, and

e. Approving extensions of time

l. Ensure that the construction methods as proposed by the contractor for carrying out the works are satisfactory; the schedule of mitigation measures for adverse environmental impacts to be monitored by the consultant will be provided;

m. Undertake project performance monitoring and evaluation and submit the progress report on weekly & monthly basis to WASA till the completion of project.

n. Regular review of implementation and progress schedules by the contractor and ensuring that the Contractors have incorporated the most effective and expeditious methodology of carrying out the works; and advise the Contractors in setting up a computerized project control system for reporting physical and financial progress as well as the forecasts, if included in the bids and/or if demanded later on by the WASA. Subsequently, closely monitor the construction progress on regular basis to determine whether it is proceeding in accordance with the approved work program.

o. Consultant shall prepare presentations/Reports etc related to the Project as and when required / demanded by Management / EA.

p. Consultant shall be responsible for all arrangements for site visits by Management or any Govt. Representative.

q. Give notice to the Contractors of any defects and deficiencies, and issue instructions for the removal and substitution of the improper works, where provided under the contract. If required, order suspension of the work(s) and/or recommend to WASA other recourse available under the Contract.
r. Advising on the selection of contractor's equipment. Assess minimum construction equipment, plant and machinery requirements, by type and specification, and monitor, keep and regularly update a list of the Contractors' equipment, plant and machinery in order to keep a check on the Contractors' mobilization.

s. Monitor and appraise progress of the works, and maintain a day by day project diary which shall record all events pertaining to the administration of the contract, requests from and orders given to the Contractors, and any other information which may be at a later date be of assistance in resolving queries which may arise concerning execution of the works. The Consultant shall keep the record of daily inspection reports & reports of all tests and will hand over the same to the client on monthly basis.

t. Issue monthly-consolidated progress reports on a format to be agreed with the WASA including payment estimates and comments on the Contractors' work program, and advice WASA of any problems or potential problems which might arise and cause delay in implementation and recommend corrective action(s) to be taken.

u. Assist WASA in contractual matters with the contractor (performance bonds, insurances, claims, advance payment guarantees etc.). Assist with interpretation of the Contract Documents, explain and or reconcile any ambiguities and or discrepancies in the Contract Documents, and apply various provisions of the contract documents; and provide WASA all relevant documentation needed for settling disputes (if any) with the Contractors, and make recommendations to WASA for resolving the Contractors' escalation claims, contract time extensions, variation orders, subletting, quantification of claims, rate and price fixing etc.

v. Consultant will establish independent design and site offices with all facilities like computers printers, copier, generator set and reserve a separate office/room for client staff for close coordination / liaison etc.

w. The consultant shall be responsible to pay the penalties to Employer if they fail to perform the services up to the mark and there are damages or project delayed due to their poor control and command on their part. The liquidated damages shall not be more than 20% of their remunerations.

x. The consultant shall suggest methodology for execution of work on round the Clock basis, if required, for early completion of work. One month prior to the expiry of the Maintenance Period of the work, the consultant shall carry out a Detailed Final Inspection of the work and submit a report to the Client pointing out the defects, if any, in the work.

y. Jointly inspect with WASA the completed all works, and prepare "as built" drawings and plans (as the case may be), and provide report(s) testifying to the satisfactory completion of the contracts.

z. The consultant shall prepare and submit complete set (10 No.) GIS based as built drawings showing disposal stations, Forcemain, , laid sewer lines and other allied structures/ necessary details along with manholes on GIS maps under instant project.
aa. The consultant shall recommend to WASA for issuance of completion certificate stating that the work has been completed as per specifications, drawings, estimates and contract agreement.

bb. The Consultant shall prepare the Revised PC-I if required or any variations / deviations occur in the original scope of work as per site conditions.

cc. The consultant will submit completion report of the Project after completion of work and shall prepare & submit PC-IV to the client in soft and hard form.

dd. Assist WASA for settlement of the Audit Paras and Enquiries (if any) pertain to the Project until one (01) year after completion without any remuneration.

ee. Inspect the completed works periodically during the defect liability period within the term covering the Consultant's Agreement, prepare lists of deficiencies (if any), and carry out supervision of the remedial works, and issue the Defects Liability certificates after the rectification of notified defects by the Contractors.

ff. Establish a comprehensive system of maintaining site records including site correspondence, survey data, inspection records, test data, site diaries, records of meetings, financial records, progress records etc.

gg. Consultant shall prepare still photographs of work progress and movie as per international standard of all the activity on the project from the date of start to the end, attached with progress reports and hand over three copies of the same at the time of completion to the client.

hh. The supervision consultant will provide any of the following services: (i) prepare reports, Presentation on Power Point, i/c technical appraisals, additional contract documentation, and/or review and comment on the contractor's proposals, as may be required for the successful completion of the Project; and (ii) provide any other specialist services as may be required from time to time.(iii) The consultant will brief the project to the high ups during inspection of project and give the presentation of project on multimedia as and when required for high administration / political leadership.

ii. The employer will authorize all additional services, other than minor extras that do not materially affect the scope of the supervision work, at the rates established in the supervision contract, or at rates mutually agreed upon when the services require the use of specialists not listed in the contract. The consultant shall carry out such services as additional services.

jj. The interpretation made by the Employer on any clause of the TOR / contract will be final.

Part (III):Supervision of Supply, Installation, Commissioning of Pumps

The Consultant will assist WASA in the supply and installation of all the equipment, machineries, accessories etc. required for Disposal Station by

a. Consultant will depute Mechanical and Electrical expert for supervision of installation of Equipment & Machinery and submit comprehensive performance report after carrying out equipment inspection at manufacturing site along with client. He shall also provide operational Manual to client.

b. Assure that all materials and goods are new and as per standard & specification of Contract. All the equipment is supplied by following the relevant Standards/ Guidelines and conforms to the prevailing National Standards of the manufacturing country.

c. Ensuring the quality of supplied pumps equipment, machinery and accessories are according to required specifications

d. All the equipmentare installed in accordance with the Standards and codes of practice / in accordance with the standards prescribed by the manufacturer or any other standards required for the installation.

e. Certify that test run and commissioning of Pumping Machinery is satisfactory and goals are achieved.

Part IV:Management of Project

(i) Work with WASA- Lahore in planning, implementing, managing and monitoring all project activities; take a proactive role in advising the Director Construction on all project-related issues, including policy issues, grant covenants and special conditions.

(ii) Establish a Project Performance Management System (PPMS)

(iii) Develop Computerized Subprojects Monitoring System and Contract Ledger including work plans for construction stage of all subprojects; monitor and analyze regularly the physical and financial progress; recommend ways to accelerate project implementation; assess reasons for delay and identify measures for improvement.

(iv) Assist WASA Lahore with the implementation of PPMS developed and agreed including a benchmark survey and subsequent monitoring and evaluation surveys.

(v) Continuously monitor progress of the project as per PPMS and prepare regular progress reports identified in the PPMS and based on the progress reports, take appropriate corrective action.

Annex XIII

Social Survey Questionnaire

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF LAYING OF SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

SOCIOECONOMIC SURVEY

Interview Schedule

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1. Name of Interviewer _____ Date _____
2. Location / Home Town _____
3. Name of the Respondent _____ Contact Number _____

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4. Gender

   1. Male 2. Female

5. Age _____
6. Education Level _____
7. Profession _____
8. Marital Status

   1. Married 2. Un-married

9. Language Spoken _____
10. Caste / Ethnic Group _____
11. Religion _____
12. Total number of family members living with you?

    Number _____

13. What are your normal working hours? (In case of shopkeeper/ office worker)

    Hour's _____

14. What are the major sources of your household income?

    1. _____ 2. _____ 3. _____

15. What is your average monthly income?

    Income (Rs.) _____

16. Status of ownership (In case of shop keeper/business owner/ resident)?

    1. Owner 2. Renter

17. What is type of construction of your house (In case of resident)?

    1. Pacca _____ 2. Semi Pacca _____ 3. Katcha _____

18. Since how long are you living in this area?

    Period _____

19. What are the sources of household water being used in the project area?

1. Tap/Govt supply _____ 2. Bore hole _____

3. Any other _____

20. Are you satisfied with the water quality?

1. Yes _____ 2. No _____

If no, then what are the reasons of dissatisfaction?

_____

_____

21. What is the source of energy for cooking and lightening in this area?

1. _____ 2. _____ 3. _____

22. Is there any educational institute in this area?

1. Yes 2. No

If yes, then
Name_____ Place_____

23. Is there any health facility availability in this area?

1. Yes 2. No

If yes, then
Name_____ Place_____

24. What are the major diseases common in project area?

1. _____ 2. _____ 3. _____ 4. _____

25. What is the principle mode of transport being used by you (respondent) in this area?

Mode of transport _____

_____

_____

26. Is there any shrine/mosque in this area?

1. Yes 2. No

If yes, then
Name_____ Place_____

27. Is there any archaeological/historical site in this area?

1. Yes 2. No

If yes, then
Name _____Place _____

Significance _____
_____
_____

28. Specify the existing Non -Government Organizations (NGOs) in your area and state their area of work?

Name of Organization _____ Area of interest _____
_____ _____
_____ _____

29. From which locality do you come here for your business/ job ?(Ask this question from shop keepers & employees only)

1. Name of place _____ 2. Distance _____

30. Why do you prefer this locality for residence, business, taxi, job etc.?

Reasons of preference _____
_____
_____

31. Is your house connected with sewerage system?

1. Yes 2. No

32. Are you satisfied with current sewerage drain in this area?

1. Yes 2. No

If no, then reasons _____
_____
_____

33. Do you know that Laying of Sewerage System from Larech Colony to Gulshan-e-Ravi is being constructed?

1. Yes 2. No

(If not, then tell him about the proposed Project)

34. In your opinion should this project be implemented here?

1. Yes 2. No

If yes, then reasons if no, then reasons
_____ _____
_____ _____
_____ _____

35. In your opinion, what would be the possible impacts of this project?

During construction _____

_____

_____

During operation _____

_____

_____

36. What protective measures do you suggest during construction to safeguard your interests?

Protective measures _____

_____

_____

37. In your opinion, what are some of the pressing needs of this area?

Pressing Needs _____

_____

_____

38. Any indigenous community living in project area?

1. Yes 2. No

Impact on Indigenous People_____

_____

_____

39. Status of Indigenous People?

1. Registered 2. Non-Registered

40. Income sources.

_____

_____

_____

41. Ancestral site/ Building/ Structure?

_____

_____

_____

42. History

_____

_____

_____