ANNEXURES

LIST OF ANNEXURES

ANNEXURE I: CATCHMENT AREAS ALONG PROPOSED ALTERNATE ROUTE

ANNEXURE II: GLOBAL WARMING POTENTIAL (GWP) IMPACTS

ANNEXURE III: PROCUREMENT PLAN

ANNEXURE IV: CONSTRUCTION WASTE MANAGEMENT PLAN

ANNEXURE V: SANITATION PLAN

ANNEXURE VI: TRAFFIC MANAGEMENT PLAN

ANNEXURE VII: RESOURCE CONSERVATION PLAN

ANNEXURE VIII: TREE PLANTATION PLAN

ANNEXURE IX: CHANCE FIND PROCEDURE

ANNEXURE X: CONSTRUCTION HEALTH AND SAFETY CHECKLIST

ANNEXURE XI: EMERGENCY RESPONSE PLAN

ANNEXURE XII: COST BREAKUP OF HEALTH AND SAFETY OF WORKERS

ANNEXURE XIII: NOC FROM EPA PUNJAB

ANNEXURE XIV: PICTORIAL EVIDENCE

ANNEXURE XV: CONSTRUCTION METHODOLOGY

ANNEXURE XVI: GEOTECHNICAL & SOIL INVESTIGATION REPORT

ANNEXURE XVII: ENVIRONMENTAL MONITORING REPORTS

ANNEXURE XVIII: AREA OF INFLUENCE (AOI) MAPS

ANNEXURE XIX: NEW ALIGNMENT

ANNEXURE XX: CROSS-SECTIONS OF OUTFALL DRAINS

ANNEXURE XXI: SENSITIVE RECEPTORS MAPS

ANNEXURE XXII: LIST OF PITS & SENSITIVE RECEPTORS TABLE

ANNEXURE XXIII: PITS DESIGN

ANNEXURE XXIV: LABOR MANAGEMENT PLAN

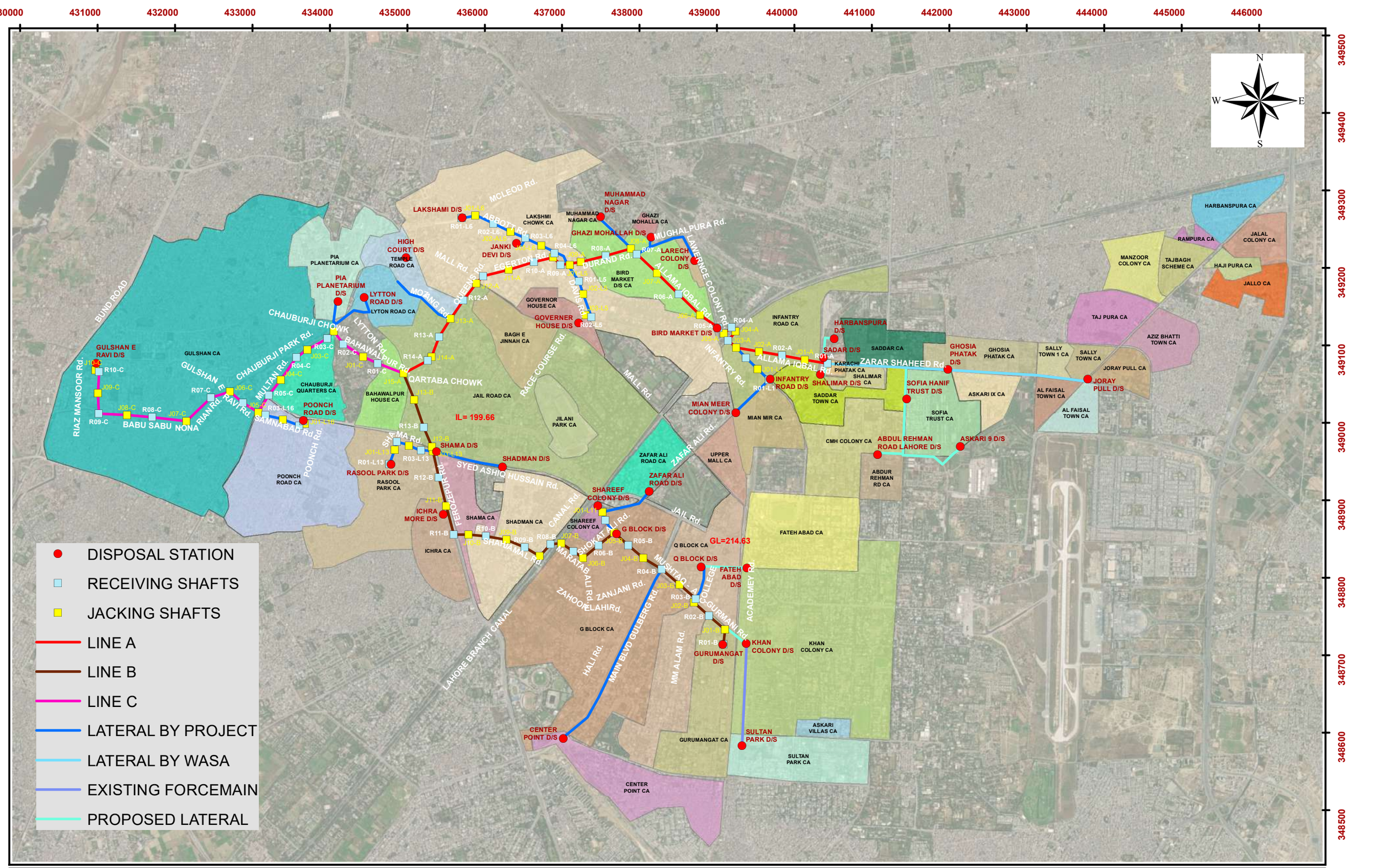
ANNEXURE XXV: PUBLIC CONSULTATION SURVEY INSTRUMENT

ANNEXURE XXVI: EXTENSION IN EPA NOC/APPROVAL

ANNEXURE XXVII: PV SOLAR SYSTEM SPECIFICATIONS

ANNEXURE I

Catchment Areas along proposed Alternate Route



04			DRAWN			
03			CHECKED BY			
02			RECOMMENDED			
01			CHD./VER.			
REV.	DATE	DESCRIPTION	APPROVED			

EBA ENGINEERING · ECSP · CCC · team consultants — A Joint Venture

WASA LAHORE

WATER AND SANITATION AGENCY, LAHORE

SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

CATCHMENTS AREA

DATE :- JUNE 2024

SCALE 1:50,000

REV:-

ANNEXURE II

GLOBAL WARMING POTENTIAL IMPACTS

COMPARISON OF POWER CONSUMPTION & CO2 EMISSIONS B/W EXISTING AND PROPOSED SEWERAGE SYSTEM FOR 25 YEARS (2025-2050)					
DESCRIPTIONS	**UNIT**	**EXISTING SYSTEM**	**PROPOSED SYSTEM**	**REDUCTION**	**%AGE REDUCTION**
POWER CONSUMPTION	KWh	426,762,243	329,468,783	97,293,460	23%
FUEL CONSUMPTION FROM GENSETS	Gal	3,116,094	0	3,116,094	100%
CO2 EMISSIONS TOTAL	Kg	196,452,067	127,174,950	69,277,117	35%
POWER PRODUCTION	KWh	0	15,519,592	15,519,592	100%
CO2 SAVING	Kg	0	7,992,590	7,992,590	100%
***TONS OF CO2/ CARBON CREDIT**	Tons/Credits	196,452.07	119,182.36	**77,269.707**	**39%**

***1 Ton of CO2 = 1 Carbon Credit**

ANNEXURE III

Procurement Plan

PROCUREMENT PLAN - LAHORE WATER AND WASTEWATER MANAGEMENT PROJECT (P000074)																				
Specific Procurement Arrangements											**Scheduled Dates**		**Contract Award Details**						**Contract Implementation Status**	**Remarks**
S/ No	**Contract No.**	**Implementing Agency**	**Description of Contract**	**Cost Estimate in Local Currency [PKR M]**	**Cost Estimate [USD M]**	**Funding Source by AIIB (%)**	**Funding Source by Others (%)**	**Procurement Category**	**Procurement Method**	**Review by Bank (Prior or Post)**	**Tender Invitation (MM/YY) (Tentative)**	**Contract Signing (MM/YY) (Tentative)**	**Contract Price [PKR M]**	**Contract Price Equivalence [USD M]**	**Contractor's Name**	**Country of Origin**	**Contract Signing Date**	**Contract Period (Months)**		**(such as Advance Contracting)**
Component 1: Investment in safe water supply infrastructure																				
1	0074-PAK-01	Project Management Unit (PMU) of PID	Construction of New Ravi Syphon, Head Regulator and Escape Channel Structure & Raw Water Intake at BRBD Canal (Irrigation Department)	9940.73	35.73	100%	-	Works	IOCT (single stage-two envelope, AIIB/World Bank/ADB's SBD for Procurement of works)	Prior	Mar-25	Jul-25	TBD	TBD	TBD	-	-	36		Advance Procurement
2	0074-PAK-02	Project Management Unit (PMU) of LWASA	Construction of Surface Water Treatment Plant & Transmission mains and Distribution network	27274.94	98.02	100%	–	Works	(Pre-Qualification in Sep 2024) IOCT (single stage-two envelope, AIIB/World Bank/ADB's SBD for Procurement of works)	Prior	Feb-25	Jun-25	TBD	TBD	TBD	-	-	36		Advance Procurement
Component 2: Investment for wastewater management																				
3	0074-PAK-03	Project Management Unit (PMU) of LWASA	Laying of Sewer line from Larech Colony & Gurumangat Road to Gulshan-e-Ravi (Through Trenchless Technology)	30752.79	110.52	100%	-	Works	IOCT (single stage-two envelope, AIIB/World Bank/ADB's SBD for Procurement of works)	Prior	Dec-24	Apr-25	TBD	TBD	TBD	-	-	30		Advance Procurement
4	0074-PAK-04	Project Management Unit (PMU) of LWASA	Construction of Ultimate Disposal Station at Gulshan-e-Ravi and Allied Works	9065.66	32.58	100%	-	Works	IOCT (single stage-two envelope, AIIB/World Bank/ADB's SBD for Procurement of works)	Prior	Dec-24	Apr-25	TBD	TBD	TBD	-	-	30		Advance Procurement
Component 3: Project management																				
5	0074-PAK-05	Project Management Unit (PMU) of LWASA	Project Management and Supervision Consultant (Water Supply Component), WASA	1166.00	4.19	100%	-	Cosultancy Services	IOCS (QCBS)	Prior	Oct-21	Jan-23	716.31	3.37	JV of DAR Al-Handasah (Shair & Partners) S.A.L JV with ASIAN Consulting Engineers (Pvt) Ltd.	Lebanon & Pakistan	31/01/2023	70		Advance Procurement
6	0074-PAK-06	Project Management Unit (PMU) of LWASA	Project Management and Supervision Consultant (Sewerage System), WASA	1274.38	4.58	100%	-	Cosultancy Services	IOCS (QCBS)	Prior	Oct-21	Apr-22	829.01	3.85	JV of EBA Engineering Inc. USA / ECSP (Pvt) Ltd. / EEC Global (Pvt) Ltd. TEAM (Pvt) Ltd.	USA & Pakistan	25/04/2022	44		Advance Procurement
7	0074-PAK-07	Project Management Unit (PMU) of PID	Detailed Design & Resident Supervision Consultant for Punjab Irrigation Department	497.04	1.79	100%	-	Cosultancy Services	NCT (QCBS)	Prior	Mar-25	Jul-25	TBD	TBD	TBD	-	-	36		
			TOTAL	**79971.53**	**287.41**															

ANNEXURE IV
CONSTRUCTION WASTE MANAGEMENT PLAN

CONSTRUCTION WASTE MANAGEMENT PLAN FOR LAYING OF TRUNK SEWER FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

1. GENERAL INTRODUCTION

Construction work refers to a wide range of materials depending on their origin; they are categorized as excavation material, demolition materials and worksite waste material. Construction waste material of the proposed project consists mainly of concrete, bentonite, masonry, limestone, sandstone, metal, and wood. In addition to this, significant amount of municipal waste will also generates from the construction camps. The solid waste generation estimated to be 450 kilogram per day for 750 construction workers during construction phase of the proposed project.

2. ORIGINS AND CAUSES OF CONSTRUCTION WASTE

Origins of Waste	Causes of Waste
Contractual	▪ Errors in contract documents; and ▪ Contract documents incomplete at commencement of construction.
Design	▪ Design changes; ▪ Design and detailing complexity; ▪ Design and construction detail errors; ▪ Unclear and unsuitable specifications; and ▪ Poor coordination and communication (late information, last minute client requirements, slow drawing revision and distribution).
Procurement	▪ Ordering errors (i.e. ordering items not in compliance with specification); ▪ Over allowances (i.e. difficulties to order small quantities); and ▪ Supplier errors.
Transportation	▪ Damage during transportation; ▪ Difficulties for delivery vehicles accessing construction sites; ▪ Insufficient protection during unloading; and ▪ Inefficient methods of unloading
On-Site Management and Planning	▪ Lack of on-site waste management plans; ▪ Improper planning for required quantities; ▪ Delays in passing information on types and sizes of materials and components to be used; ▪ Lack of on-site material control; and ▪ Lack of supervision.
Material Storage	▪ Inappropriate site storage space leading to damage or deterioration; ▪ Improper storing methods; and ▪ Materials stored far away from point of application.
Material Handling	▪ Materials supplied in loose form;

Origins of Waste	Causes of Waste
	▪ On-site transportation methods from storage to the point of application; and ▪ Inadequate material handling.
Site Operation	▪ Accidents due to negligence; ▪ Unused materials and products; ▪ Equipment malfunction; ▪ Poor craftsmanship; ▪ Use of wrong materials resulting in their disposal; ▪ Time pressure; and ▪ Poor work ethics.
Residual	▪ Waste from application processes (i.e. over preparation of mortar); ▪ Off-cuts from cutting materials to length; ▪ Waste from cutting uneconomical shapes; and ▪ Packaging.
Other	▪ Weather ▪ Vandalism ▪ Theft

3. CONSTRUCTION WASTE MANAGEMENT PLAN

i) Waste Management Goals

The contractor established goal that this project will generate at least 50 percent less waste into landfills and the processes shall be employed to ensure that this goal is met. These shall include prevention of damage to materials to be incorporated into the work due to mishandling, improper storage, contamination, inadequate protection, minimizing poor quantity estimation, and through design.

ii) Responsibility

a) The Contractor shall be responsible for the implementation of the administrative portions of this program, including the notification of subcontractor management, the training of the site supervisor and the onsite posting of this plan.

b) The site supervisor shall be responsible for the implementation of the onsite portions of this program including the training of subcontractor personnel.

iii) Waste Prevention Planning

a) In addition to other requirements specified herein it is a requirement for the work of this project that the contractor comply with the applicable city waste disposal requirements.

b) Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for reuse and or recycling where practical and possible. Waste disposal in landfills shall be minimized as much as possible.

c) Project Construction Documents: The contractor will contractually require all subcontractors to comply with the Construction Waste Management Plan (WMP). A copy of the WMP will accompany all subcontractor agreements and require subcontractor participation.
d) The "Construction Waste Management Plan" shall be implemented and executed as follows:
   i. Salvageable materials will be diverted from disposal where feasible;
   ii. There will be designated area on the construction site reserved for materials that can be recycled;
   iii. Areas shall be marked to designate what recycle materials are to be stored there; and
   iv. Hazardous waste shall be managed by a licensed hazardous waste vendor.

iv) Communication and Education Plan

a) This Waste Management Plan will be posted onsite;
b) Each subcontractor will be made aware of the intent of this project with respect to reduction of waste and recycling. Onsite recycling containers and/or areas will be plainly marked;
c) The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan;
d) All recycling containers and areas will be clearly marked;
e) Lists of acceptable and unacceptable materials will be posted at the site; and
f) All subcontractors will be informed in writing of the importance of non-contamination with other materials or trash.

v) Motivation Plan

The contractor will conduct a pre-award meeting for subcontractors. Subcontractors under consideration will be required to attend the meeting to review project goals and requirements with the project team. Attendance will be prerequisite for award of subcontracts. This document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the job site.

vi) Waste Disposal Company

Lahore Waste Management Company (LWMC)
Adress: 4th Floor, Shaheen Complex, Egerton Road, Lahore
Telephone No: +92 42 99205153-155
Fax No: +92 42 99205156
Help Line: 1139
Email: info@lwmc.com.pk

vi) Recycle Hauler

g) To be determined;
h) Contact address; and
i) Some or all recycle maybe hauled by the authorized representative.

vi) Possible Recycle Locations and Acceptable Materials

a) Coordinate with companies in Lahore or which are registered with LWMC that accept materials for recycle; and
b) Using the above as a resource, a list will be kept indicating local opportunities of expected materials. New locations should be added as needed.

ANNEXURE V
SANITATION PLAN

SANITATION PLAN FOR LAYING OF TRUNK SEWER FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

1. INTRODUCTION

This plan outlines the measures that can improve conditions at construction sites during construction and operation phase.

2. PURPOSE OF THE PLAN

The plan intends to ensure sanitation including the control of water supplies, excrete and wastewater disposal, refuse disposal, vectors of diseases, housing conditions, food supplies and handling, atmospheric conditions and ensure safe working environment for workers.

3. MANAGEMENT OF SANITATION DURING CONSTRUCTION PHASE

i. Responsibility

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

ii. Location of Camp Sites

The construction camps will be located at least 300-500 meters away from residential community. The accommodation and ancillary facilities for labor will be constructed and maintained to standards and scales approved by the Resident Engineer.

The camps will be located such that the drainage from and through the camps will not endanger aby domestic or public water supply.

All sites will be managed to avoid ditches and depressions to minimize nuisance due to stagnant water.

iii. Water Supply

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

Potable water supply systems for labor camps occupants will meet the drinking water quality standards of PEQS, 2016. In addition, the design of water system facilities will be based on the suppliers Engineer's estimates of water demands. The drinking water will be monitored regularly for drinking water quality parameters.

At all construction camps and other workplaces, good and sufficient water supply will be provided and maintained to eliminate chances of waterborne diseases to ensure health and hygiene of workers.

iv. Toilet Facilities and Hygiene

According to Health and Safety guidelines OR-OSHA, number of toilets required at construction site is as one toilet for twenty workers. Table 1 shows the number of toilets required in accordance

with the number of employees at construction site. The total number of employees at construction site are estimated to be 750 workers.

No. of Employees	No. of Toilets and Urinals by OSHA	Total No. of Toilets and Urinals required at Construction Site
Up to 20 Employees	1 Toilet	50 Toilets
Up to 40 Employees	1 Urinal	25 Urinals

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

Toilet facilities adequate for the capacity of the camp will be provided. Each toilet room will be located, so as to be accessible.

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

These toilets will be distinctly marked by signs printed in native language of the persons occupying the camp, or marked with easily understood pictures or symbols.

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

Proper facility for hand washing and other cleaning activities will be provided as follows:

- 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 will be designed, built and operated in compliance with the relevant legislation so that no health hazard occurs and no pollution to the air, ground or adjacent watercourse takes place.

Garbage bins will be provided in the camps and regularly emptied and the garbage disposed of in hygienic manner.

Unless otherwise arranged for the local sanitary authority, arrangement for disposal of excreta will be done in the already existing sewerage system in the area.

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

vi. Maintenance of Sanitary Facility

Proper maintenance of toilets and other sanitary facilities will be ensured by Health and Safey Inspector. Toilets and other sanitary facilities will be cleaned at least four times a day and at least twice during working hours and kept in a strict sanitary condition. Receptacles will be tarred inside and outside at once a year.

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

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

4. MANAGEMENT OF SANITATION DURING OPERATIONAL PHASE

A proper sanitation plan will be adopted for maintaining the hygienic conditions during the operational phase of the project. It will include:

- Site clearance;
- Sewage and Storm Water Drainage clearance; and
- Solid Waste Management

i. Site Clearance

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

ii. Storm Water Drainage Clearance

Construction material pose risk of clogging in drainage and sewer pipelines. Oil spillage from vehicles and throwing of solid waste by road users due to lack of bins into nearby drainage and sewer pipes are other threats. In case of storm water drains and pipelines clogging, the concerned department i.e. LWASA is responsible for un-clogging of these sewer and pipelines,

iii. Solid Waste Management

Municipal solid waste produced as a result of commercial activities, by road users and from nearby residential community will be collected and handled properly by the concerned department. Waste bins will be deployed along roads, regular cleaning of the roads will be ensured twice a day by at least one deputed sweeper.

iv. Training and Awareness

Training and awareness sessions will be organized for workers before commencement of project. The implementation of sanitation plan will be more effective if the importance of hygiene, sanitation and safety are known to the workers.

ANNEXURE VI
TRAFFIC MANAGEMENT PLAN

WATER AND SANITATION AGENCY LAHORE (LWASA)

LAHORE DEVELOPMENT AUTHORITY (LDA)

SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI IN LAHORE CITY (THROUGH TRENCHLESS TECHNOLOGY)

Traffic Management Plan

December 2024

1 INTRODUCTION

The Project is expected to pass through major roads with relatively high volumes of traffic. It is therefore important to ensure that traffic is managed in a manner that facilitates flow of traffic along with ensuring the safety of the road users. The vehicular traffic not only requires management on site itself, but also need a major traffic diversion plan as the project involves huge construction activities.

2 OBJECTIVE

The purpose of the Plan is to ensure that traffic is managed in a safe and efficient manner. As such, the management of traffic in terms of this plan is intended to avoid and minimize traffic risks to and impacts on the health and safety of the road users, under both routine and non-routine circumstances. This Plan shall apply during the construction phase of the Project.

3 TRUNK SEWER LINES

The project has been divided in three Lines as given by:

- Line-A (Allama Iqbal Road to Ferozepur Road near Qartaba Chowk)
- Line-B (Gulberg Q Block link Road to Ferozepur Road near Qartaba Chowk)
- Line-C (Bahawalpur Road near Qartaba Chowk to Main Boulevard Gulshan-E Ravi)

Trenchless sewer will be laid on each line. Tunnel Boring machine will pass through these roads and shafts will be made on these roads throughout the length of trunk sewer. The details of these roads are as follows:

Road Name	Available ROW (m)	Road Category	Pipe Dimensions (m)	Jack Shaft Dimensions (m)
Line-A				
Allama Iqbal Road	25-30	Dual Carriageway	1.8	8.25 x 8.25
Canal Road	50	Dual Carriageway	2.4	9.75 x 10.50
Durand Road (Before Durand Road and Queen Marry Road intersection)	15	Single Carriageway	2.4	9.75 x 10.50
Durand Road	18	Dual Carriageway	2.4	9.75 x 10.50
Devis Road	15	Single Carriageway	2.4	9.75 x 10.50
Egerton Road	30	Dual Carriageway	2.4	9.75 x 10.50
Egerton Road (After Al-Hamra Hall intersection)	12-25	Single Carriageway	2.4	9.75 x 10.50
Queens Road	20	Dual Carriageway	2.4	9.75 x 10.50
Ferozpur Road	50	Dual Carriageway	3.5	9.75 x 10.50

Line-B				
Q-block Link Road	9	Single Carriageway	1.5	8.25 x 6.75
Mushtaq Ahmed Gurmani Road	12	Single Carriageway	1.5	8.25 x 6.75
Ayesha Sadiqa Road	9	Single Carriageway	1.8	8.25 x 8.25
Nailla Shaheed Road	25	Dual Carriageway	1.8	8.25 x 8.25
Syed Ashiq Hussain Road	18	Dual Carriageway	2.4	9.75 x 10.50
Ferozpur Road	35	Dual Carriageway	2.4	9.75 x 10.50
Line-C				
Bahawalpur Road	13	Single Carriageway	3.5	9.75 x 10.50
Chauburji Park Road	10	Single Carriageway	3.5	9.75 x 10.50
Main Boulevard Gulshan-e-Ravi	30	Dual Carriageway	3.5	9.75 x 10.50

4 PROPOSED TRAFFIC PLAN DURING CONSTRUCTION

Traffic management plan has been prepared for three lines based on the available Right of Way (ROW), traffic conditions and dimensions of shafts.

4.1 LINE-A

The traffic circulations on roads of Line-A are presented in the following figures. The alternate route provided for the traffic on the road is marked by yellow color. One carriageway of the dual-carriageway roads will be open for construction while other will be used for traffic circulation. Traffic flow on the following roads will be affected in the Line-A:

- Abbott Road
- Allama Iqbal Road 1
- Allama Iqbal Road 2
- Allama Iqbal Road Lateral
- Canal and Allama Iqbal Road
- Davis Road
- Durand Road
- Egerton Road
- Infantry Road
- Mughalpura Road
- Queens Road
- Shimla Hill Road

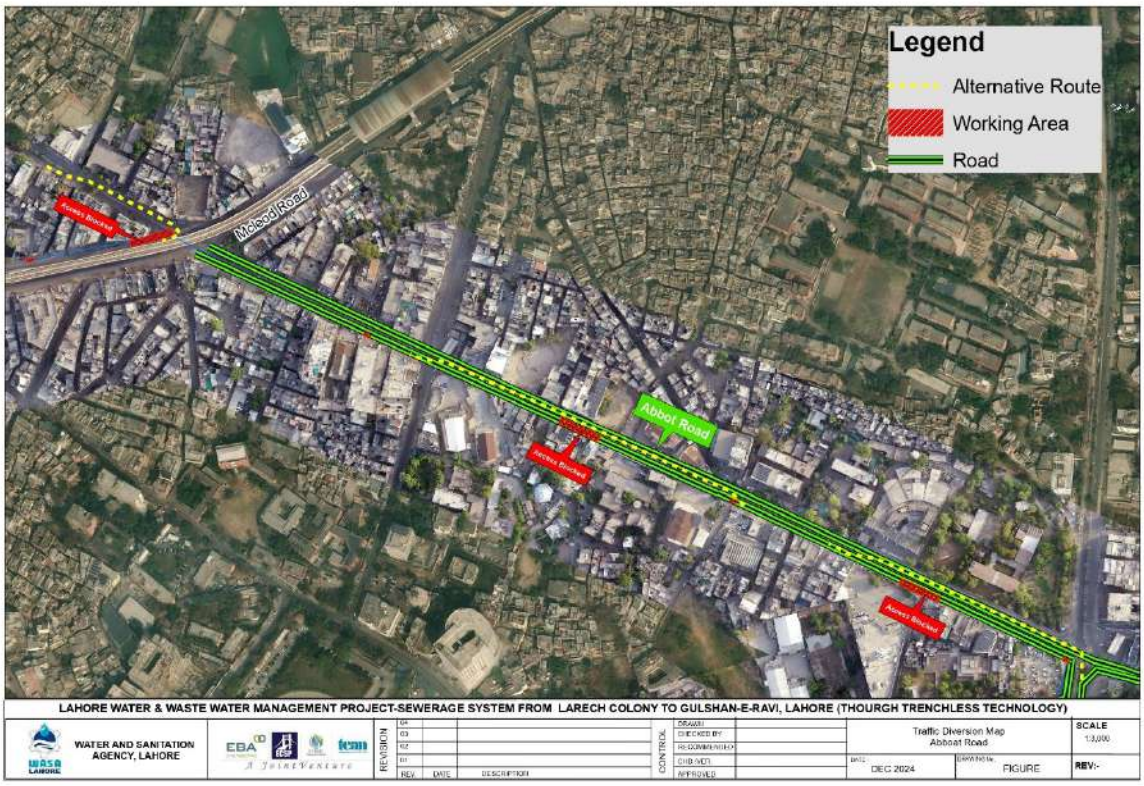


Figure 1: Abbott Road

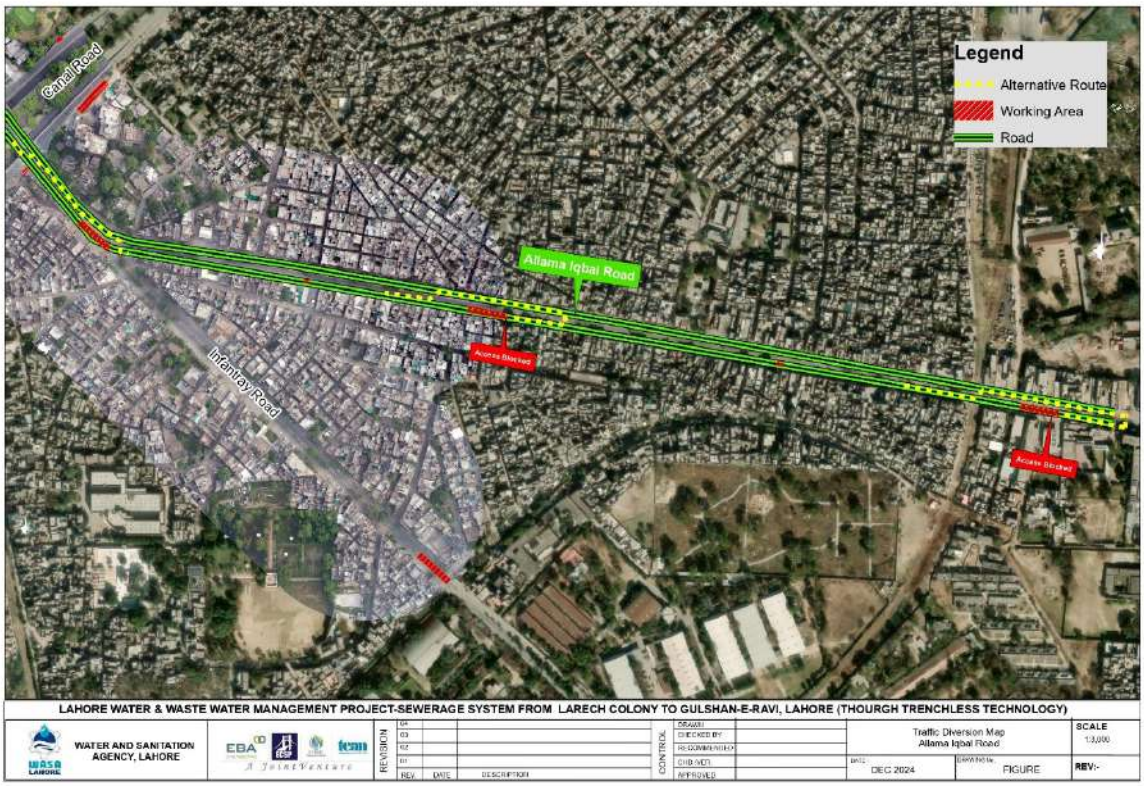


Figure 2: Allama Iqbal Road 1

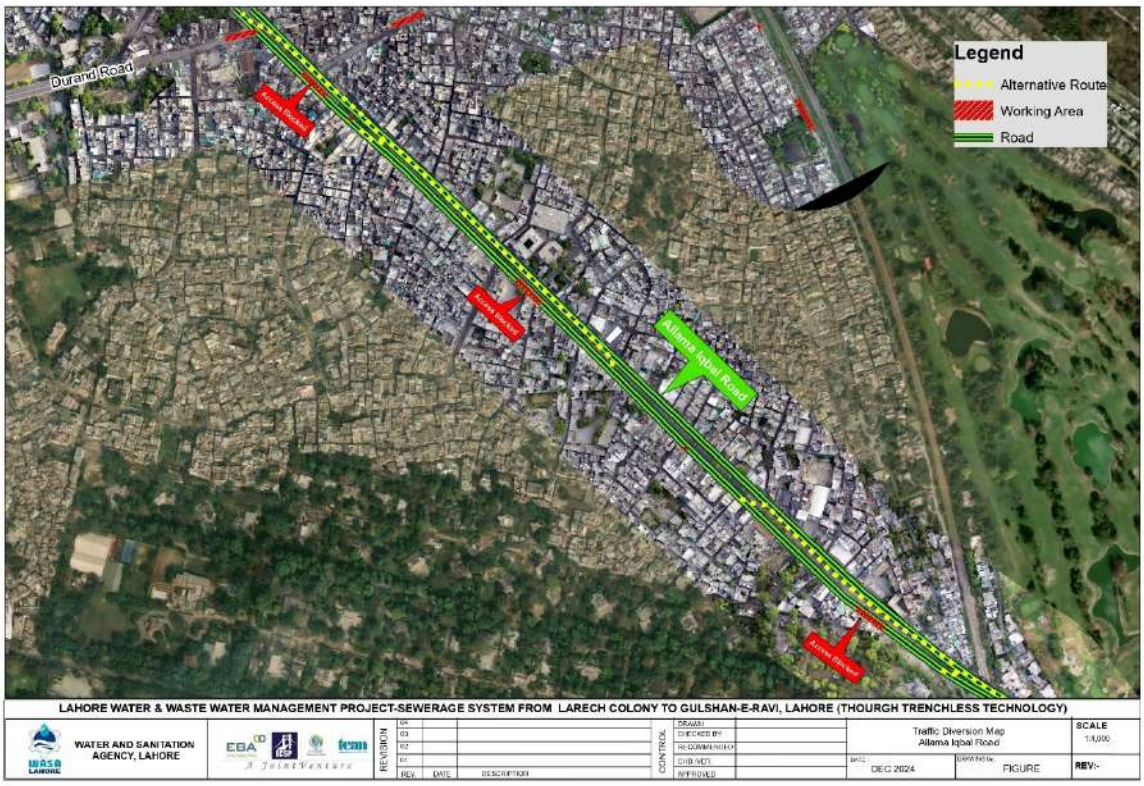


Figure 3: Allama Iqbal Road 2

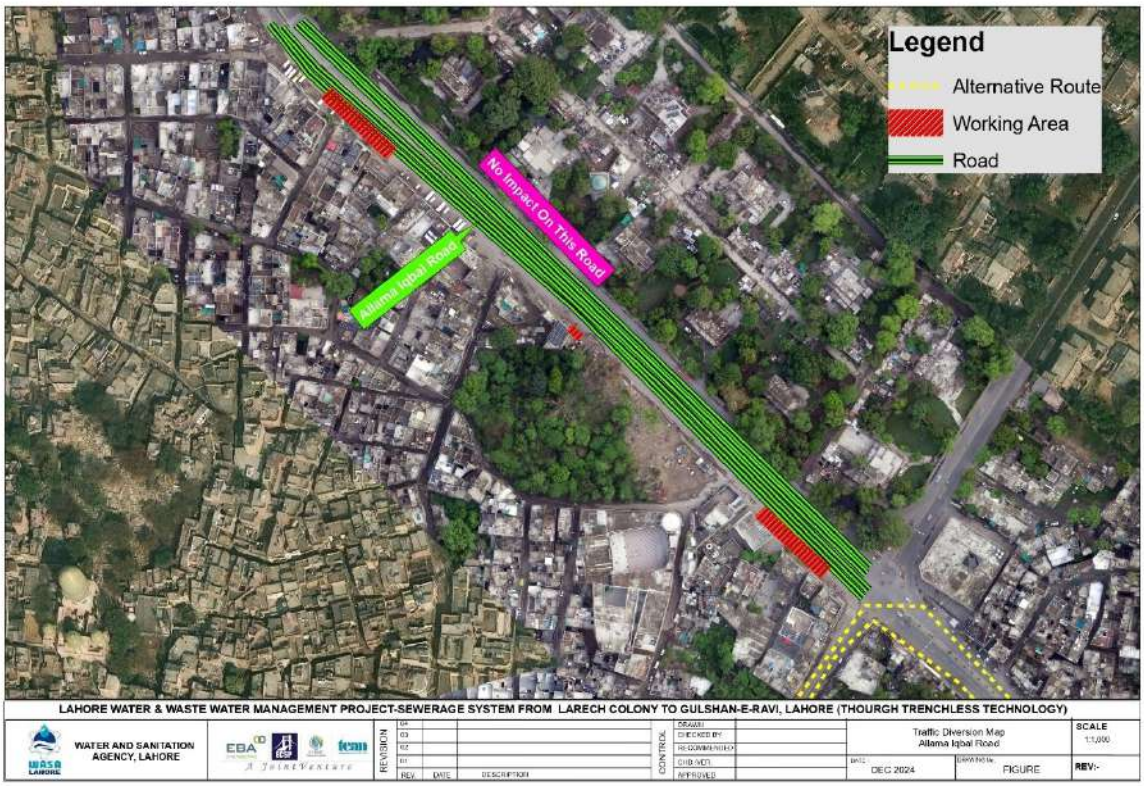


Figure 4: Allama Iqbal Road Lateral

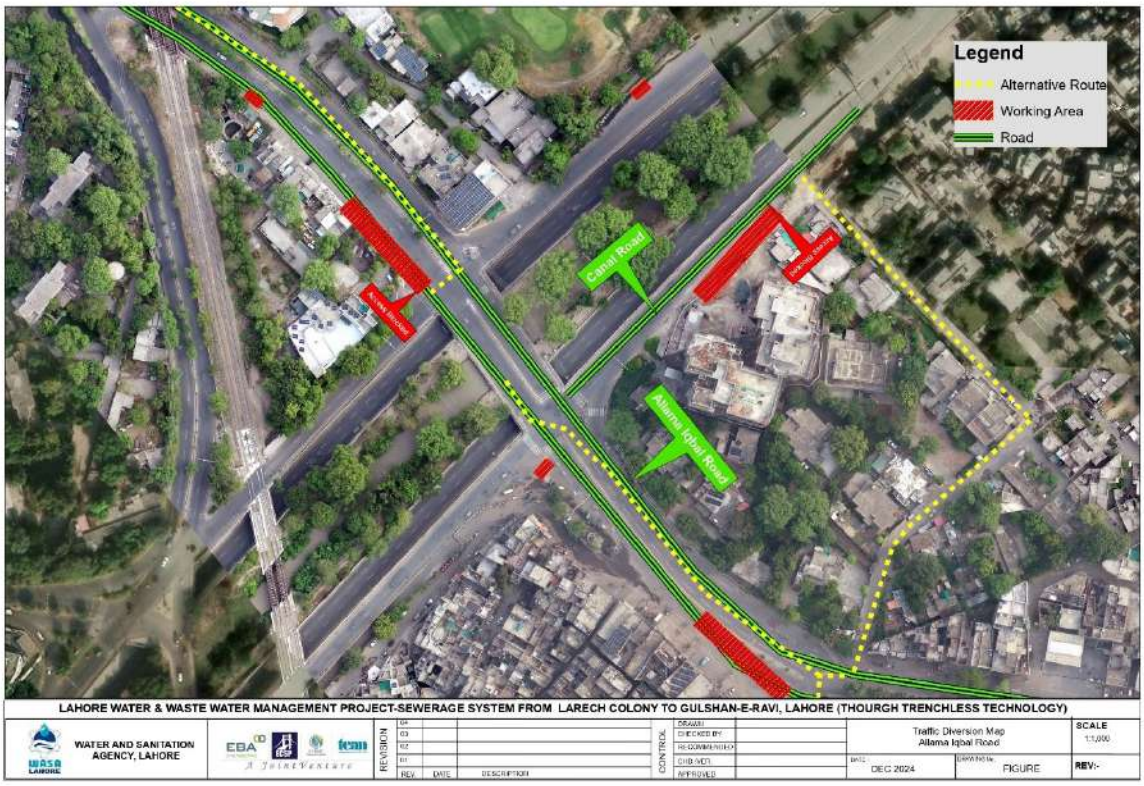


Figure 5: Canal and Allama Iqbal Road

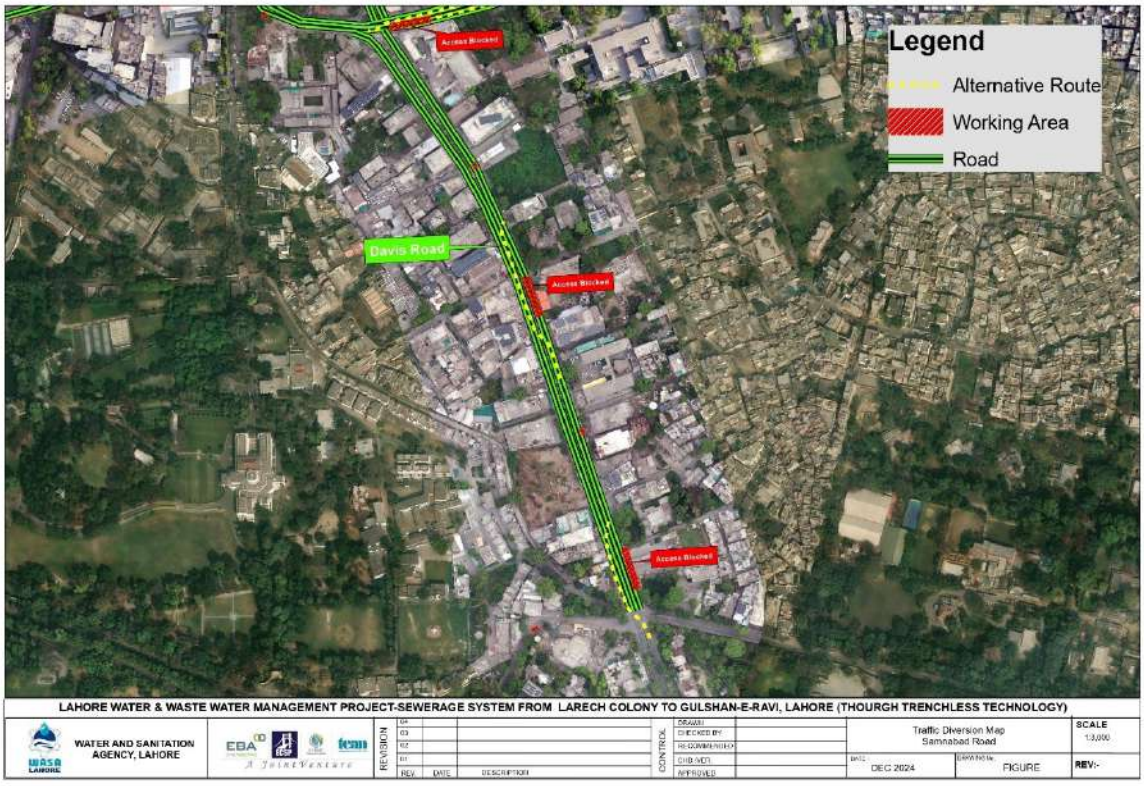


Figure 6: Davis Road

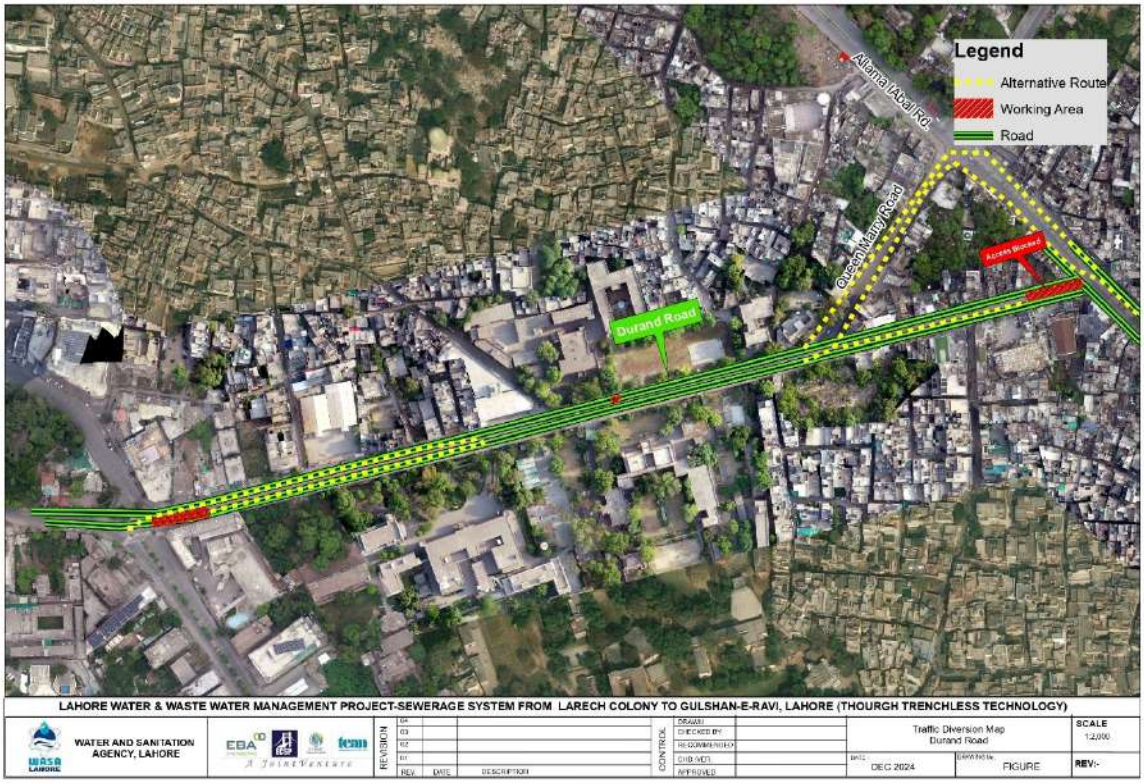


Figure 7: Durand Road

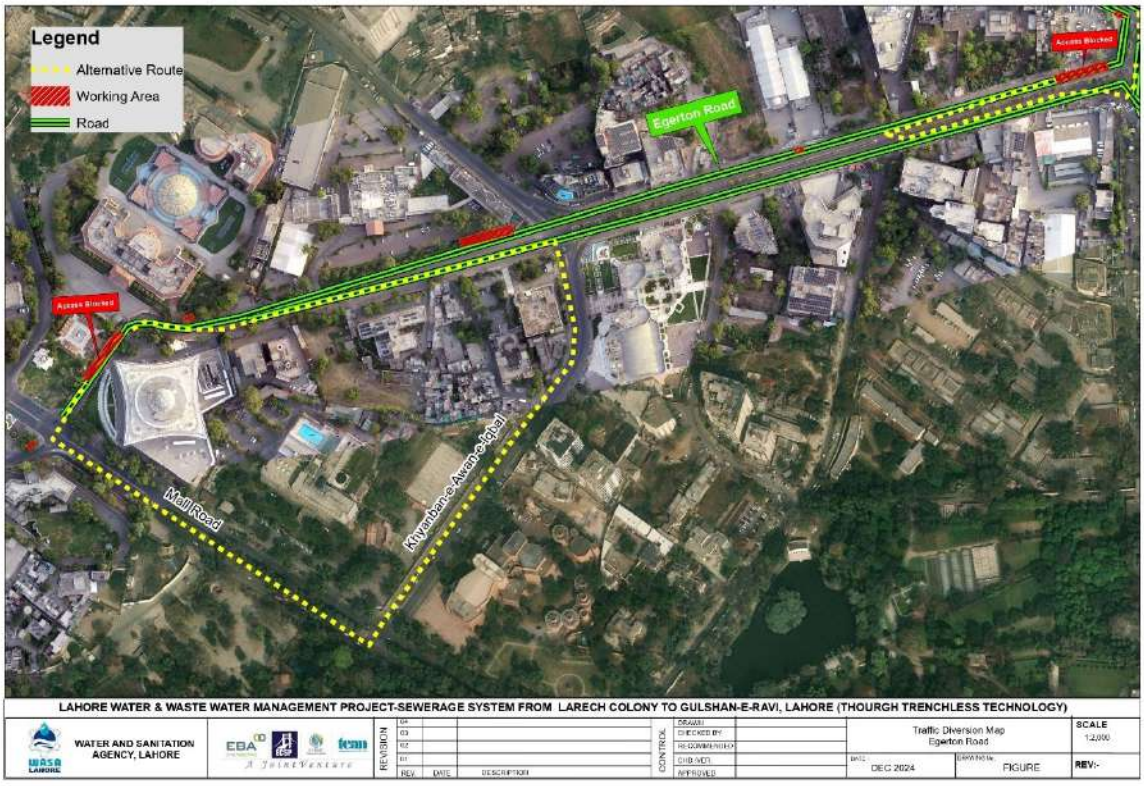


Figure 8: Egerton Road

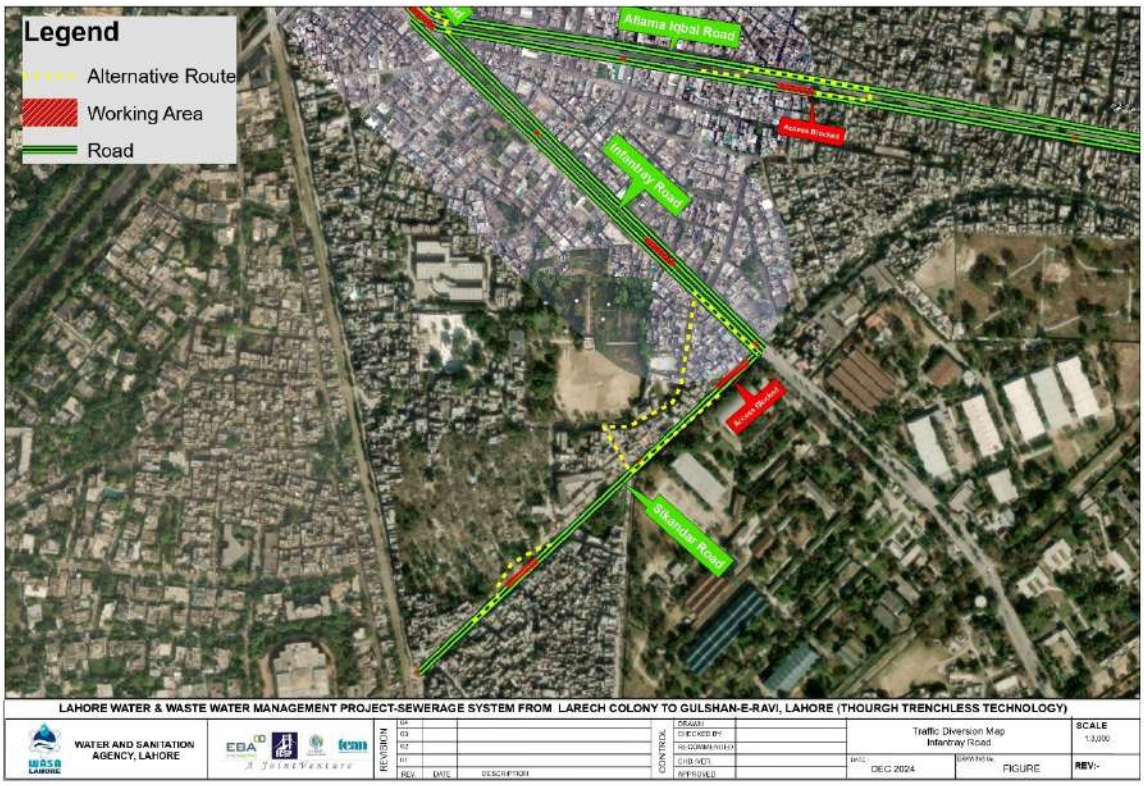


Figure 9: Infantry Road

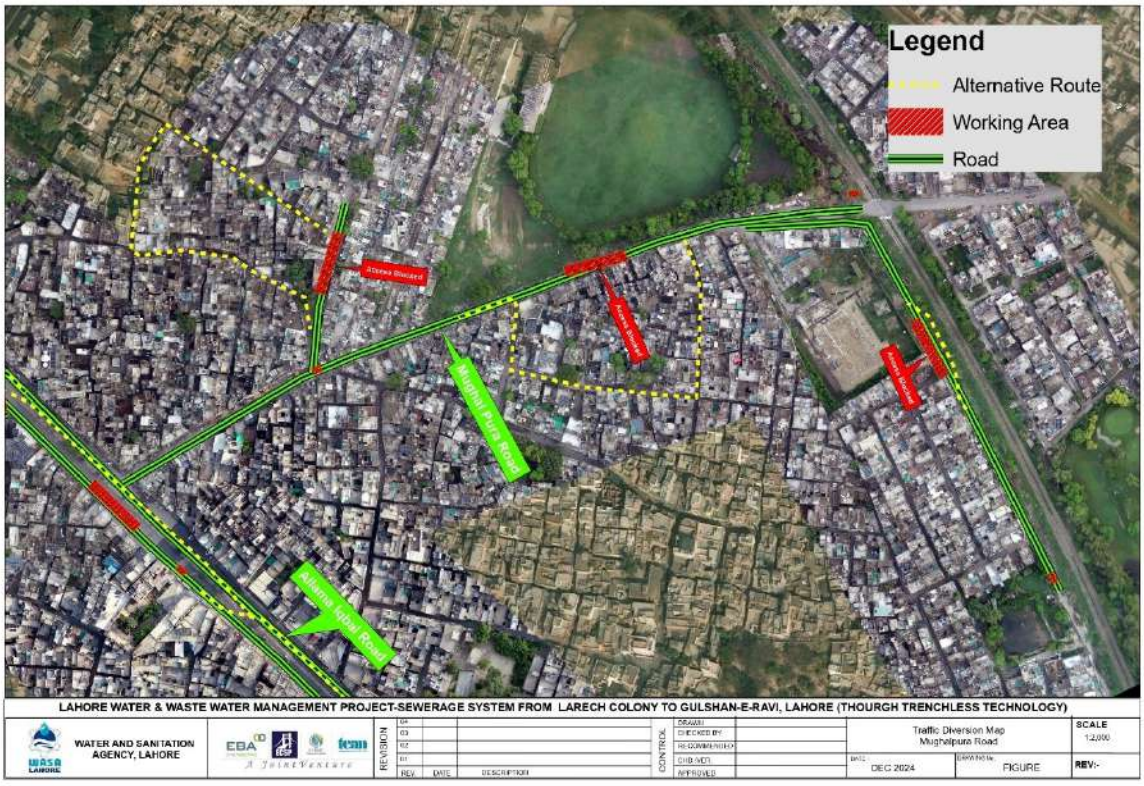


Figure 10: Mughalpura Road

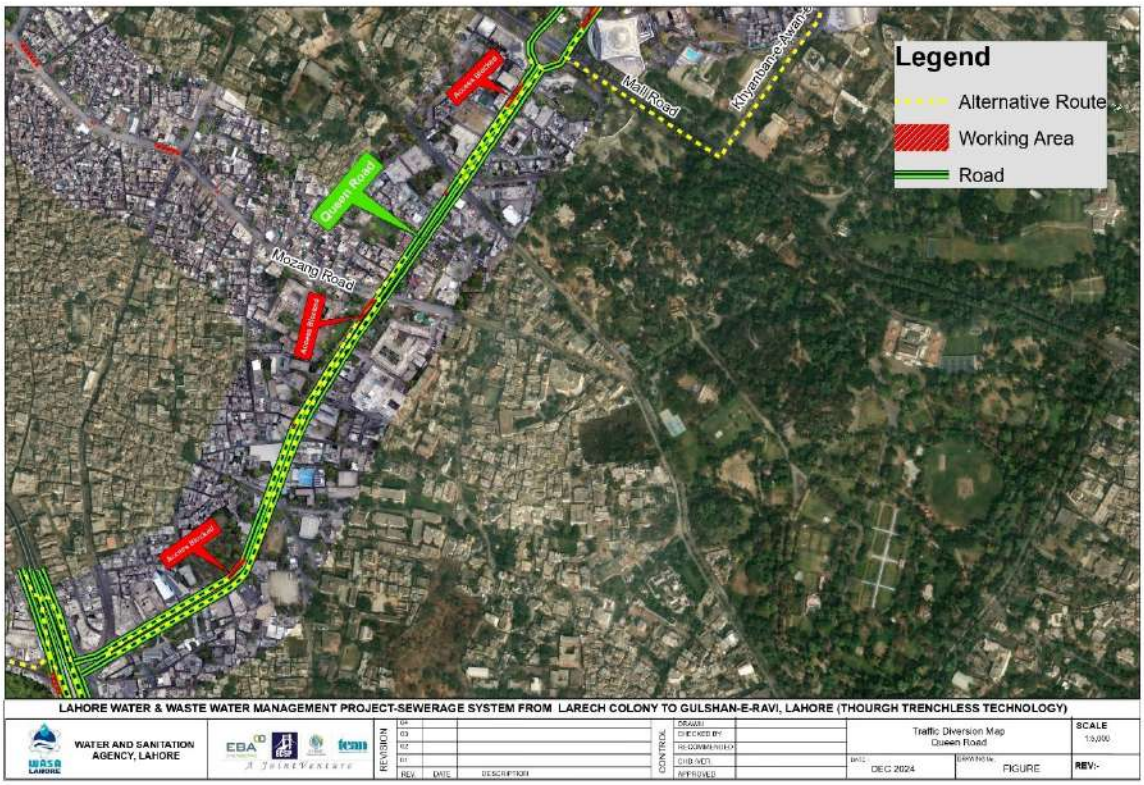


Figure 11: Queens Road

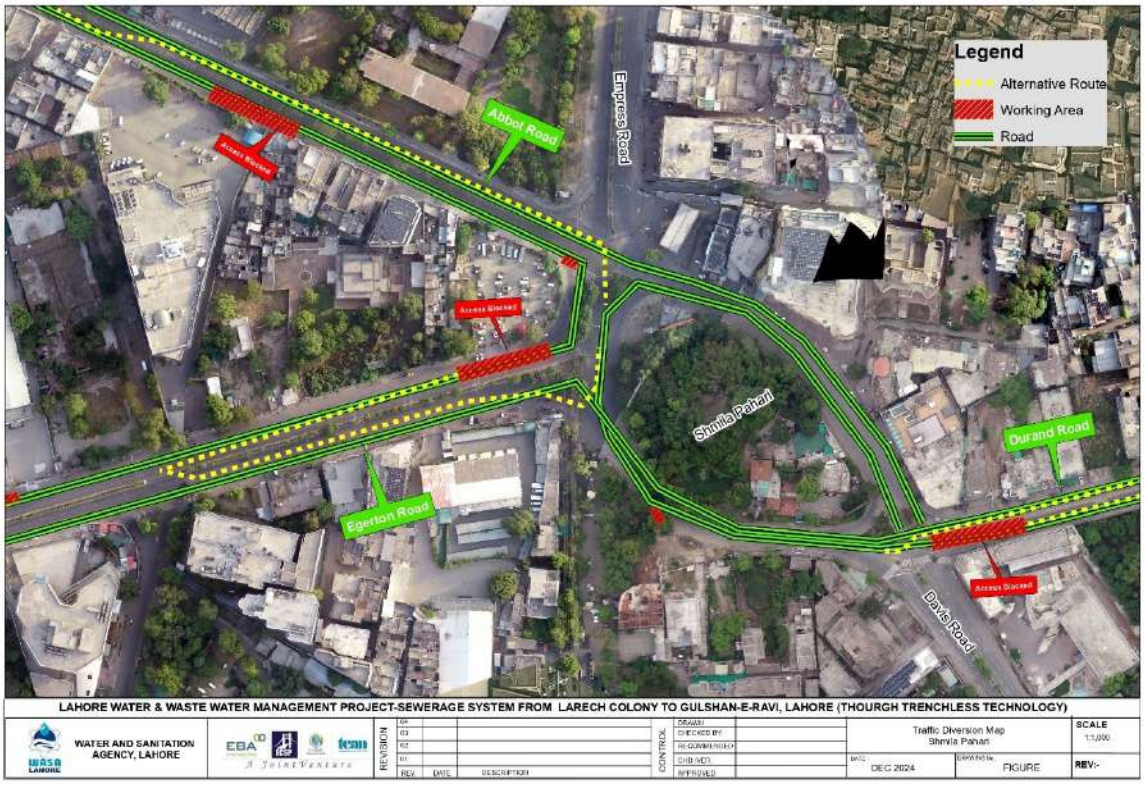


Figure 12: Shimla Hill Road

4.2 LINE-B

The traffic circulations on roads of Line-B are presented in the following figures. The alternate route provided for the traffic on the road is marked by yellow color. One carriageway of the dual-carriageway roads will be open for construction while other will be used for traffic circulation. Traffic flow on the following roads will be affected in the Line-B:

- Shama Road
- Shah Jamal Road
- Mushtaq Ahmed Gurmani Road
- Maratab Ali Road
- Main Boulevard Gulberg
- Ferozpur Road 1
- Ferozpur Road 2
- College Road
- Ashiq Hussain Road
- Moulana Zafar Ali Road



Figure 13: Shama Road

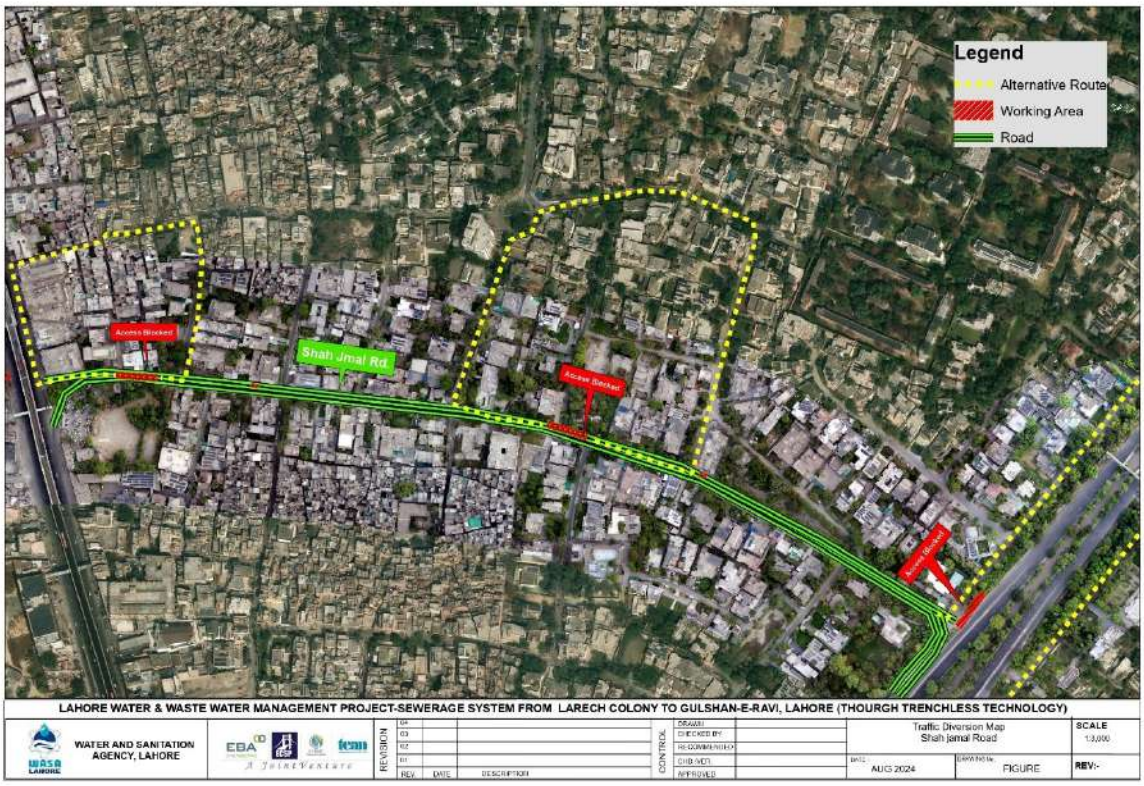


Figure 14: Shah Jamal Road

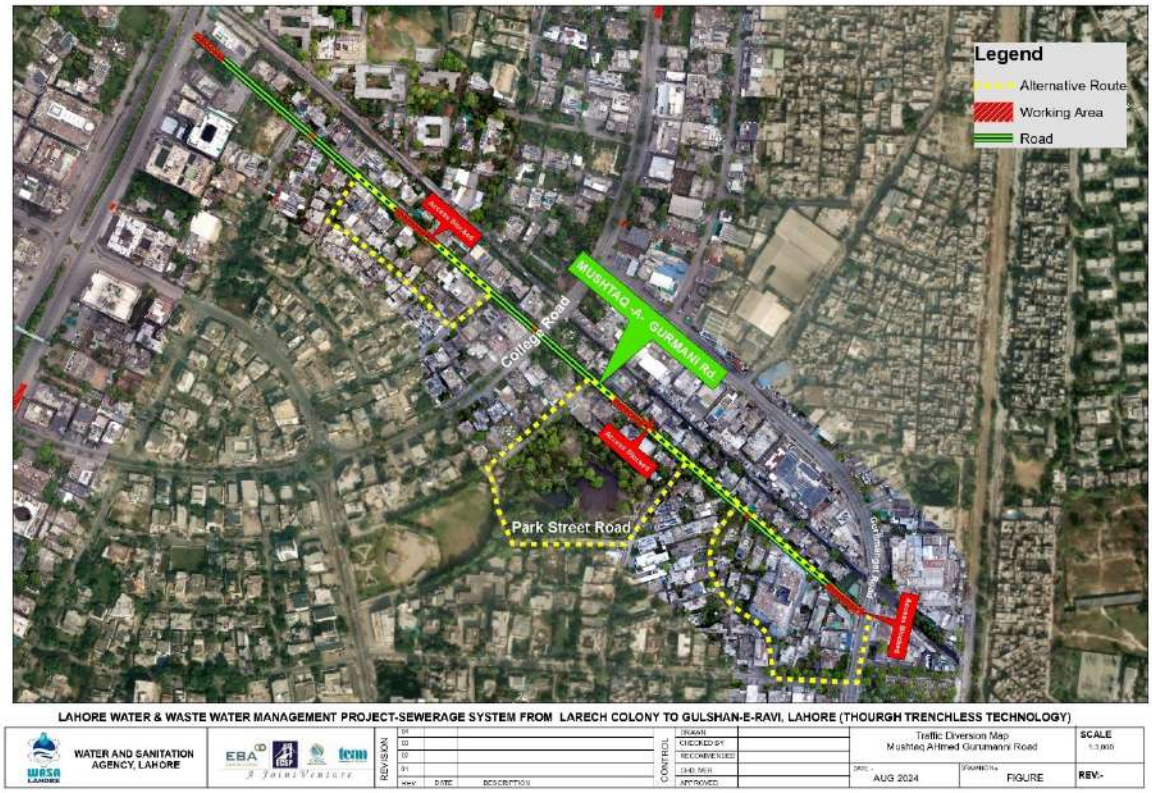


Figure 15: Mushtaq Ahmed Gurmani Road

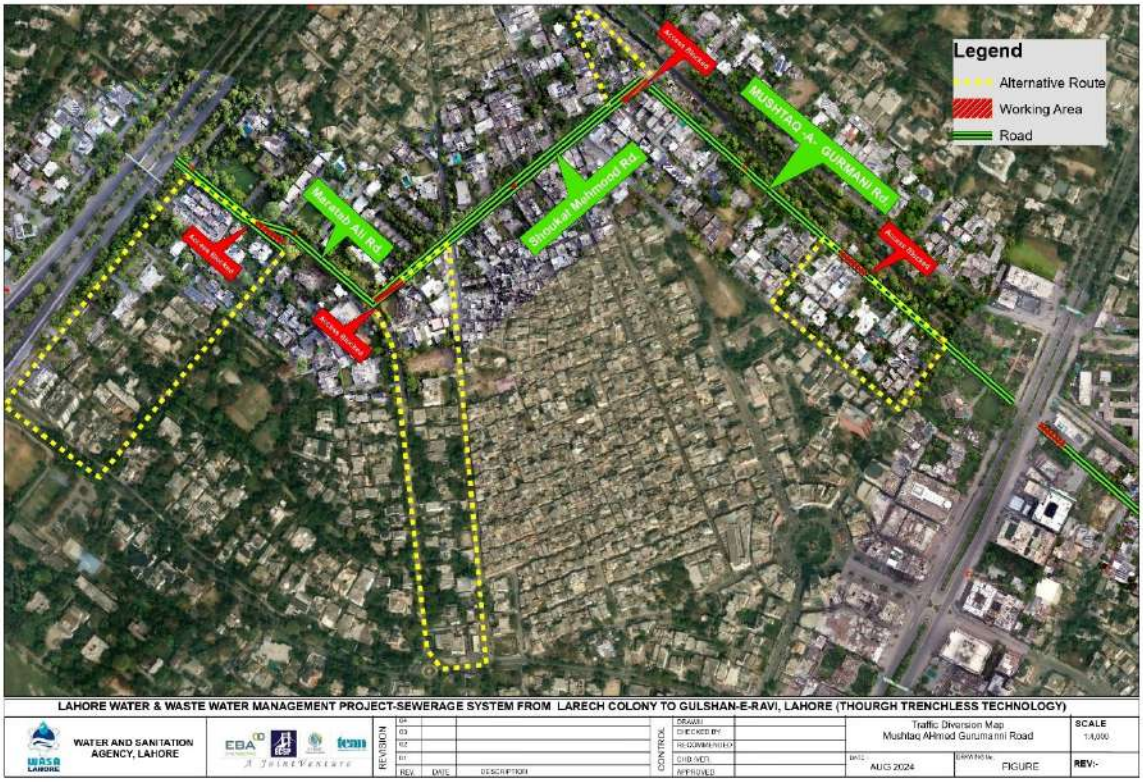


Figure 16: Maratab Ali Road

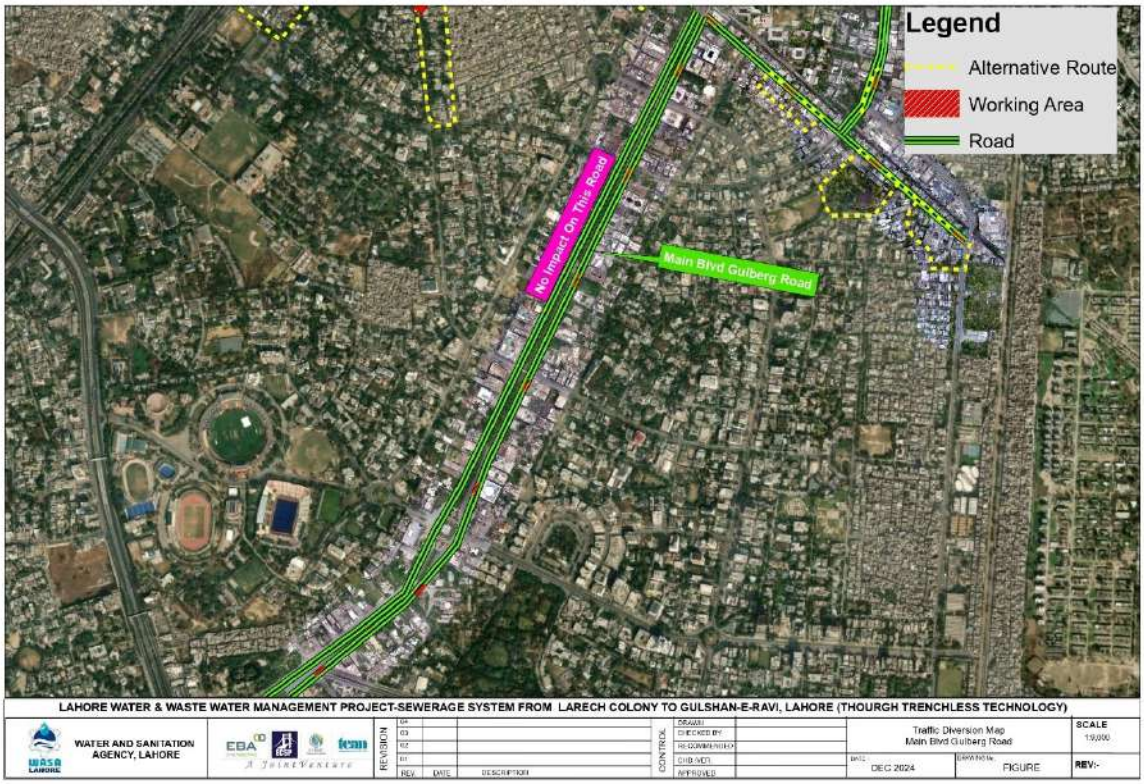


Figure 17: Main Boulevard Gulberg

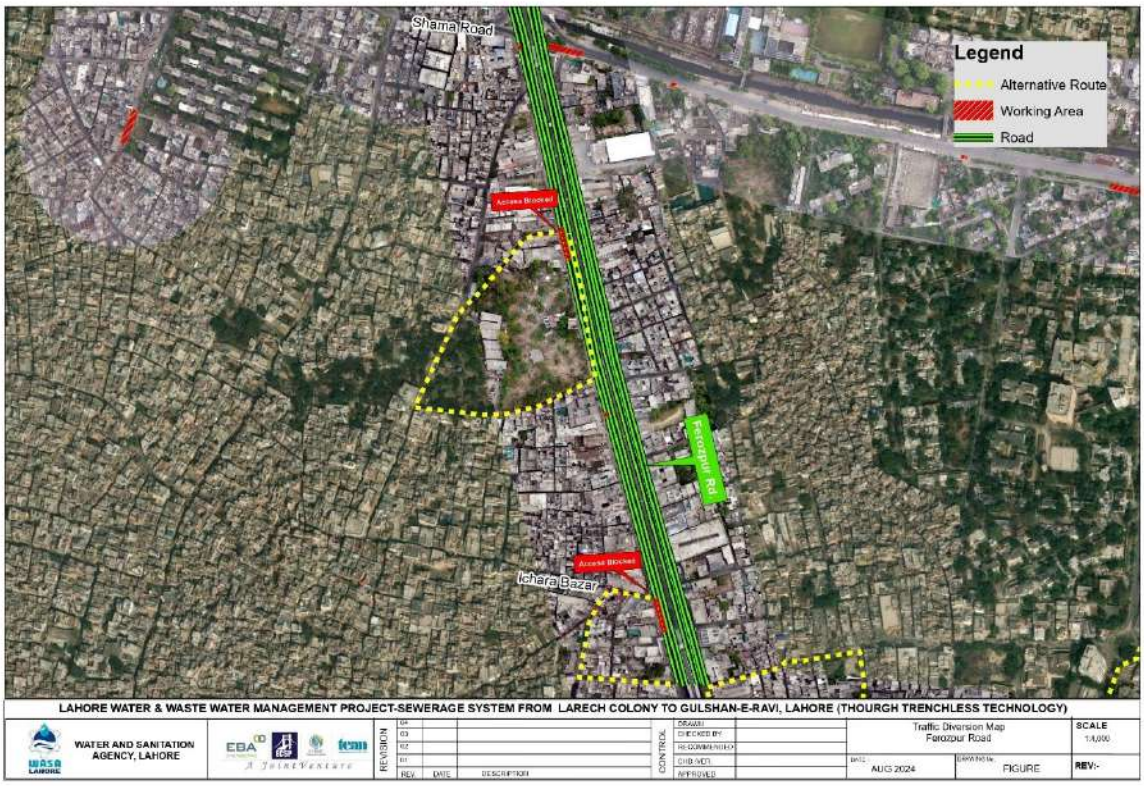


Figure 18: Ferozpur Road 1



Figure 19: Ferozpur Road 2

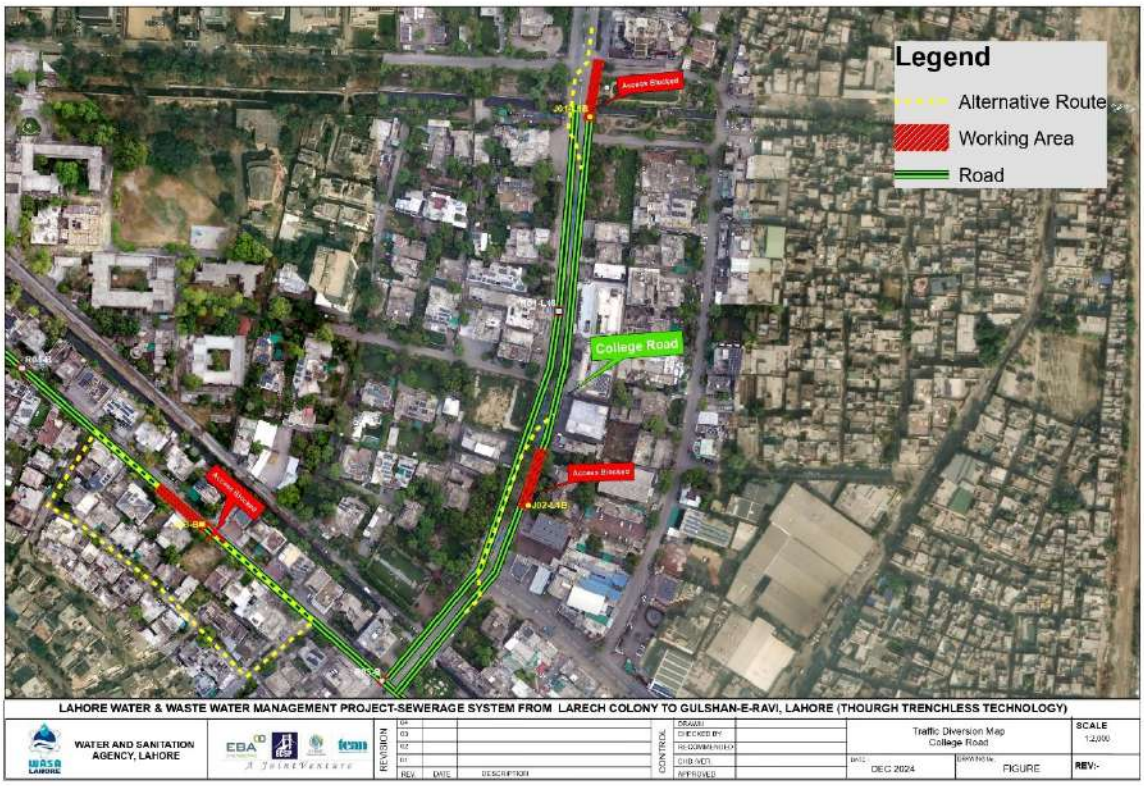


Figure 20: College Road

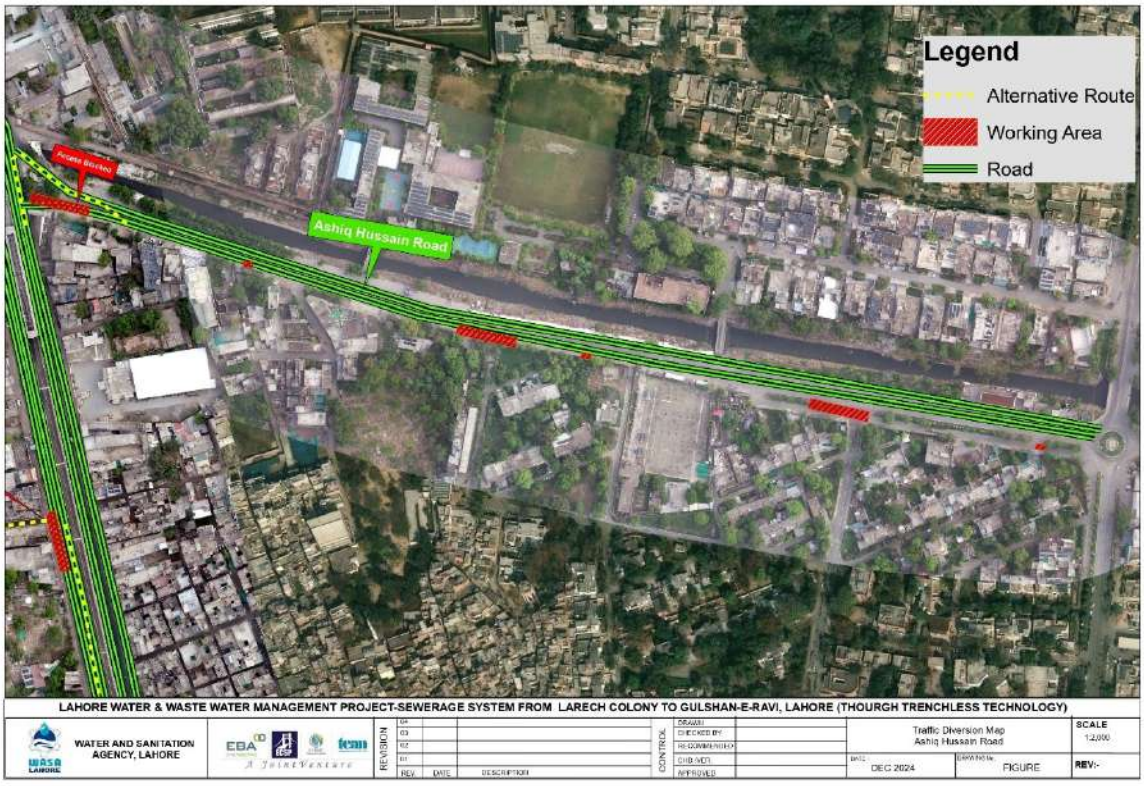


Figure 21: Ashiq Hussain Road

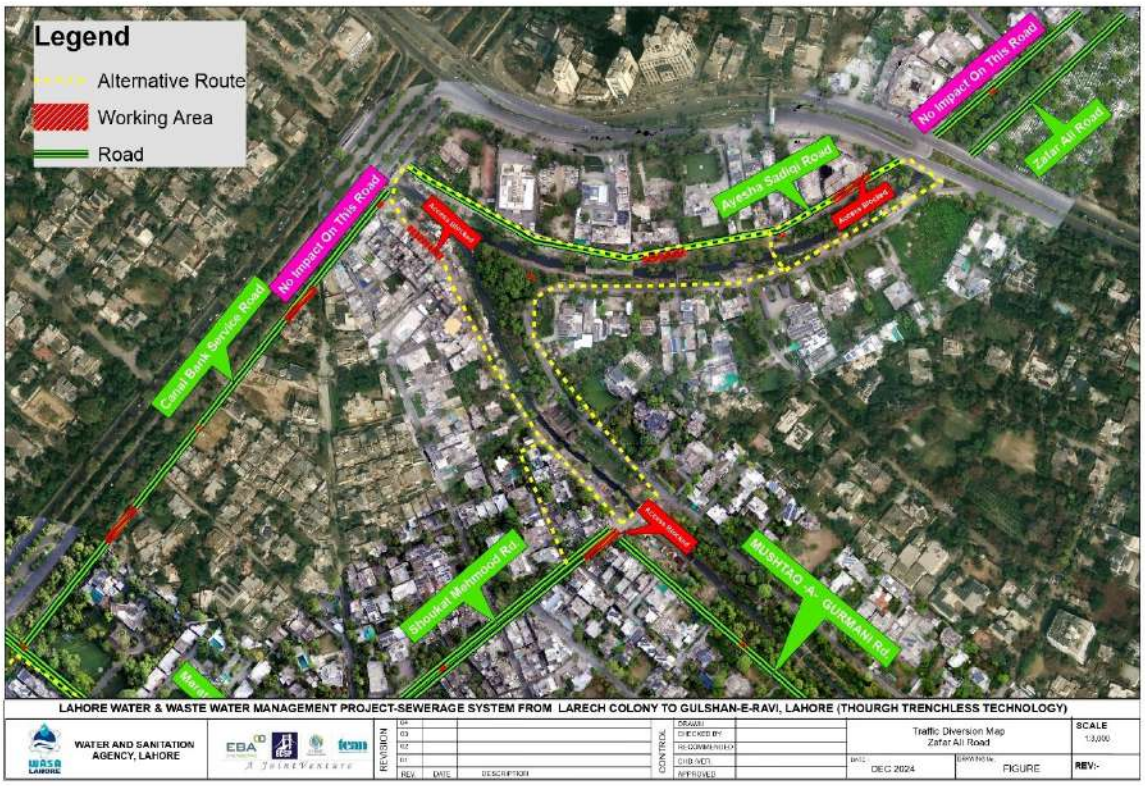


Figure 22: Moulana Zafar Ali Road

4.3 LINE-C

The traffic circulations on roads of Line-C are presented in the following figures. The alternate route provided for the traffic on the road is marked by yellow color. One carriageway of the dual-carriageway roads will be open for construction while other will be used for traffic circulation. Traffic flow on the following roads will be affected in the Line-C:

- Lytton Road
- Samanabad Road
- Bahawalpur Road
- Multan Road
- Gulshan-e-Ravi Road
- Nonarian Road

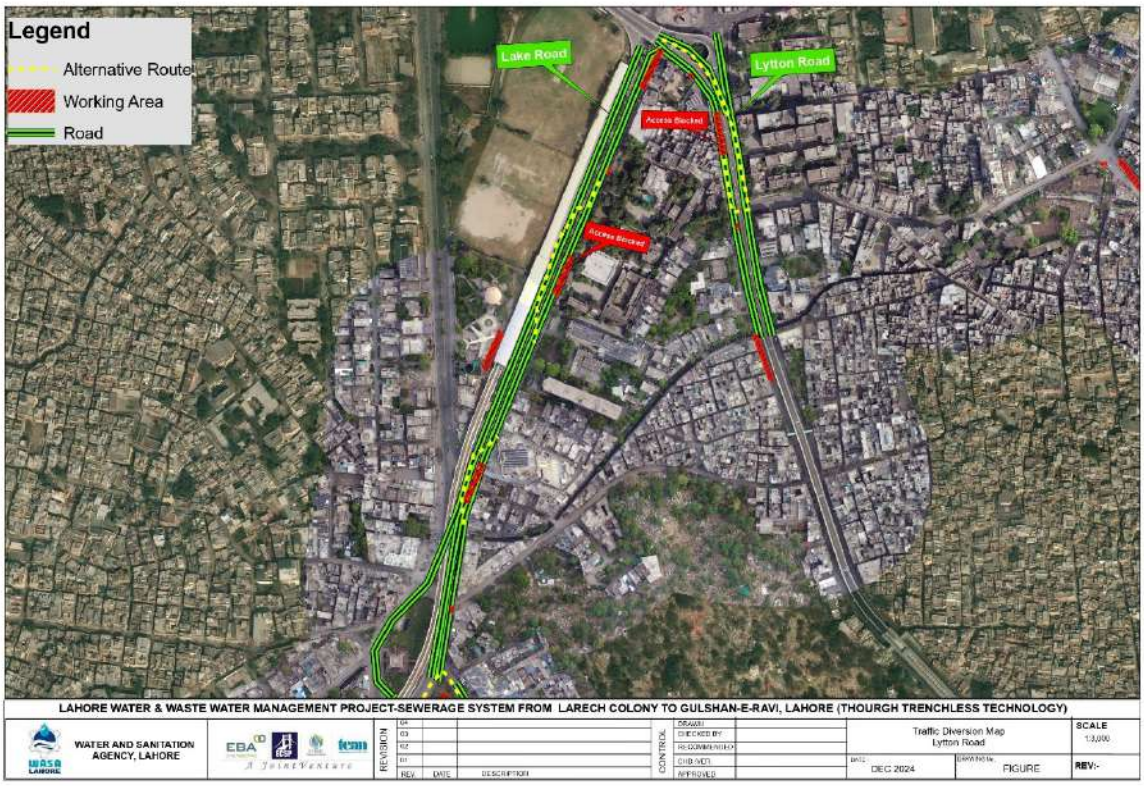


Figure 23: Lytton Road

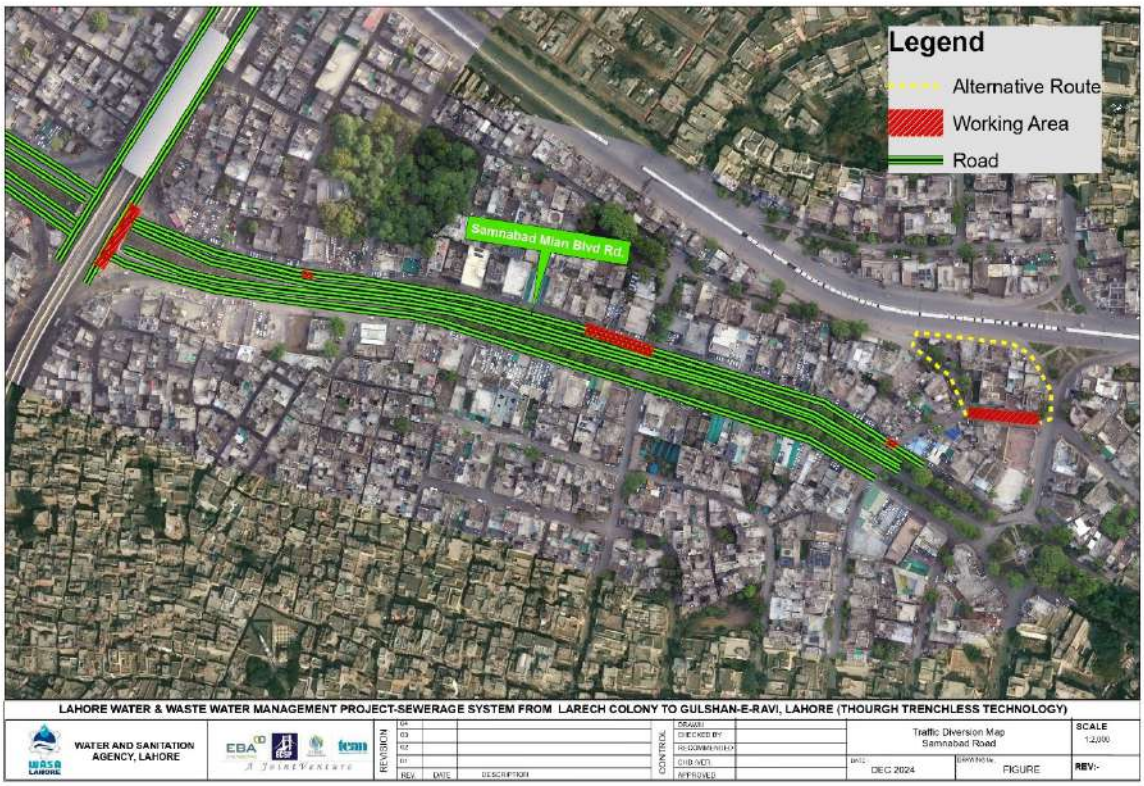


Figure 24: Samanabad Road

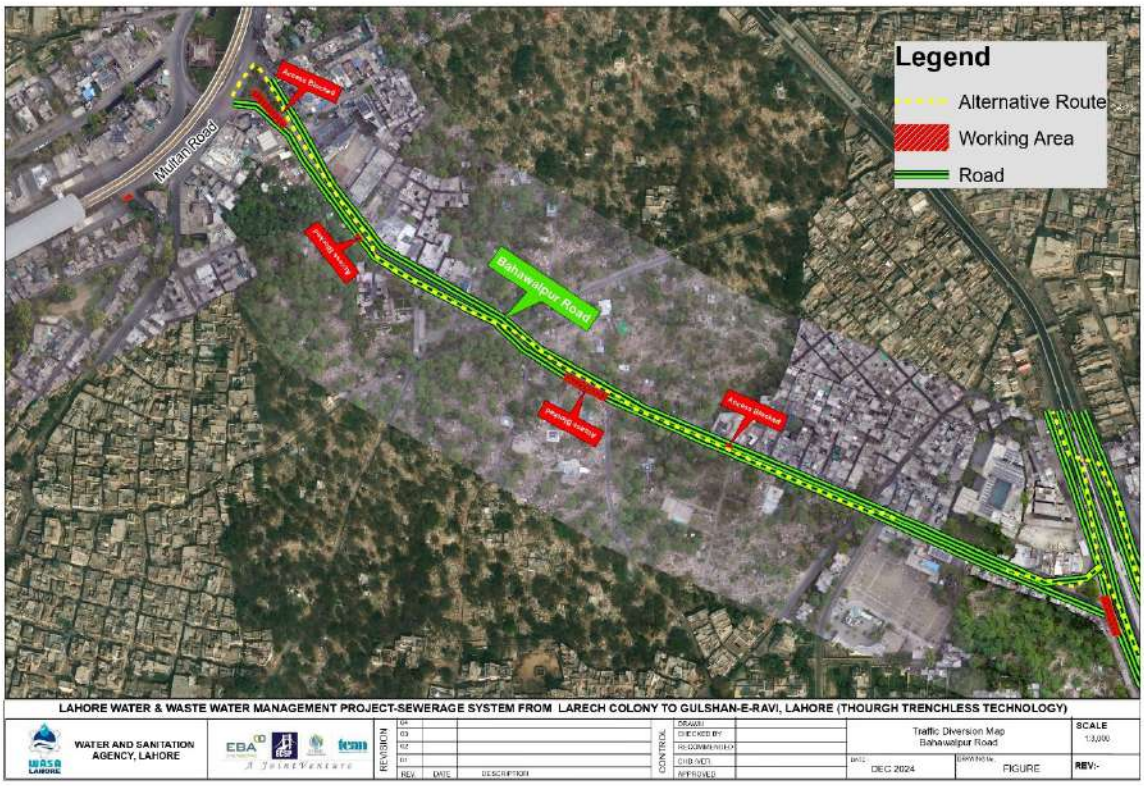


Figure 25: Bahawalpur Road

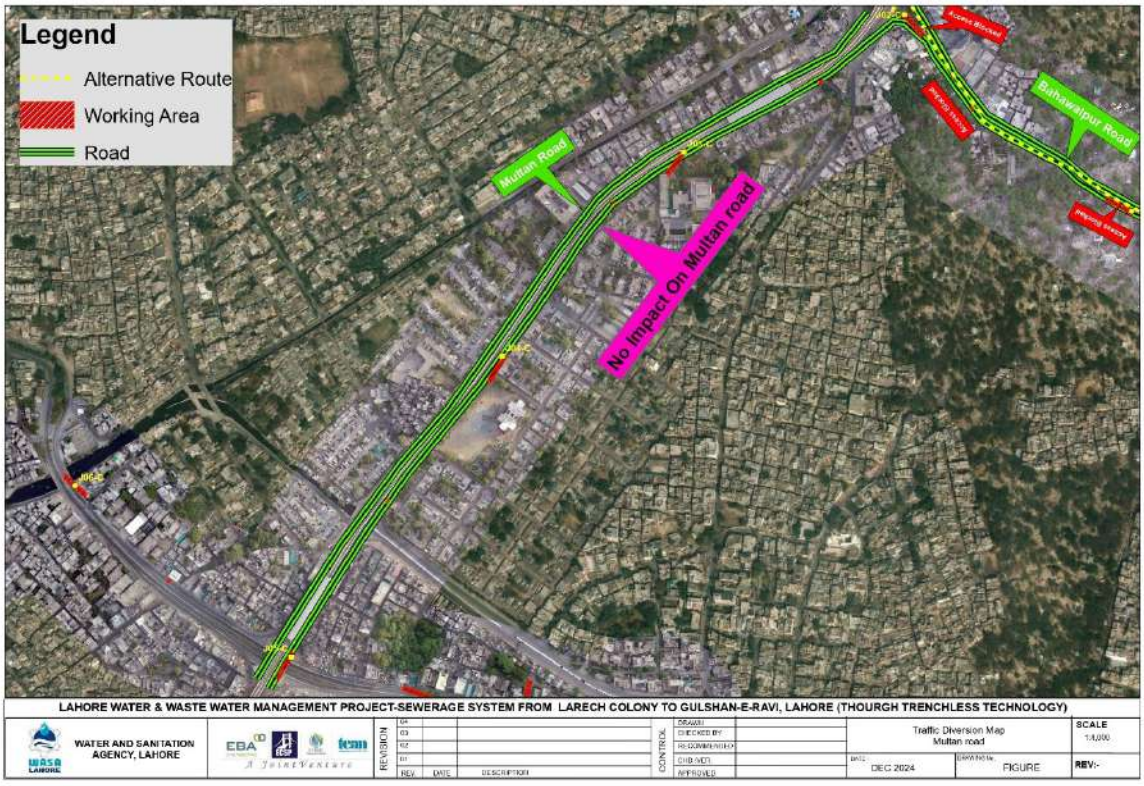


Figure 26: Multan Road

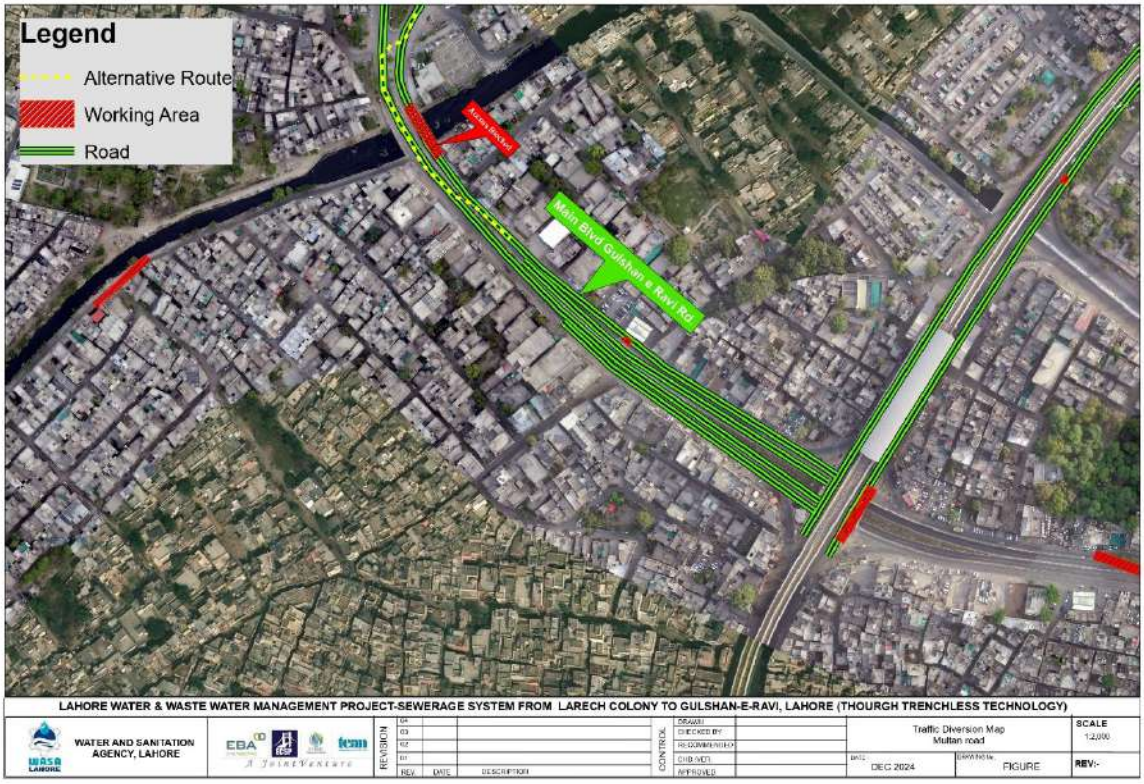


Figure 27: Gulshan-e-Ravi Road

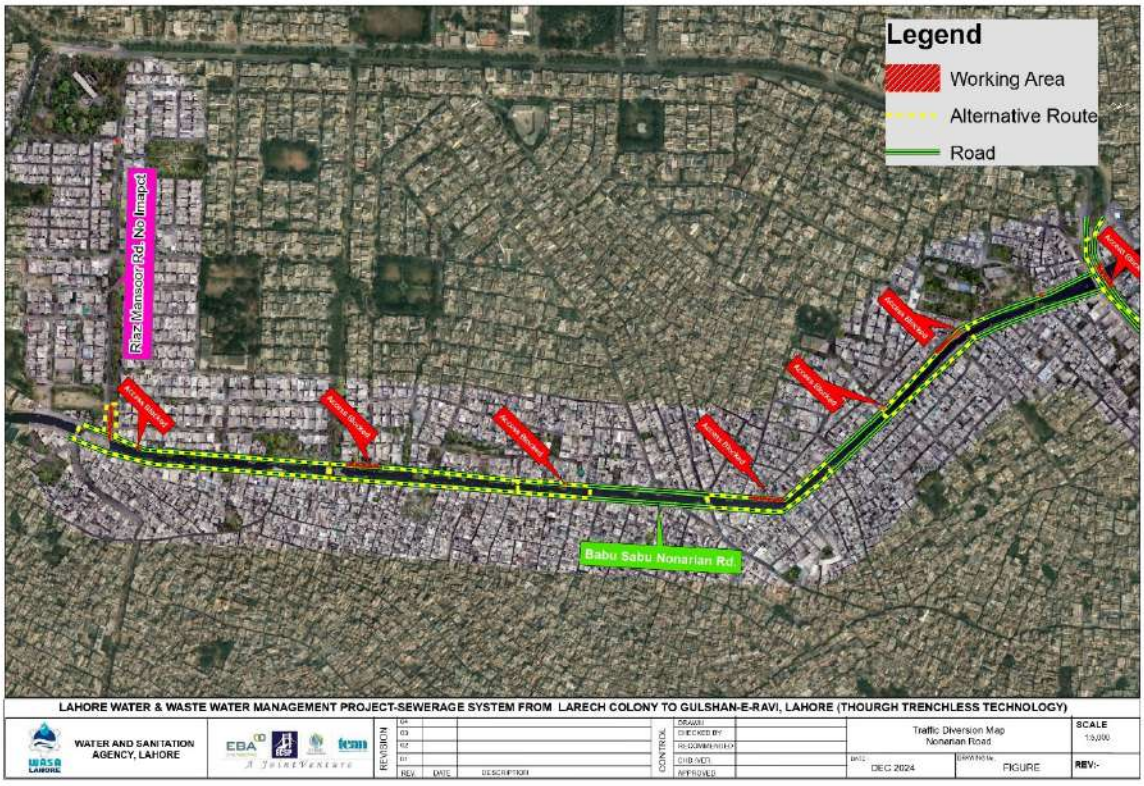


Figure 28: Nonarian Road

5 ANALYZE THE IMPACT DUE TO STREET AND ROAD CLOSURE

Apart from the capacity analysis, final decisions to temporary close a particular street and road and divert the traffic should involve the following steps:

- Approval from the Lahore Traffic Police to use the local streets and roads as detours; Consultation with businesses, community members, residents, road users and traffic police regarding the mitigation measures necessary at the detours where the road is diverted during the construction;
- Determining of the maximum number of days allowed for road closure, and incorporation of such provisions into the contract documents;
- Determining if additional traffic control or temporary improvements are needed along the detour route;
- Considering how access will be provided to the worksite;
- Contacting emergency service, school officials, and transit authorities to determine if there are impacts to their operations; and
- Publish a notice through print and electronic media about road closure to avoid hindrance to public. As part of this notice, the public should be advised of alternate routes that commuters can take or will have to take as result of the traffic diversion.

If full road-closure of certain routes within the proposed project area is not feasible due to inadequate capacity of the Detour Street or public opposition, the full closure can be restricted to weekends with the construction commencing on Saturday night and ending on Monday morning prior to the morning peak period.

6 PUBLIC AWARENESS AND NOTIFICATIONS

As per discussions in the previous sections, there will be travel delays during the construction, as is the case with most construction projects, although on a reduced scale if utilities and traffic management are properly coordinated. There are additional grounds for travel delays in the area, as most of the streets and roads in the proposed project sites lack sufficient capacity to accommodate additional traffic from diverted traffic, as a result of street and road closure to accommodate the construction activities.

The awareness campaign and the prior notification for the public will be a continuous activity which the project will carry out to compensate for the above delays and minimize public claims as result of these problems. These activities will take place sufficiently in advance of the time, when the roadblocks or traffic diversions take place at the particular streets and roads. The reason for this is to allow sufficient time for the public and residents to understand the changes to their travel plans. The project will notify the public about the roadblocks and traffic diversion through public notices, ward level meetings, and city level meeting with the elected representatives.

The Project Management Unit (PMU) of LWASA, Supervision Consultant and Contractor will also conduct an awareness campaign to educate the public about the following issues:

- Traffic control devices in place at the construction sites (signs, traffic cones, and barriers);
- Defensive driving behavior along the construction sites; and
- Reduced speeds enforced at the construction sites and traffic diversions.

It may be necessary to conduct the awareness programs and campaigns on road safety during construction. The campaign will cater to all types of target groups i.e. children, adults, disabled and drivers. Therefore, these campaigns will be conducted in schools and community centers. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the proposed project area and will also be available at the PIU, and the Contractor's site office. The text of the brochure should be concise to be effective, with a lot of graphics.

It will serve the following purpose:

- Explain why the brochure was prepared, along with a brief description of the proposed project;
- Advise the public to expect the unexpected delays or roadblocks;
- Educate the public about the various traffic control devices and safety measures adopted at the construction sites;
- Educate the public about the safe road user behavior to emulate at the construction sites;
- Inform the public how to stay informed or where to inquire about road safety issues at the construction sites (name, telephone and mobile number of the contact person); and
- Indicate the office hours of authorized representatives.

7 INSTALL TRAFFIC CONTROL DEVICES AT THE CONSTRUCTION SITES AND TRAFFIC DIVERSION ROUTES

The purpose of installing traffic control devices at the construction sites is to delineate these areas to warn, inform, and direct the road users about a hazard ahead, and to protect them as well as the workers. As proper delineation is a key to achieve the above objective, it is important to install good traffic signs at the construction sites.

The following traffic control devices are used in construction sites: Signs;

- Pavement Markings;
- Channelizing Devices;
- Arrow Panels; and
- Warning Lights

Procedures for installing traffic control devices at any construction sites vary, depending on road configuration, location of the work, construction activity, duration, traffic speed and volume, and pedestrian traffic. Work will take place along major roads, and the minor internal roads. As such, the traffic volume and road geometry vary. The main roads carry considerable traffic; roads are narrow but carry traffic. However, regardless of where the construction takes place, all the construction sites should be cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary “STOP" and “GO").

Following is a typical set-up for installing traffic control devices at the construction sites of the area, depending on the location of work on the road way, and road geometrics:

- Work on shoulder or parking lane;
- Shoulder or parking lane closed on divided road;
- Work in travel lane;
- Lane closure on road with low volume;
- Lane closure on a two-line road with low volume (with yield sign);
- Lane closure on a two-line road with low volume (one flagger operation);

- Lane closure on a two-lane road (two flagger operation);
- Lane closure on a four-lane undivided road;
- Lane closure on divided roadway;
- Half road closure on multi-lane roadway; and
- Street closure with detour.

The construction sites should take into consideration, for the space required for a buffer zone between the workers and the traffic (lateral and longitudinal), and the transition space required for delineation, as applicable. For the construction works, a 30-centimeter clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 centimeter is necessary to install the temporary traffic signs and cones.

Traffic police should regulate traffic away from the construction sites and enforce the traffic diversion outcome from full street closure in certain areas during construction. Flaggers and personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type) for regulating the traffic during night time.

In addition to the delineation devices, all the construction workers should wear fluorescent safety vests and helmets in order to be visible to the motorists at all times. There should be provision for lighting beacons and illumination for night constructions.

ANNEXURE VII
RESOURCE CONSERVATION PLAN

RESOURCE CONSERVATION PLAN FOR LAYING OF TRUNK SEWER FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

1. INTRODUCTION

The most of the resources in this world are finite and non-renewable in nature. We are completely dependent on these resources to fulfill all our daily requirements. Therefore, sustainable development calls for the need to conserve resources in a way that meet our needs of present generation as well as future generation, 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 and 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:
  - Estimation of construction material required for the project;
  - Estimation of fuel consumption for construction machinery, construction vehicles and generators;
  - Estimations of the energy requirements during all the stages of the project; and
  - 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 inspector shall 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.

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 idle 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 use of heating and cooling systems during extreme weathers events;
- 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 and 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 and controlled as far as possible and direct discharges to air shall be avoided by strictly adhering to the mitigation measures outlined in ESIA report;
- Waste water shall not be discharged directly into the canal and must be managed as per the recommendations presented in ESIA; and
- Construction and demolition waste, and municipal solid waste shall not be dumped and burnt openly, and shall be handled according to the preventative measure given in ESIA study.

5. CHECKING AND CORRECTIVE ACTIONS

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

ANNEXURE VIII
TREE PLANTATION PLAN

TREE PLANTATION/REFORESTATION PLAN FOR LAYING OF TRUNK SEWER FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

1. GENERAL

Afforestation is highly important to maintain the biodiversity and ecological balances. It is also important to prevent global warming, soil erosion and pollution. Afforestation purifies the environment and helps in reducing the carbon dioxide level. Afforestation and horticultural practices will not only reduce the risk been made but will also increase the carrying capacity of the area regarding many positive aspects including greenery of over populated cities.

The basic purpose of afforestation /plantation of suitable species in the proposed project area is to reduce the risk been made due to cutting of approximately 194 trees for the proposed project and to enhance green cover and improve the overall environment and the aesthetics of the city by planting 1940 trees with 1:10 (recommended initially). Damages to the grass cover and other herbs and shrubs will be assessed after final design and during construction phase of the proposed project jointly by PHA, Supervision team and Contractor.

2. OBJECTIVES

- Protection and conservation of flora and fauna of the project area;
- To increase the aesthetic values and carrying capacity of the area, as due to construction activities 194 number of trees maybe cut down and some green belts and grassy land are also prone to damages for which assessment is recommended after final design by joint visits with PHA Lahore and Consultant Ecologist;
- Afforestation of suitable species in the project area will reduce soil erosion and maintain the biodiversity of the project area; and
- Plantation in the project shall act as protection wall against noise, wind borne dust particles, and will reduce sedimentation.

3. PLANTING SEASON

Plantation should be completed in the spring season in the shortest possible time. The trees maybe given appropriate time to become well established prior to dry season. A good rule of thumb is to start planting when the soil is moist to a depth of 15-25 centimeters or to the bottom of the planting hole. Failures of planting too late are more common failures of planting too early. To obtain good results and avoid labor shortage in these areas, considerable preparatory planning is required. The size of plantation might have to be modified to the availability of labor.

4. PITS

Pits should be dug in the project area according to species nature while considering silvicultural and ecological aspects. The pits should be of two feet dia at the top and one feet dia at the bottom with a depth of 1-3/4'' feet but it may vary specie to specie. The earth taken out of the pits will be deposited below each pit in a crescent shape, so as to form a ridge with a clear berm of nine inches in front and maybe accordingly. Moreover, planting should be carried

out in the pits and sowing on the berms, before or immediately after the first shower of rain. The choice of species for the project area is given below **Table** 1.

Table 1: Recommended Species for Afforestation in the Project Area

Sr. No.	Local Name	Scientific Name
1.	Alstonia	*Alstonia scholaris*
2.	Ashoka	*Saraca asoca*
3.	Pipal	*Ficus religiosa*
4.	Mulberry	*Morus alba*

5. PLANTATION TECHNIQUE

Plantation of broad leafed species is to be carried out in the immediate vicinity of the project area or adjacent to boundaries in jurisdiction. The project area can be afforested and vegetation cover can be improved by adopting standard afforestation technique of digging pits. The project area is suitable for plantation activities and can be managed thoroughly with care. This is the minimum number of plants (1940) to be planted; if the available roads do not have proper space for plantation, then it is recommended to plant in vicinities along the project alignment.

6. MAINTENANCE OF PLANTATION

Once a plantation has been established, the work should not be considered finished. The maintenance of the plantation is necessary i.e.:

- To protect the plantation against weather events, fire, insects and fungi, and fauna;
- A variety of cultural treatments should be conducted to promote favourable growth conditions include weeding, thinning and watering. Harvesting operations, when required, should match the skills of the people who will perform the tasks;
- Fencing which marks boundaries and protects the trees and shrubs should be erected, if required;
- Maintenance may include measures that are silvicultural (such as well-timed and careful removal of damaged trees and shrubs), chemical (with insecticides or fungicides), biological (with parasites), and mechanical (removing or destroying pests, and erecting fences.); and
- Trespassing by public can threaten the success of a planting program; therefore, planning should also include methods of dealing with this potential problem.

7. COST

The cost and maintenance of one hectare of afforestation in the proposed project area has been estimated including cost of layout, digging, planting, carriage and watch and ward, and its maintenance for five years. **Table 2** shows the approximate cost of plantation of one hectare area as standard and just for understating.

NOTE: *The provided rates are tentative and approximate, as final rates will be provided by PHA just before starting construction works but not at the current stage because of many technical and administrative issues.* ***NOC*** *is mandatory from PHA and Safe City Lahore prior to the implementation of the proposed project.*

Table 2: Basis of Cost Estimation for Plantation of One Hectare

Sr. No.	Item of Work	Man Days	Rate (Rs.)	Cost (Rs.)
A. INITIAL PLANTATION COST				
a.	**Works**			
1.	Layout of pits	2.47	1500	3,705
2.	Digging of pits	17.29	1500	25,935
3.	Planting	12.35	1500	18525
Sub Total (1+2+3)1				**48,165**
b.	**Watch and Ward**			
1.	Internal carriage of plants	7.41	1500	11,115
2.	Carriage of plants from nursery to plantation site	--	Lump Sum	3,000
Sub Total (1+2)				**14,115**
c.	**Watch and Ward**			
1.	Watch and ward for the initial Year	9.0	1500	13,500
Sub Total (1)				**13,500**
Total (a + b + c)				***75,780***
B. MAINTENANCE AND RESTOCKING OF PLANTING				
a.	**After 1st Year of Planting**			
1.	Watch and ward @ 1 Chowkidar for 12 months	9.0	1500	13,500
2.	Restocking 1st year after Planting	4.34	1500	6,510
Sub Total (1+2)				***20,010***
b.	**After 2nd Year of Planting**			
1.	Watch and ward @ 1 Chowkidar for 12 months	9.0	1500	13,500
2.	Restocking 2nd year after Planting	4.34	1500	6,510
Sub Total (1+2)				***20,010***
c.	**After 3rd Year of Planting**			
1.	Watch and ward @ 1 Chowkidar for 12 months	9.0	1500	13,500
2.	Restocking 3rd year after Planting	4.34	1500	6,510
Sub Total (1+2)				***20,010***

Annexure-VIII

Sr. No.	Item of Work	Man Days	Rate (Rs.)	Cost (Rs.)
d.	**After 4th Year of Planting**			
1.	Watch and ward @ 1 Chowkidar for 12 months	9.0	1500	13,500
2.	Restocking 4th year after Planting	4.34	1500	6,510
	Sub Total (1+2)			***20,010***
e.	**After 5th Year of Planting**			
1.	Watch and ward @ 1 Chowkidar for 12 months	9.0	1500	13,500
	Sub Total (1)			**13,500**
	Total (a + b + c + d + e)			***93,540***
	Grand Total (A+B)			***169,320***

Keeping in view the above standards, table is being prepared for the current project area, Following details will show the total cost estimated for the plantation to be carried out:

Number of plants to be planted	= 1940 say 1950/-
Purchasing of Plants (Average Rs. 500 per Plant) from Private Nursery	**= 950,000/- PKR**
Total cost of initial plantation and Maintenance for one hectare	= 169,320/- PKR
Total cost of initial plantation and maintenance for single plant	= 589.00/- PKR
Total cost of overall plantation including five (05) years maintenance and Purchasing	**= 111,320/- PKR (950,000+169,320) = 1.12 Million PKR**

Note: *The above rates and calculations are approximate and tentative which will be updated according to the standard rates of concerned PHA, Implementing Agency and Market.*

ANNEXURE IX
CHANCE FIND PROCEDURE

CHANCE FIND PROCEDURES

Project may involve 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 preserve those 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; and
- After stopping work, the contractor must immediately report the discovery to the Supervision Engineer;
- Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance; and
- Work will not re-commence in this location until agreement has been reached between DOA and proponent as to any required mitigation measures, which may include excavation and recovery of the item.

The contact Address of Archeology Department is given below:

Archeology Department
1st Floor Auqaf Department,
Shahrah-e-Quaid-e- Azam, Lahore
Tel: 042-99231526 and 99231527

ANNEXURE X
CONSTRUCTION HEALTH AND SAFETY CHECKLIST

Construction HSE Checklist

Company name: _____

Address of worksite: _____

Supervisor: _____

Date: _____ **Time:** _____

Inspector: _____

Jobsite (General)

	Yes	No	N/A	Date Corrected
1. Are posters and safety signs or warnings in place?	☐	☐	☐	
2. Are safety meetings held periodically?	☐	☐	☐	
3. Is a first-aid kit available and adequately stocked?	☐	☐	☐	
4. Has job-related safety training been completed?	☐	☐	☐	
5. Has an accident reporting procedure been established?	☐	☐	☐	
6. Is a substance abuse policy in place?	☐	☐	☐	
7. Are injury records kept?	☐	☐	☐	
8. Are emergency telephone numbers posted?	☐	☐	☐	
9. Are traffic routes identified?	☐	☐	☐	
10. Are there procedures to handle hazardous waste?	☐	☐	☐	

Housekeeping and Sanitation

	Yes	No	N/A	Date Corrected
1. Are work area(s) generally neat and clean?	☐	☐	☐	
2. Is waste and trash regularly disposed of?	☐	☐	☐	
3. Are passageways and walkways clear?	☐	☐	☐	
4. Is the work area well lighted?	☐	☐	☐	
5. Are waste containers provided and used?	☐	☐	☐	
6. Are sanitary facilities adequate and clean?	☐	☐	☐	

	Yes	No	N/A	Date Corrected
7. Is there an adequate potable water supply?	☐	☐	☐	
8. Are there adequate drinking cups?	☐	☐	☐	
9. Have nails, boards, and debris been removed?	☐	☐	☐	
10. Are eye-flushing facilities available?	☐	☐	☐	
11. Are emergency showers available?	☐	☐	☐	

Hazard Communication

	Yes	No	N/A	Date Corrected
1. Is there a written program?	☐	☐	☐	
2. Are employees trained?	☐	☐	☐	
3. Are safety data sheets on file and readily available?	☐	☐	☐	
4. Are control and disposal measure(s) established?	☐	☐	☐	
5. Are material(s) properly stored and labeled?	☐	☐	☐	
6. Is a log of all chemicals on site available?	☐	☐	☐	
7. Are labels legible?	☐	☐	☐	

Fire Prevention

	Yes	No	N/A	Date Corrected
1. Are an adequate number and types of fire extinguisher(s) Available?	☐	☐	☐	
2. Is fire prevention/extinguisher training performed?	☐	☐	☐	
3. Are inspections of fire extinguishers performed periodically?	☐	☐	☐	
4. Is the telephone number of the fire department posted?	☐	☐	☐	
5. Are fire extinguisher(s) provided on appropriate equipment?	☐	☐	☐	
6. Are flammable liquids stored in approved containers and Correctly labeled?	☐	☐	☐	
7. Are flammable liquids properly stored?	☐	☐	☐	
8. Is a fire alarm available?	☐	☐	☐	
9. Is a fire evacuation plan established?	☐	☐	☐	
10. Are fuel supplies protected from accidental impact?	☐	☐	☐	
11. Is fire training given to appropriate personnel?	☐	☐	☐	
12. Is equipment shut down prior to refueling?	☐	☐	☐	
13.Is equipment properly grounded to fuel trucks before refueling?	☐	☐	☐	
14. Are no-smoking signs posted and enforced?	☐	☐	☐	
15.Are hydrants clear and access to public thoroughfare open?	☐	☐	☐	

Electrical

	Yes	No	N/A	Date Corrected
1. Do electrical devices have a current inspection and coding?	☐	☐	☐	
2. Is electrical equipment properly maintained?	☐	☐	☐	
3. Are fuses provided?	☐	☐	☐	
4. Are electrical dangers posted?	☐	☐	☐	
5. Are terminal boxes equipped with required covers, and is the cover used?	☐	☐	☐	

6. Are circuits labeled in terminal boxes?	☐ ☐ ☐

Personal Protective Equipment (PPE)

	Yes	No	N/A	Date Corrected
1. Have hazard evaluations been performed and certified?	☐	☐	☐	
2. Is protective equipment adequate for exposure?	☐	☐	☐	
3. Are employees issued PPE where needed?	☐	☐	☐	
4. Is PPE being used?	☐	☐	☐	
5. Are employees trained in the use of PPE?	☐	☐	☐	
6. Are inspections being conducted before and after use of PPE?	☐	☐	☐	
7. Is adequate maintenance and sanitary storage available and used?	☐	☐	☐	
8. Is adequate fall protection provided?	☐	☐	☐	
9. Is eye protection available?	☐	☐	☐	
10. Is face protection (glasses, goggles, shields) available?	☐	☐	☐	
11.Is hearing protection available?	☐	☐	☐	
12. Are respirators used to protect against harmful dust, asbestos, sand blasting, and welding (lead, paint, and galvanized zinc or cadmium)?	☐	☐	☐	
13.Is head protection available?	☐	☐	☐	
14. Is hand and foot protection available?	☐	☐	☐	
15. Are physical exams performed as required?	☐	☐	☐	

Hand Tools

	Yes	No	N/A	Date Corrected
1. Are proper tool(s) used for the job?	☐	☐	☐	
2. Are handles free of cracks and properly attached to tools?	☐	☐	☐	
3. Are inspections and proper maintenance performed prior to use?	☐	☐	☐	
4. Are tools neatly stored and safely carried?	☐	☐	☐	

Ladders

	Yes	No	N/A	Date Corrected
1. Are ladders inspected and in good condition?	☐	☐	☐	
2. Are ladders used properly?	☐	☐	☐	

3. Are ladders secured to prevent slipping, sliding, or falling?	☐	☐	☐	
4. Do side rails extend 36 inches above top of landing?	☐	☐	☐	
5. Are any ladders spliced?	☐	☐	☐	
6. Are rungs or cleats not over 12 inches at center?	☐	☐	☐	
7. Are ladders properly maintained and stored?	☐	☐	☐	
8. Are any ladders painted?	☐	☐	☐	
9. Is fall protection provided for fixed ladders in excess of 20 feet long?	☐	☐	☐	
10. Are aluminum ladders of sufficient strength for the task?	☐	☐	☐	

Scaffolds

	Yes	No	N/A	Date Corrected
1. Is erecting the scaffold properly supervised?	☐	☐	☐	
2. Are all structural members free from defects, and do they meet safety factors?	☐	☐	☐	
3. Are all scaffold connections secured?	☐	☐	☐	
4. Are scaffolds erected on solid footing?	☐	☐	☐	
5. Is scaffold tied to structure?	☐	☐	☐	
6. Are working areas free of dirt, debris, snow, ice, and grease?	☐	☐	☐	
7. Are employees protected from falling objects?	☐	☐	☐	
8. Is scaffold plumb and square, with cross-bracing?	☐	☐	☐	
9. Are guard rails, intermediate rails, and toe boards in place?	☐	☐	☐	
10. Are ropes and cables in good condition?	☐	☐	☐	
11. Is fall protection available and in use?	☐	☐	☐	

Excavation and Shoring

	Yes	No	N/A	Date Corrected
1. Are holes, trenches, and cuts more than 5 feet deep shored, benched, and sloped, or are trench boxes used?	☐	☐	☐	
2. Are operations supervised by a competent person?	☐	☐	☐	
3. Are spoil banks at least 2 feet from edges of cut?				
4. Are ladders placed to ensure no more than 25 feet of lateral travel by worker?	☐	☐	☐	
5. Are ladders properly secured?	☐	☐	☐	
6. Are adjacent structures properly shored?	☐	☐	☐	
7. Is shoring and sheathing correct for soil and depth?	☐	☐	☐	
8. Are roads and sidewalks supported and protected?	☐	☐	☐	
9. Is excavation barricaded and lighting provided?	☐	☐	☐	

10. Are equipment ramps adequate?	☐	☐	☐	
11. Have underground utility installations been identified?	☐	☐	☐	
12. Are registered professional engineer designs or approvals performed?	☐	☐	☐	
13. Are confined-space entry permit required plans established?	☐	☐	☐	
14. Are daily inspections completed by a competent person?	☐	☐	☐	

Heavy Equipment

	Yes	No	N/A	Date Corrected
1. Is regular inspection and maintenance performed?	☐	☐	☐	
2. Are seat belts provided and used in equipment with rollover protection structure?	☐	☐	☐	
3. Is a slow-moving-vehicle emblem attached to rear of equipment operating at less than 25 mph?	☐	☐	☐	
4. Are employees riding equipment with proper seating?	☐	☐	☐	
5. Are lights, brakes, and warning signals operative?	☐	☐	☐	
6. Are wheels chocked when necessary?	☐	☐	☐	
7. Are haul roads well maintained and laid out properly?	☐	☐	☐	
8. Is equipment properly secured when not in use?	☐	☐	☐	
9. Are noise arresters used?	☐	☐	☐	
10.Are spark arresters used as necessary?	☐	☐	☐	

Motor Vehicles

	Yes	No	N/A	Date Corrected
1. Are motor vehicles regularly inspected and maintained?	☐	☐	☐	
2. **Are motor vehicle operators qualified?**	☐	☐	☐	
3. Are local and state laws observed?	☐	☐	☐	
4. Are vehicles' brakes, lights, and warning devices operative?	☐	☐	☐	
5. Are weight limits and load stress controlled?	☐	☐	☐	
6. Are personnel carried in the correct manner?	☐	☐	☐	
7. Is all vehicle glass in good condition?	☐	☐	☐	
8. Are backup signals provided?	☐	☐	☐	
9. **Are fire extinguisher(s) installed?**	☐	☐	☐	
10. Are seat belts worn?	☐	☐	☐	
11. Are tie-down straps or chains regularly inspected?	☐	☐	☐	
12. Are all vehicles checked at the beginning and end of each shift?	☐	☐	☐	

Barricades

	Yes	No	N/A	Date Corrected
1. Are floor openings planked over or barricaded?	☐	☐	☐	
2. Are roadways and sidewalks protected?	☐	☐	☐	
3. Is adequate lighting provided?	☐	☐	☐	
4. Are barricades or covers installed over shafts, wall openings, stairways, stairwells, trenches, and outriggers?	☐	☐	☐	

Handling and Storage of Materials

	Yes	No	N/A	Date Corrected
1. Are materials properly stored or stacked?	☐	☐	☐	
2. Are shelves, racks, and overhead storage load-rated?	☐	☐	☐	
3. Are passageways clear?	☐	☐	☐	
4. Are there sufficient employees to do the job?	☐	☐	☐	
5. Are employees lifting materials correctly?	☐	☐	☐	
6. Are materials protected from weather?	☐	☐	☐	
7. Are employees protected from falling into hoppers and bins?	☐	☐	☐	
8. Is dust protection used?	☐	☐	☐	
9. Is the correct type of fire extinguisher(s) and other fire protection available?	☐	☐	☐	
10. Is traffic controlled through the storage area?	☐	☐	☐	
11. Is rigging inspected prior to use?	☐	☐	☐	
12. Is a competent person responsible for materials storage and Handling?	☐	☐	☐	

Concrete Construction

	Yes	No	N/A	Date Corrected
1. Are holes, trenches, and cuts more than 5 feet deep shored and sloped, or are trench boxesused?	☐	☐	☐	
2. Are operations supervised by a competent person?	☐	☐	☐	
3. Are soil banks at least 2 feet from edges of cut?	☐	☐	☐	
4. Are ladders placed to ensure no more than 25 feet of lateral travel by worker?	☐	☐	☐	
5. Are ladders properly secured?	☐	☐	☐	
6. Are adjacent structures properly shored?	☐	☐	☐	
7. Is shoring and sheathing correct for soil and depth?	☐	☐	☐	

ANNEXURE XI
EMERGENCY RESPONSE PLAN

EMERGENCY RESPONSE PLAN FOR LAYING OF TRUNK SEWER FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE

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;
- Coordinate between various 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 further improvements are needed.

3. PLANNING

i. Emergency Response Team

A 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 clearly defined.

The primary responsibilities of the team 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:

- Team Leader

- Safety Engineer
- Reporting Officer / Inspector

A) Team Leader

- Approve and 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; and
- Assure that the Emergency Response Plan is adequate, effective and can be implemented practically.

B) 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.

C) 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 taken thereby 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 **Figure 1.**

ii. Hazard Identification

A comprehensive identification and evaluation of the hazards and risks likely to cause an emergency shall be done by Emergency Response Team (ERT). Major potential emergencies identified in the proposed projects are as follows:

- Structural failure;
- Disruption of Utility (Power, Water, Telecommunications and Gas);
- Accidents;
- Vehicle accident;
- Fog and Smog;
- Power equipment failure or vandalism;
- Fire explosion;

- Earthquake;
- Terrorism including bombing; and
- Disease Outbreak.

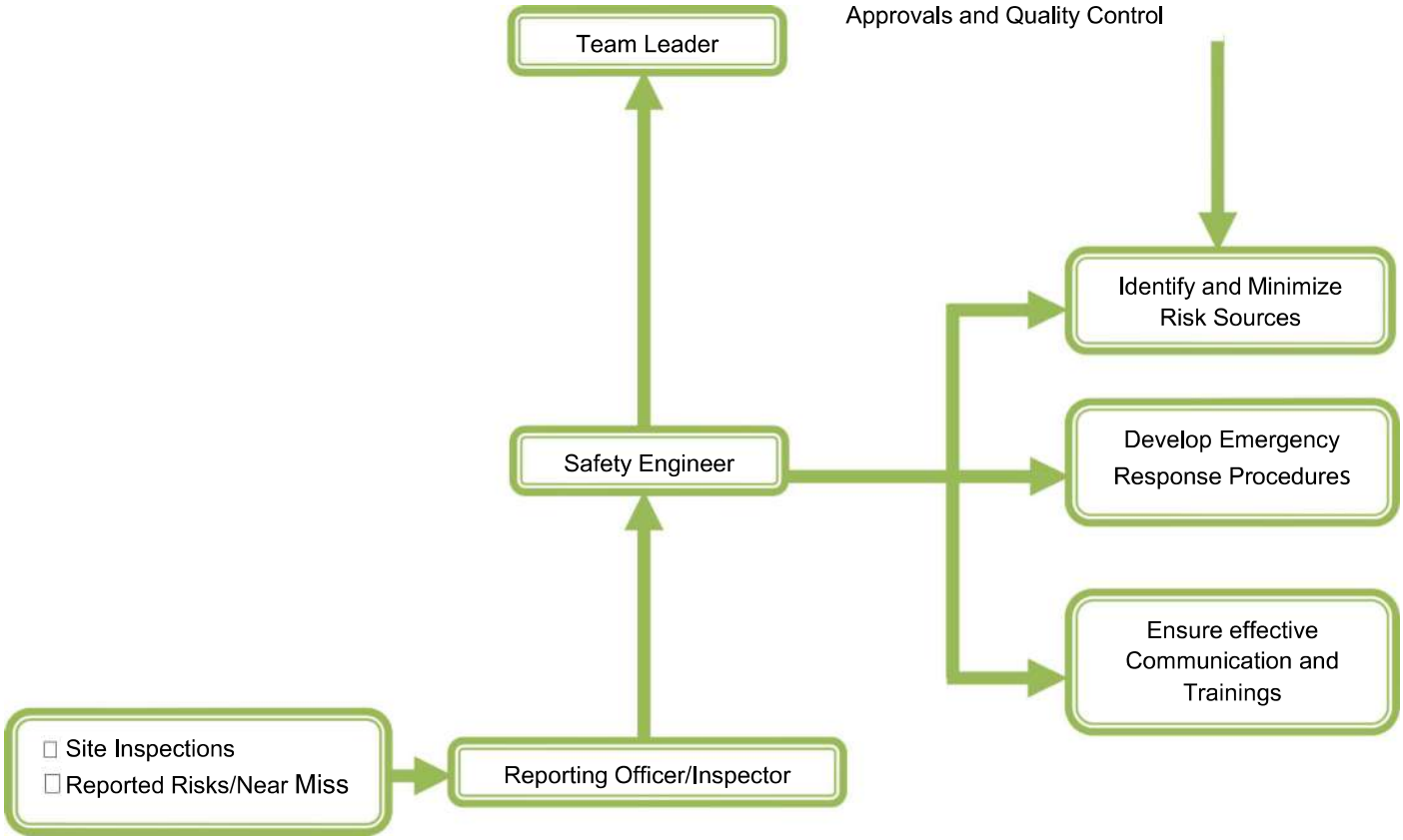


Figure 1: Framework of Responsibilities

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 and smog;
- Regular inspection and maintenance of construction machinery and the structural integrity;
- Review of work schedules based on weather updates; and
- Security controls based on political situations.

4. EMERGENCY PREPAREDNESS

The ERT shall be prepared with all necessary resources and the personnel's shall be trained regularly.

i. Resources

A) 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.

B) Equipment's

All the necessary equipment's needed in an event of emergencies shall be made available, as a minimum. The equipment's needed include:

- Personal protective equipment's (PPEs);
- Alarms;
- Fire extinguishers;
- Crowd control, flashlights, signs, and barricades;
- First aid facility;
- Detection instruments, e.g.; personal alarm kits and smoke detection instruments; and
- Tools to fix minor vandalism.

C) Communication

All external and internal communication systems shall be made available. Local emergency numbers shall be clearly posted and communicated to the personnel involved in construction and operation activities.

The local emergency numbers are given in **Table 1**, which shall be regularly updated.

Table 1: Emergency Numbers

No.	Emergency Services	Numbers Lahore (042)
1.	Edhi Ambulance	440159/444460
2.	Emergency Police	15
3.	Bomb Disposal	7352825
4.	Rescue	1122
5.	Fire Brigade Center	16
6.	Hospital Civil (casualties)	7310130-9

D) 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; and
- Providing advice and reports of the situation to stakeholders.

i. Emergency Response Procedure

Any person can report about an emergency, an on-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 of response is applicable to almost any emergency and should be followed in sequence.

A) 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.

B) 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.

C) Protection from Further Losses

- Once the site is restricted, to provide protection and reduce further losses, the source causing the emergency shall be controlled including equipment's, materials, environment and accident scene from continuing damage or further hazards to the area and people. For-example: suppress fire, prevent objects from falling, shut down equipment or utilities, and take other necessary measures as required depending upon the type of emergency;
- Provide first aid if required;
- Designate people to emergency duties such as assign personnel to guide emergency services on arrival;
- Headcount personnel to identify any missing persons;
- Personnel shall be directed to safe locations;
- Arrange diversions for the traffic to reduce disturbance to the flow of traffic, if and as far as possible; and
- 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

A) 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.

B) Emergency Response Team and Management

Members of ERT shall be immediately informed and the management shall also be kept informed.

C) 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.

D) 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 restored in 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 and replacement of the assets and infrastructure;
- Reinstatement of disrupted services;
- Road and bridge repairs; and
- Updation of safety arrangements and emergency response procedures to ensure better safety and security in any other arising emergencies.

ANNEXURE XII
COST BREAKUP OF HEALTH AND SAFETY OF WORKERS

Cost Breakup of Health and Safety of Workers

Sr. No.	PPE	Quantity	Rate (PKR)	Total Cost (PKR)
1.	Dust Masks	750	300	225,000
2.	Safety Shoes	750	17,000	1,27,50,000
3.	Gloves	750	1,500	11,25,000
4.	First Aid Box	06	20,000	1,20,000
5.	Ear Plugs	750	300	2,25,000
6.	Safety Helmets	750	1,700	12,75,000
7.	Safety Jackets	750	1,300	9,75,000
8.	Dust Bins	21	3,000	63,000
9.	Warning Tapes	10	500	5,000
10.	Safety Cones	60	1,000	60,000
11.	Safety Sign Boards	50	2,700	1,35,000
12.	Medical Screening for Workers	750	3,000	22,50,000
Grand Total			**1,90,66,000**	

A total of **PKR 1,90,66,000/-** or **19.06 million** will be allocated for the assurance of Health and Safety of construction workers through the provision of necessary Personal Protective Equipment (PPE) during the construction phase.

ANNEXURE XIII
NOC FROM EPA PUNJAB

GOVERNMENT OF THE PUNJAB
ENVIRONMENTAL PROTECTION AGENCY
National Hockey Stadium, Gate No. 10
Ferozepur Road, Lahore

NO. DD (EIA)/EPA/F-95(EIA)/2016/ 60
Dated: 07 /02/ 2022

To

Dy. Managing Director (Engg.),
Water & Sanitation Agency (WASA),
Zafar Elahi Road, B-Block, Gulberg-II,
Lahore

Subject: **DECISION OF EPA PUNJAB REGARDING PROJECT "LAYING OF SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE BY WASA"**

1. Description of Project: Laying of sewerage system from Larech Colony to Gulshan-e-Ravi, Lahore using TBM and new disposal station at Gulshan-e-Ravi for sewerage disposal as well as to cater storm water and to reduce the flooding in the area.

2. Location of Project: 28 km covering Central Zone of Lahore (Larech Colony to Gulshan-e-Ravi, Lahore)

3. Date of receiving of IEE: 11.09.2016

4. EPA Punjab has reviewed the Environmental Impact Assessment (EIA) Report and considered Site Inspection Report received from Deputy Director (Environment), Lahore vide letter No. 4862/DO(Env)/LHR dated 31.12.2016 and proceedings of Public Hearing held on 25.03.2021. EPA Punjab has also considered the recommendations of **Committee of Experts** (Meeting dated 22.10.2021), recommendations of Committee notified by DG EPA vide No. PA/DG/EPA/1-9(Misc)/2021 dated 21.10.2021 in meeting held on 01.12.2021 and other relevant record to take lawful decision.

5. **Environmental Protection Agency Punjab accords Environmental Approval under Regulation 12 of IEE/EIA Regulations 2000 read with Section 12 of Punjab Environment Protection Act 1997 for the establishment / construction of your aforesaid project subject to the following conditions:**

i. The Proponent shall ensure compliance with the Punjab Environmental Quality Standards (PEQS) notified for particulate matter, gaseous emissions, waste water and noise so as to protect the air, water bodies, soil and health of the people.
ii. Mitigation Measures suggested in the EIA Report and Environmental Management Plan (EMP) shall be strictly adhered to control any negative impacts on soil, ground water, air and biological resources of the Project area;
iii. The proponent shall maintain the auditable record of measures taken during implementation of Environmental Management Plan for periodical verification by EPA, Punjab;
iv. Monitoring shall be carried out during the entire period of the project activities. Monitoring Reports shall be submitted to EPA Field Office and Director (ML&I) Lahore on quarterly basis;
v. The proponent shall provide a copy of EIA report and copy of this letter to the contractors for their information and compliance with conditions / measures suggested in these documents;
vi. The proponent shall transplant existing trees (if any) in the project area in coordination with Parks and Horticulture Authority (PHA).
vii. The Proponent, shall plant 2000 trees of 6-7 feet height of indigenous species in district Lahore. The Proponent shall also take measures for protection and upkeep of these trees and shall maintain their proper record for verification by EPA;

viii. The construction material shall be stored in such a way that it shall not destroy or damage environment of the locality;
ix. The proponent shall sprinkle water on daily basis during construction activities as dust suppressant;
x. The proponent shall redress the grievances/objections / concerns of stakeholders on priority basis (if arises at any stage);
xi. The proponent shall obtain NOCs/ Clearance of all other relevant departments if the same is required under any law;
xii. Camping sites during construction shall be located at a suitable distance from any settlement to avoid disturbance to the local people and proponent will ensure restoration of camping site to its original condition as well. Sewage generated from camping sites shall be treated in septic tanks;
xiii. Compensation shall be provided to the inhabitants in case of loss of property, shops, businesses etc. in accordance with the rates agreed upon as per law. All conflicting issues regarding compensation shall be settled amicably before or during the project activities with the approval of competent authority by involving all stakeholders;
xiv. The proponent shall ensure preservation and compensation of social environment as per law of the land;
xv. The proponent shall do landscaping and restore the environment after completion of the construction work;
xvi. The proponent shall allocate sufficient budget for enhancement / beautification of environment;
xvii. The proponent shall make proper arrangement to avoid the disturbance of traffic flow during construction phase;
xviii. The proponent shall take effective measures to protect the patients of the nearby hospitals and residents of the area from noise pollution; and
xix. The proponent shall relocate/ restore all the public utilities likely to be affected by the proposed project.

6. This Environmental Approval for the project does not absolve the proponent of the responsibility of obtaining necessary permissions from any other authority which is required under the law.

7. The proponent shall be liable for correctness and validity of information supplied to this department by the Environmental Consultant.

8. This approval shall be treated as null and void if all or any of the conditions mentioned above, is/are not complied with. This approval does not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law in force.

9. This approval shall be valid (for commencement of construction) for a period of three years from the date of issue under Regulation 16 of IEE / EIA Regulations, 2000.

10. This approval can be withdrawn at anytime without any prior notice if deemed necessary in the public / national interest.

ASSISTANT DIRECTOR (EIA)
for DIRECTOR GENERAL, EPA, PUNJAB

NO. & DATE EVEN.

i. A copy is forwarded to the Deputy Director (Environment), Lahore. They are requested to ensure compliance with the conditions mentioned in the Environmental Approval and maintain the file / record of correspondence with the project proponent properly.
ii. *A copy is forwarded to Director (ML&I), Lahore. He is requested to ensure compliance with the conditions mentioned in Environmental Approval at 5(i) and 5(iv).*
iii. *One Window Cell, EPA Punjab*

ASSISTANT DIRECTOR (EIA)

ANNEXURE XIV
PICTORIAL EVIDENCE

Consultation Held In August, 2024

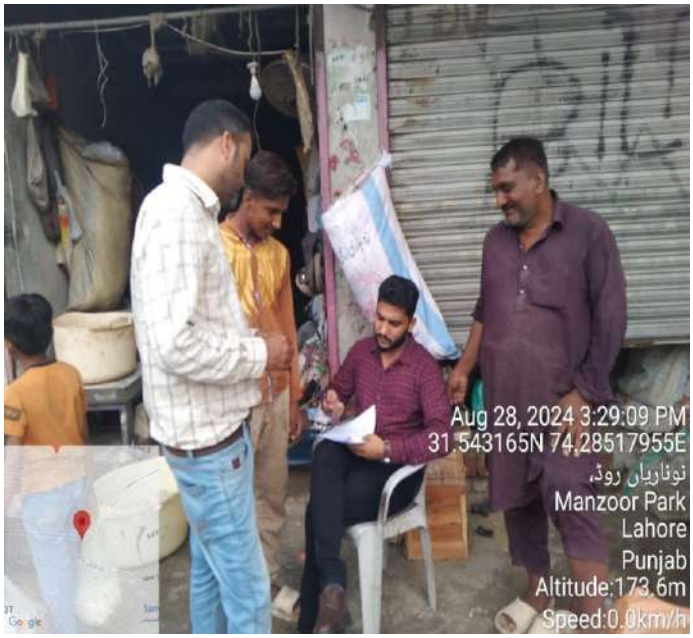









Aug 28, 2024 3:01:37 PM
31.54588936N 74.28873104E
Gulshan-e-Ravi
Lahore
Punjab
Altitude:164.8m
Speed:0.0km/h


Aug 28, 2024 3:29:09 PM
31.543165N 74.28517955E
نوناریاں روڈ،
Manzoor Park
Lahore
Punjab
Altitude:173.6m
Speed:0.0km/h


Aug 28, 2024 12:27:59 PM
31.54450112N 74.35987274E
Upper Mall Scheme
Lahore
Punjab
Altitude:185.8m
Speed:0.0km/h
MIAN MIR COLONY


Aug 28, 2024 12:06:06 PM
222° SW
Altitude:205.2m
Speed:0.1km/h


Mansoor Trust
Stand
Google
G7VF+FPR، بابو صابو – ٹوٹاریاں روڈ، Shera Kot
Lahore, Punjab 54000, Pakistan
31.543797
74.2737778
30/08/2024 13:07:21 pm GMT+05:00




GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
42, J Block Block J Gulshan-e-Ravi, Lahore, Punjab 54500, Pakistan
Lat 31.5498308° Long 74.2716233°
25/09/24 12:37:30 PM
Google


GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
51-Mohallah Urdu Nagar, Mauza Nawan Kot, Samnaabad More, Gulshan-e-Ravi,
Lahore, Gulfishan Colony Lahore, Punjab 54000, Pakistan
Lat 31.545704° Long 74.2929375°
24/09/24 10:38:33 AM


GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
42, J Block Block J Gulshan-e-Ravi,
Lahore, Punjab 54500, Pakistan
Lat 31.5498423° Long 74.2715301°
25/09/24 12:57:36 PM
Google


GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
42, J Block Block J Gulshan-e-Ravi,
Lahore, Punjab 54500, Pakistan
Lat 31.5498423° Long 74.2715301°
25/09/24 12:56:36 PM
Google


GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
42, J Block Block J Gulshan-e-Ravi,
Lahore, Punjab 54500, Pakistan
Lat 31.5498423° Long 74.2715301°
25/09/24 12:57:51 PM
36.1 °C
237° SW
39.0 µT
Google


GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
42, J Block Block J Gulshan-e-Ravi,
Lahore, Punjab 54500, Pakistan
Lat 31.5498308° Long 74.2716233°
25/09/24 12:41:23 PM
36.1 °C
214° SW
43.0 µT
Google


GPS MAP CAMERA
LAHORE,PUNJAB,PAKISTAN
42, J Block Block J Gulshan-e-Ravi,
Lahore, Punjab 54500, Pakistan
Lat 31.5498308° Long 74.2716233°
25/09/24 12:35:26 PM
0.0 °C
333° NW
39.0 µT
Google



Public Consultations in December 2024










Dec 12, 2024 3:15:22 PM
31.5434612N 74.28478734E
نوتاریاں روڈ
Manzoor Park
Lahore
Punjab
Altitude:170.2m
Speed:0.0km/h


Dec 11, 2024 1:40:08 PM
31.56522707N 74.32931964E
22 Abbott Road
Qila Gujjar Singh
Lahore
Punjab
Altitude:189.3m
Speed:0.9km/h


Dec 11, 2024 1:01:21 PM
31.5653515N 74.3290986E
Montgomery Road
Garhi Shahu
Lahore
Punjab
Altitude:182.1m


Dec 11, 2024 1:01:16 PM
31.5646921N 74.3307031E
Montgomery Road
Garhi Shahu
Lahore
Punjab


WE DESIGN KITCHEN AS PER YOUR REQUIREMENTS
Dec 10, 2024 2:09:46 PM
31.54815869N 74.36428471E
Umar Colony
Lahore
Punjab
Altitude:196.2m
Speed:0.0km/h

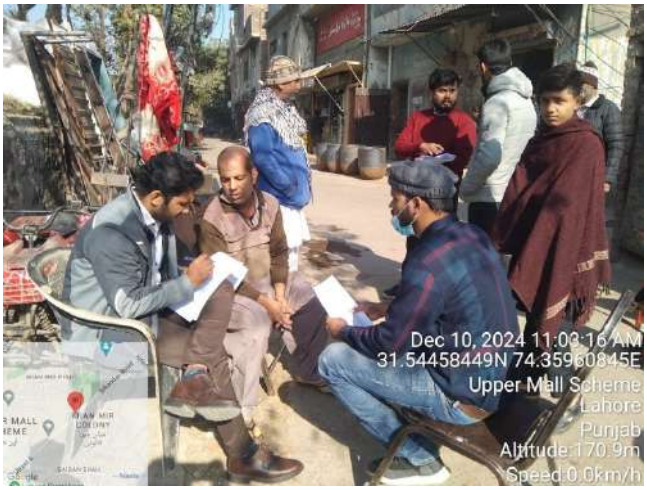

Dec 11, 2024 11:29:13 AM
31.56282201N 74.34268684E
44/A Allama Iqbal Road
Garhi Shahu
Lahore
Punjab
Altitude:177.8m
Speed:0.0km/h


Dec 10, 2024 2:09:37 PM
31.54822157N 74.36429452E
Umar Colony
Lahore
Punjab
Altitude:196.1m
Speed:0.0km/h


Dec 10, 2024 11:38:14 AM
31.54480094N 74.3599722E
Sikandar Road
Upper Mall Scheme
Lahore
Punjab
Altitude:167.7m
Speed:0.0km/h


Dec 10, 2024 11:38:04 AM
31.54479885N 74.35996649E
Sikandar Road
Upper Mall Scheme
Lahore
Punjab
Altitude:168.2m
Speed:0.0km/h


Dec 10, 2024 11:03:07 AM
31.54456052N 74.35962385E
Upper Mall Scheme
Lahore
Punjab
Altitude:175.5m
Speed:0.0km/h


Dec 10, 2024 11:03:16 AM
31.54458449N 74.35960845E
Upper Mall Scheme
Lahore
Punjab
Altitude:170.9m
Speed:0.0km/h

ANNEXURE XV:

CONSTRUCTION METHODOLOGY

CONSTRUCTION METHODOLOGY

1. GENERAL

The project is located in the busy and congested urban areas of Lahore Metropolis with a large number of buildings and infrastructure along the right of way. To avert the potential risk of heave or settlement and avoid the decades old utilities in the city, the sewer will be placed using Trenchless technology “Horizontal Boring and Pipe Jacking technology having minimum cover of ten meter, which is many times the rule of thumb, minimum 2D pipe diameter cover to provide the stable arch above the tunnel.

2. TRENCHLESS TECHNOLOGY

The Trenchless technology “Horizontal Boring/ Pipe Jacking technology” have been proposed to lay the trunk sewer lines. 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. SLURRY MTBM

This machine can excavate the material at the tunnel face and mix 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 man 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 1**.



Figure-1: TBM Machine

Bentonite*

Bentonite is clay generated frequently from the alteration of volcanic ash, consisting predominantly of smectite minerals, usually montmorillonite. It is used during the tunneling both as transport medium for excavated material in the slurry circuit, and as a support medium for the tunnel face. The other benefits for which bentonite are used in slurry TBM is as follows:

- Support the excavation by exerting hydrostatic pressure on its walls i.e. to prevent the collapse or retain an area;
- Remain in the excavation, and not flow to any great extent into the soil thereby acting as a sealant;
- Suspend detritus and prevent sludgy layers building up at the base of the excavation;
- Staying insular and non-reactive by clean displacement by concrete, with no significant interference with the bond between reinforcement and set concrete; and
- Cleaning to remove suspended detritus, by passing through screens and hydro-cyclones, in preparation for re-use.

Bentonite will be reused, whereas, LWMC shall be responsible for the management of remaining wastes.

4. SCHEDULE OF TBM EQUIPMENT FOR PROJECT

In addition to the cutter head and shield comprising the TBM assembly, the following equipment will also be made part of the TBM operation i.e.:

- Slurry Separation Plant and Pumps;
- Bentonite Lubrication Plant;
- Control Room;
- Guidance System;
- Power Supply;
- Launching Seal;

*Source: https://theconstructor.org/others/bentonite-uses-construction/13332/

- Main Jacks with thrust ring;
- Inter Jacking Equipment; and
- Air Locks and Supply Lines.

Micro-tunneling system must be capable of the following:

- Data recording with direct printing or electronic copy of drive record for
- Steering position
- Laser position on target
- Length driven, day date time
- Torque cutter head and jacking force
- Working under water depth of maximum 3.5 bar;
- Offer minimum 3 IJS stations controls;
- Bearing lubrication system;
- Automatic bentonite lubrication system; and
- Straight or curved alignments required.

5. JACKING SYSTEM

The jacking system for the project will consist of main hydraulic jacking system installed in jacking pit having capability to push the TBM and pipe string through the ground in a controlled manner. The jacking capacity will be higher than the anticipated jacking forces with sufficient degree of safety factor.

The project pipe diameters allow installing the intermediate jacking stations. These stations shall be of

similar capacity as of the main jacking system and installed at the designed interval to increase the drive length and to apply the jacking force at the advancing pipe strings without overstressing and keeping the pipe joints within the range of recommended joint deflection angle (i.e., 0.5 degree).

6. PIPE LUBRICATIONS

The pipe lubrication shall be the integral part of TBM and pipe jacking operation for reducing the jacking force requirement. This system will consist of mixing tank, holding tank and pump to convey the lubricant from holding tank to application point. The TBM rear can shall also be equipped with lubrication ports and afterward each third pipes shall have the lubrication ports.

All TBM components i.e., jacks, lubrication system, slurry system, guidance system, and power supplies shall work integrally and operated through a central control room.

7. SHAFTS

A large number of launch, reception and intermediate shafts have to be constructed. Each shaft will have their specific construction purpose, however all these shaft shall be converted in man-holes at the end of construction. Therefore, the shafts shall be temporary as well as permanent project component.

The sunk-in caisson construction technique involves sinking a cast-in-place concrete caisson into the ground under its own weight, while excavating inside the caisson with a clam shell bucket. The excavation can be performed without dewatering in advance. To withstand groundwater pressure, a termite concrete slab is placed and cured at the bottom of the caisson. Then the caisson can be dewatered to provide a dry working space. Slurry or ground improvement can be used in conjunction with the sunk-in caisson to provide lubrication and stabilize the sides of the excavated hole and minimize any settlement that may occur at nearby structures. All the caisson shafts have to be constructed above the water table.

Figure 2 show the different stages of proposed caisson construction for drive and reception shafts, which will eventually be converted into manholes along the pipeline.



Figure 2: Different Stages of Caisson (Shaft) Construction

7.1. THRUST BLOCK AND BASE SLAB

The micro-tunneling machine shall be driven in opposite direction in each drive shaft, therefore need two thrust walls each at the rear of the jacking frame. The second thrust must be braced by a trapezoidal concrete thrust block that will envelop the pipes (if they are protruding into the jacking shaft) and it will in turn push off of the launch eye of the first finished drive.

7.2. TBM LAND STAGING AREA

The construction staging areas are required near the jacking shafts to provide space for the construction equipment, material storage and laydown, materials handling, and spoils removal and disposal. Support facilities are also needed such as office trailers, and other facilities. The working area of the drive shaft which normally needs for size ranges of tunnel requiring for the current project is about approx. 30 x 30 meter[1] (8,000 to 10,000 square feet).

Typical footprint of 1500 and 2400 ID micro tunneling construction layout is shown as **figure 3 and 4.** Sufficient space is required to store casing pipe segments either at the staging area or nearby the staging area. Supplemental space may be required at an offsite location for supplies and equipment.

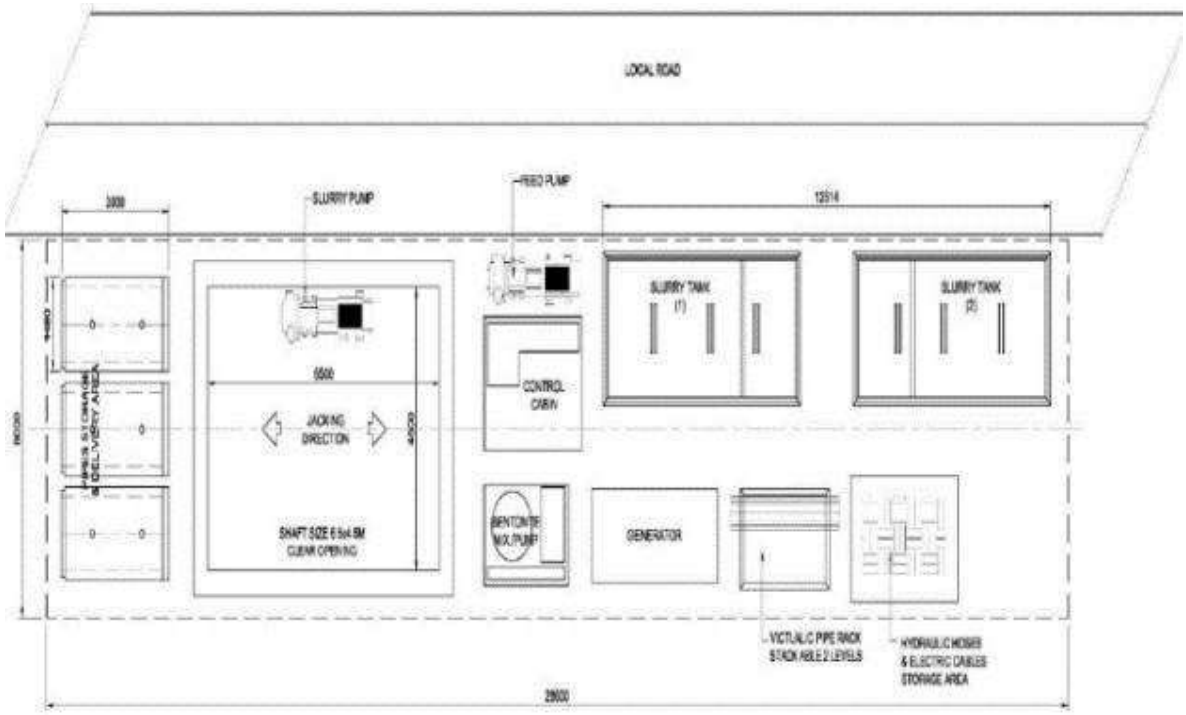


Figure** Error! No text of specified style in document.:* ***Typical Ground Footprint of 1500mm Pipeline Jacking Shaft

[1] Design Report for Laying of Trunk Sewer from Larech Colony to Gulshan-e-Ravi.

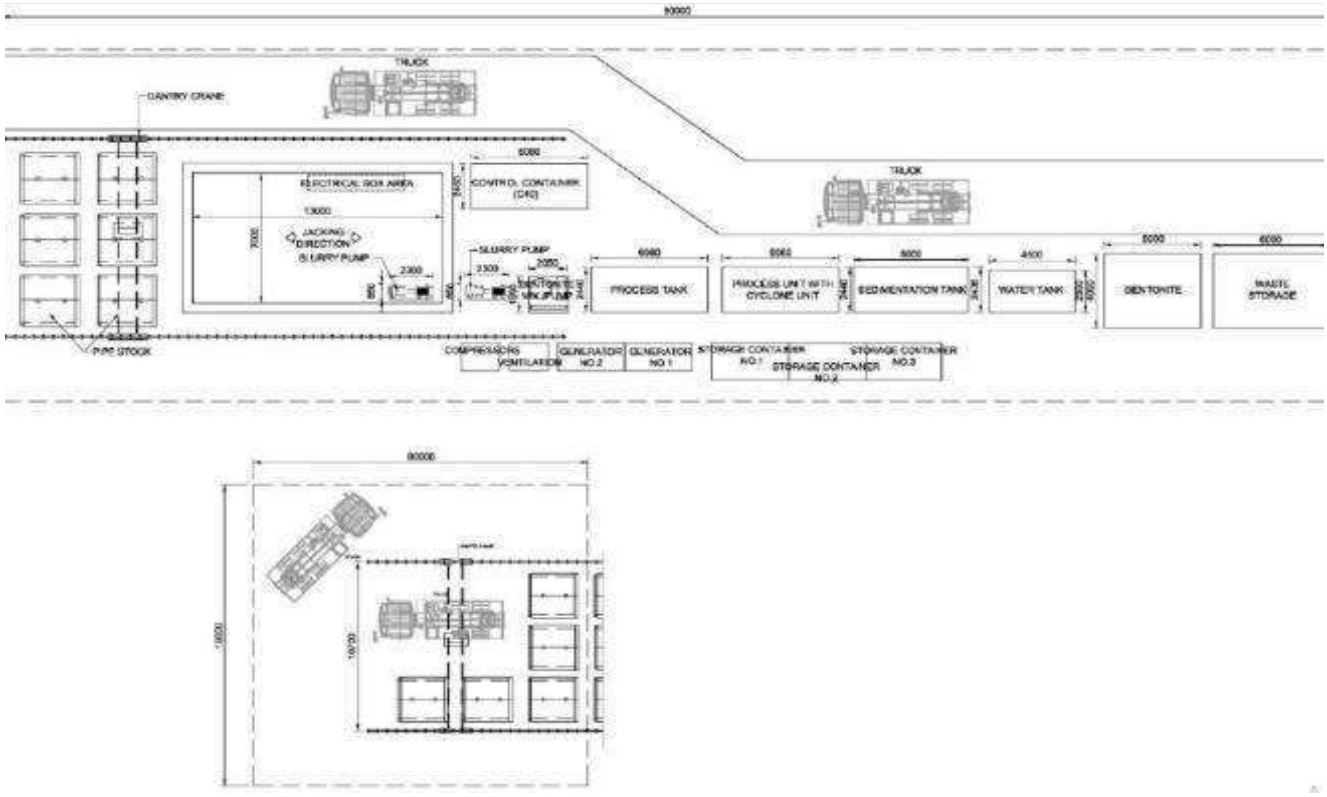


Figure 4: **Typical Ground Footprint of 2400mm Pipeline Jacking Shaft**

ANNEXURE XVI: GEOTECHNICAL & SOIL INVESTIGATION REPORT

GEOTECHNICAL STUDIES

1. Introduction

Detailed Geotechnical investigation was carried out for the design of the project. The purpose of current study was to confirm geotechnical information collected during previous studies and provide the further information about the surface and subsurface soil formations at the project site in order to develop a sufficient design for the EPC project. The information collected comprises type of materials and their engineering properties required for design. In addition, determination of ground water level and bearing capacity at foundation level was studied to decide the most suitable design and safe foundations.

2. Previous Studies

During feasibility stage National Engineering Services Pakistan (NESPAK) managed to drill thirty-four (34) Boreholes: Seventeen (17) boreholes 15 to 20m depth and other seventeen (17) boreholes were extended down to 25m depth below existing ground level. Following field testing was done during drilling of boreholes.

- Standard Penetration Test (SPT)
- Permeability Test in selected boreholes.

Following soil parameters were given in the report:

Table** Error! No text of specified style in document.**1: Soil Parameters

Soil Type	Depth (m)		Bulk Density, γ_b	Angle of Internal Friction, Ø
	From	To	kN/m^3	Degree
Fill Material	0.0	1.0 - 2.0	17	-
Silty Sand/Sandy Silt	1.0 - 2.0	9.0	17	29
Silty Sand	9.0	13.0	17.5	30
Silty Sand	13.0	18.0	18.0	29
Silty Sand/Poorly graded Sand	18.0	25.0	18.5	33

3. Present Geotechnical Study

When designing and costing of work to be carried out using micro tunneling method, a thorough site investigation, both factual and interpretative reports are required in order to determine the characteristics of the subsurface soils likely to be encountered, together with details of the ground water table in the vicinity. In order to achieve the said objective, confirmatory geotechnical investigations have been carried out as discussed below.

3.1 Scope of the Confirmatory Geotechnical Investigations

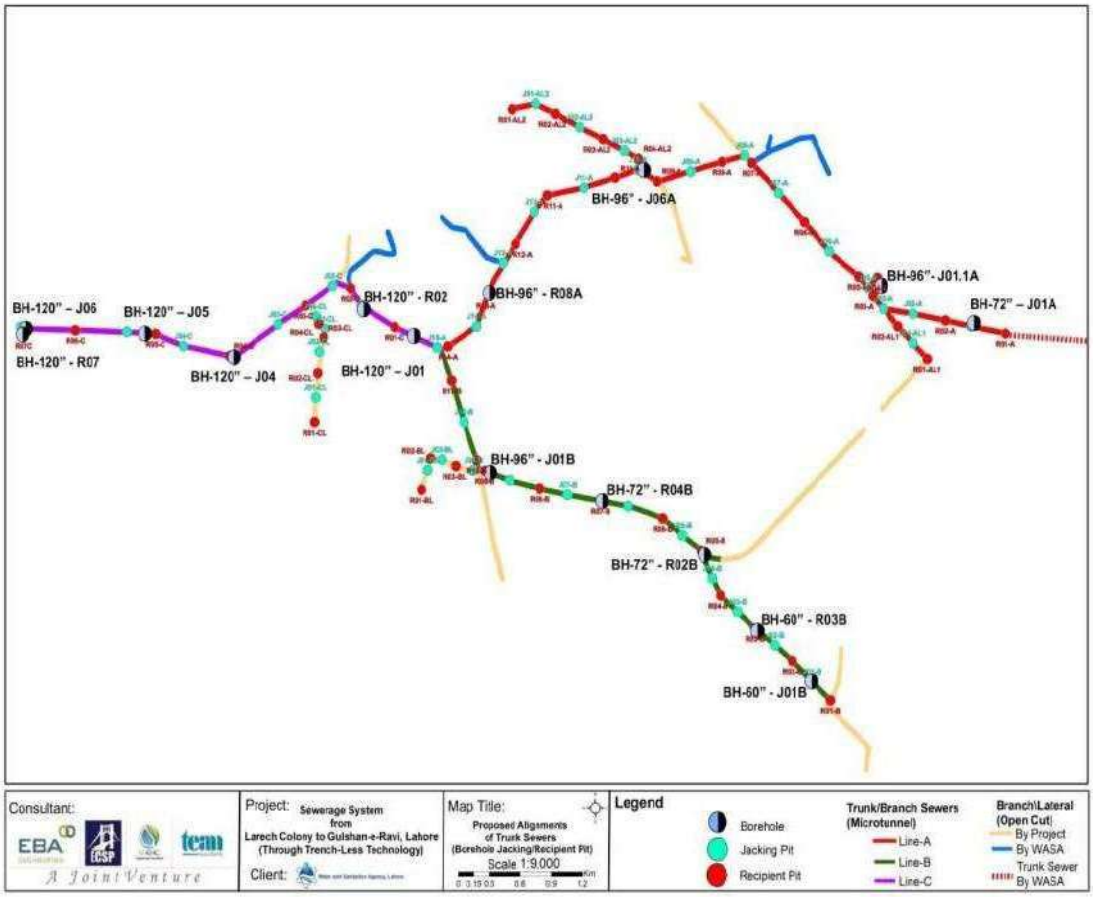
During the present phase, PMC hired M/s Pioneer Associates Lahore to execute confirmatory geotechnical investigations with the following scope:

Drilling of fifteen (15) boreholes, seven (7) up to a depth of 30.0 m and remaining eight (8) extended down to 40 m depth below the existing ground level. Two drilling methods were recommended, i.e. rotary and hand auger; 50% bores with each method. The location of these boreholes is given in figure 3.9 below:

1. Performance of field testing including Standard Penetration Test (SPT) and Permeability test.
2. Collection of disturbed, undisturbed soil samples and groundwater samples.

3. Installation of piezometer in case groundwater encountered.
4. Carry out laboratory tests on selected soil samples from boreholes to determine the engineering characteristics and chemical properties.
5. Report the Engineering analysis of field and laboratory findings. Conclusions and recommendations to develop the design parameters required for the TBM expert.
6. All the field activities were supervised by PMC field geotechnical engineer/geologist.

Figure 1: Location of Boreholes



4. Investigation Methodology

Keeping in view the scope of work and specifications generally followed for the detailed geotechnical studies, a program of field work was prepared. The exploratory borings were drilled using straight rotary drilling rigs and hand auger. Field tests (i.e. Standard Penetration Test (SPT) use to perform at designated depths in accordance with relevant American Society of testing materials (ASTM) standard. Soil samples use to collect from the boreholes using appropriate samplers for identification and subsequent laboratory testing. Selected soil samples were subjected to various laboratory tests for evaluation of classification, strength and chemical characteristics of the subsurface strata. The laboratory tests were performed in accordance with the relevant ASTM and British Standards (BS) standards and specifications.

4.1 Field Investigations

4.1.1 General

The proposed field work consisted of drilling, field testing and sampling of the subsurface soil samples at designated depths. The borehole locations were decided by the PMC and marked in the field by the contractor's geologist using hand held GPS.

A list of coordinates/status of the borehole locations is provided in the following table:

Table** Error! No text of specified style in document.**2: List of Borehole Coordinates and Status

Section	Borehole No	Northing	Easting	Elevation (m)	Type of Boring	Type of Boring	Depth (m)
Line A	72" – J01A				HAND AUGER	HAND AUGER	30
	96"- J01.1A	31.553824	74.359695	215.0	ROTARY	ROTARY	30
	96" - J06A	31.562387	74.335384	214.0	HAND AUGER	HAND AUGER	30
	96" - R08A	31.553099	74.319713	213.0	ROTARY	ROTARY	30
Line B	60" - J01B	31.524185	74.352757	215.0	ROTARY	ROTARY	30
	60" - R03B	31.527920	74.347234	214.0	HAND AUGER	HAND AUGER	30
	72" - R02B	31.533596	74.341766	214.0	ROTARY	ROTARY	30
	72" - R04B	31.537564	74.331319	213.0	HAND AUGER	HAND AUGER	40
	96" - J01B	31.539617	74.319888	212.0	ROTARY	ROTARY	40
Line C	120" – J01	31.549824	74.312010	213.0	ROTARY	ROTARY	30
	120" - R02	31.551801	74.306867	212.0	HAND AUGER	HAND AUGER	30
	120" – J04	31.548136	74.293693	209.0	HAND AUGER	HAND AUGER	27
	120" – J05	31.549846	74.284581	208.0	ROTARY	ROTARY	40
	120" – J06	31.550152	74.272443	208.0	ROTARY	ROTARY	40
	120" - R07	31.549714	74.272093	207.0	ROTARY	ROTARY	40

Note: The borehole 120-J04 was drilled by using hand auger and abandoned at 27m depth because hard clay was encountered and it was not possible to continue further by using hand auger.

4.1.2 Execution of Boreholes

All the fifteen boreholes were completed as per scope of work.

Straight Rotary drilling rigs were used to drill the boreholes using the rotary water flush drilling method. The logs of the completed boreholes have been attached herewith.

Auger drilling of the boreholes was carried out by using hand auger. In this method boring is carried out by Auger down to the maximum depth possible. Then further drilling was advanced by using light percussion. Casing was used to avoid any collapse in the borehole. The soil cuttings can be collected for identification of the subsurface strata. The cuttings, however, are not used for laboratory testing since these are badly disturbed and do not represent true texture of the subsoil.

4.1.3 In-Situ Sampling

Disturbed Sampling

Due to the un-cemented nature of the sandy materials encountered in the boreholes disturbed soil samples (using split spoon) were obtained. The samples recovered were examined, described and classified by our geotechnical engineer, properly labeled, preserved and placed in safe container and finally taken to store to deliver to the laboratory for testing.

Undisturbed Sampling

Undisturbed soil samples were retrieved from the boreholes using Denison pitcher sampler having tube diameter 76 mm. The samples recovered were examined, described and classified by our geotechnical engineer properly preserved, labeled and placed in proper sequence in the container to maintain the natural moisture content and taken to store to deliver to laboratory for testing. These samples were obtained to perform direct shear test, consolidation test and unconfined compression test in the laboratory.

4.1.4 In-Situ Testing

Standard Penetration Tests (SPT)

Standard Penetration Test (SPT) was performed in all the drilled boreholes in the encountered materials to obtain approximate relative densities of the ground materials. The test was performed in accordance to ASTM D 1586 – 11. The SPT equipment used in this project consisted of a hammer (63.5kg weight) and 45cm long split tube (5.0cm diameter) with a hammer drop of 760mm.

SPT hammer and guide rod was checked in house and found as per requirement of ASTM standard.

The standard blow count $N_{60\ (corr)}$ can be computed by the following formula.

$N_{60\ (corr)} = N_{field} * C_E * C_B * C_S * C_R$

(Foundation Analysis & Design by Joseph E. Bowles fifth edition 1999)

Where

N_{field}: SPT N from field

C_E: Effects of energy= ER/60, (ER: energy ratio)

C_B = Correction for borehole diameter = 1.0

C_S = Sampler correction = 1.0

C_R = Correction for rod length = 0.75 (0.0-4.0m)

= 0.85 (4.0-6.0m)

= 0.95 (6.0-10.0m)

= 1.0 (> 10.0m)

The test results shown on the log of boring are attached as well as subsurface profiles at the respective test depths. The Standard Penetration Test is defined in the legend of log of boring, along with the interpretation of the test results.

Permeability

The ability of soil to allow flow of water through it is called as permeability of soil. It is very important factor for the structures which are in contact with water. Flow of water in soil takes

place through void spaces, which are interconnected. Water does not flow in a straight line, but in a winding path. However in soil mechanics flow is considered to be in a straight line at an effective velocity. The velocity of flow depends on size of pores.

Permeability can be calculated by falling head, rising head and constant head test. The pressure in the borehole may be increased by introducing water into it, which is commonly called a falling head or inflow test, or it may be decreased by pumping water out of it in a rising head or outflow test. The pressure may be held constant during a test (constant head test) or it may be allowed to vary (a variable head test). Typical values of different soils are given below in **Table 3.**

Table** Error! No text of specified style in document.**: Values of Relative Permeability and Permeability Coefficient of different soils

Soil	Permeability Coefficient, k (cm/sec)	Relative Permeability
Coarse gravel	Exceeds 10^{-1}	High
Sand, Clean	10^{-1} to10^{-3}	Medium
Sand, dirty	10^{-3} to10^{-5}	Low
Silt	10^{-5} to10^{-7}	Very Low
Clay	Less than 10^{-7}	Impervious

Falling Head Permeability Test

The test was carried out adopting the following procedure.

- The test was carried out in boreholes drilled by hand auger method / rotary drilling with water flush. The borehole was drilled to the required depth of proposed permeability test.
- The borehole casing was filled with water to the top level and the drop in water level against time shall be recorded.

Constant Head Permeability Test

In the Constant Head Permeability test water is added to the casing at a rate sufficient to maintain a constant water level at or near the top of the casing for a period of not less than 10 minutes. The water may be added by pouring from calibrated containers or by pumping through a graduated cylinder. The data recorded should consist of the amount of water added to the casing at 1, 2 and 5 minutes after the start of the test and at 5 minute intervals thereafter until an adequate determination of the permeability has been made.

The following data were recorded for all field permeability tests in addition to the readings specified:

- Steady, ground water level before test.
- Internal diameter of casing.
- Height of casing above ground level.
- Depths of other casing below ground level.
- Depth of smallest casing below ground level.

- Depth of hole below ground level.
- Diameter of hole below casing.

RESULTS OF PERMEABILITY TESTS

Six no permeability tests (four falling head and two constant head) were performed. Following table is indicating the results of permeability.

Sr. No.	Section	Borehole No.	Depth (m)	K (cm/sec)	Test Method
1	Line - A	72-J01A	8	3.65×10^{-4}	Falling Head
2		96-J06A	10	2.278×10^{-3}	Constant Head
3	Line - B	60-R03B	16	1.429×10^{-3}	Constant Head
4		72-R04B	15	3.88×10^{-4}	Falling Head
5	Line - C	120-R02	13	2.10×10^{-4}	Falling Head
6		120-J04	12	3.06×10^{-4}	Falling Head

4.1.5 Laboratory Testing

In order to determine the physical, chemical and mechanical properties of the subsurface materials, laboratory tests have been planned on selected representative samples recovered from the boreholes. The purpose of laboratory testing was to confirm the field description and to determine the index and chemical properties of the material encountered. All the testing has been performed at Geotechnical Engineering Laboratory, Department of Civil Engineering, University of Engineering and Technology, Lahore. The laboratory tests were performed according to American Society for Testing and Materials (ASTM) Standards and / or British Standards (BS), as appropriate. Detail of laboratory tests is given below.

- ASTM D 2216-98, Standard Test Method for, “Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass".
- ASTM D 4318-00, Standard Test Method for, “Liquid Limit, Plastic Limit and Plasticity Index of Soils”.
- ASTM D 422-63(2002), Standard Test Method for “Particle – Size Analysis of Soils”.
- ASTM D 2435 Consolidation properties of soil
- ASTM D 2166 Unconfined compressive strength of cohesive soil.
- ASTM D 3080 Direct shear test of soils under consolidated drained conditions.
- B.S. 1377: Part 3: 1990, clause 5, "Determination of The Sulphate Content of Soil and Ground Water". Gravimetric method for acid extracts in which hydrochloric acid was used.
- B.S. 1377: Part 3: 1990, clause 7.3 "Determination of Acid-Soluble Chloride Content". Nitric acid was used.
- B.S. 1377: Part 3: 1990, 3 "Determination of organic matter content was used.
- B.S. 1377: Part 3: 1990, clause 9, "Determination of the pH Value".

4.1.6 Lithology and Stratigraphy

Confirmatory Geotechnical investigations are completed along the proposed alignments of the Trunk Sewers and at the location of proposed disposal station. The data of the boreholes have revealed the following distinct lithological units:

Trunk Sewer Line A

The following information is based on only one (01) completed borehole. The depths are below NSL.

- Fill material consisting of Silt, Clay mixed with sand, brick pieces and polythene bags etc. was encountered down to depth of 0.9 m.
- Fill material was underlain by light brown, firm to very stiff Silty Clay/Silt with Sand layer down to 5.80 m depth.
- The Silty Clay/Silt with Sand layer is followed by light grey, medium dense to dense Silty Sand layer down to a maximum of 9.6 m depth.
- The Silty Sand layer is followed by grey, medium dense to very dense fine Sand down to the maximum investigated depth of 30 m.

Trunk Sewer Line B

The following information is based on five (05) completed boreholes and all the depths are below NSL.

- Fill material consisting of Silty Clay mixed with brick pieces and polythene bags etc. was encountered down to a maximum depth of 5.5 m.
- Fill material was underlain by brown, firm to stiff, silty Clay/clayey Silt down to depth of 0.5 to 15.6m.
- This clay layer was underlain by light grey, medium dense to dense fine Sand down to depth of 30 to 40m.
- Thin lenses of silty Clay/clayey Silt encountered below 15.6 and 40m depth.

Trunk Sewer LINE C

The following information is based on six (6) completed boreholes and all the depths are below NSL.

- Fill material consisting of Silty Clay mixed with brick pieces and polythene bags etc. was encountered down to a maximum depth of 3.70m.
- Fill material was underlain by light brown, stiff to very stiff Silty Clay/Clayey Silt with Sand down to depth of 0.75 to 10.60 m.
- The Silty Clay/Clayey Silt with Sand is followed by light grey, medium dense to dense Silty Sand layer down to a depth of 1.6 to 25.5 m.
- Fine sand was underlain by light brown, very stiff to hard Silty Clay/Clayey Silt with Sand layer down to depth of 23.0 to 32 m.
- The Clay layer is followed by light brown, dense to very dense fine Sand down to a depth of 32.0 to 40 m and that is the maximum depth investigated.

4.1.7 Groundwater Table

In general no groundwater encountered down to the maximum depth investigated, however few boreholes groundwater encountered and that seems to be perched water. Following table is indicating the details.

Table** Error! No text of specified style in document.**2: Depths of Groundwater in Boreholes

Borehole No	Date	GWT (m)*	Remarks
120-J04	04 - Oct – 2022	19.20	
	05 - Oct – 2022	21.52	09:00
	05 - Oct – 2022	26.23	10:30 after bailed out
	05 - Oct – 2022	23.82	14:30
	05 - Oct – 2022	22.83	17:30
	06 - Oct – 2022	21.61	09:00
	08 - Oct – 2022	19.21	09:15 (Piezometer installed)
	10 - Oct – 2022	19.48	10:30
	6 - Oct – 2022	19.31	12:10
72-R04B	16 - Oct - 2022	37.14	09:00
	17 - Oct - 2022	37.10	09:20
	18 - Oct - 2022	-	Borehole collapsed at 35.62m
96-J01B	20 - Oct - 022	35.0	09:00 after bailed out
	21 - Oct - 2022	36.72	10:45

Notes:

- *All the measured depth is below natural surface level.
- Above level is not constant and is subject to change with seasonal and climatic conditions.

5. Preliminary JV Parameters

Up till now only eight results of direct shear test have been received and presented below as it is.

Table** Error! No text of specified style in document..**3: Results of Direct Shear Test

Section	Borehole No	Depth (m)	Cohesion (kN/m^2)	Angle of Internal Friction (Ø)
Line - B	60” J01B	13.0	0.5	30
		20.0	0.6	29.2
	60” R03B	17.0	1.4	29.2
	72” R02B	13.0	0.1	31.8
Line - C	120” J01	9.0	2.2	27
		20	1.1	29
	120” R02	14	0.3	31
	120” J06	12	0.5	30

Note: Range of above values will be generalized after receiving all the laboratory test results.

6. Comparison of Parameters

Table** Error! No text of specified style in document..**4: Comparison of Results by NESPAK

NES PAK DATA			JV CONFIRMATORY
Depth (m)		Angle of Internal Friction (Ø)	Angle of Internal Friction (Ø)
From	To		
9.0	13.0	30	27 - 31.8
13.0	18.0	29	29 - 31
18.0	25.0	33	29 - 29.2

7. Conclusions

Based on the confirmatory geotechnical study and the laboratory test results obtained, results are more or less similar to the values presented by NESPAK.

8. Limitations

The borings indicate the subsurface conditions at the locations, dates, and depths indicated and it is not warranted that they are strictly representative of the materials and conditions at other locations, times, and greater depths.

ANNEXURE XVII: ENVIRONMENTAL MONITORING REPORTS

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)

Reference Number:	ESPAK/0069P/23/AA/0729/00086	**Date:**	17/02/2023
Name of Industry/Client:	Micro Tunneling Project WASA Lahore		
Address:	1 Nursery Lane, Lawrance Road, Lahore		
Validation Officer:	Muhammad Nadeem, Research Officer		
Nature of Sample:	Ambient Air	**Monitoring Location:**	Garhi Shahu Point-1 (GPS: 31.55552°, 74.355452°)
Date of Sample Collection:	09/02/2023		
Sample Collected/Sent By:	Muhammad Zubair, Analyst (Field), ESPAK	**Grab / Composite:**	Continuous - 24 Hours
Date of Completion of Analysis:	10/02/2023		

S. No	Parameters	Limit Values (PEQS-24Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m³ (8 Hours)	2.3 mg/m³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO_2)	120 µg/m³	18.2 µg/m³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O_3)	130 µg/m³ (1 Hour)	8.0 µg/m³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m³	16.3 µg/m³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO_2	80 µg/m³	22.9 µg/m³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter $PM_{2.5}$	35 µg/m³	**39.4 µg/m³**	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM_{10}	150 µg/m³	**156 µg/m³**	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m³	**528 µg/m³**	High Volume Sampler (HVS)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)

Reference Number: ESPAK/0069P/23/AA/0729/00086 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

1. **Sample Analyzed By:** Muhammad Zubair
   Analyst (Field)
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

Environmental Services Pakistan ESPAK Tel:+924235154012-17

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED Management System Certification Body MSCB 194

Client Name	Micro Tunneling Project WASA Lahore
Monitoring Address	1 Nursery Lane, Lawrance Road, Lahore
Co-Ordinates	31.55552°, 74.355452°
Monitoring Location	Ghari Shahu - Point 1
Parameter	Ambient Air and Noise Mointoring
Equipment Used	Environment S.A & Noise Meter
Sampling interval	60 minutes
Sampling duration	24 hours
Monitoring Date	09-Feb-2023 to 10-Feb-2023

Date - Time	CO	SO_2	O_3	NO	NO_2	$PM_{2.5}$	PM_{10}	Noise
	mg/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	dB(A)
09/02/2023 15:07	2.4	19.9	8.0	18.8	20.8	41.1	156	74.1
09/02/2023 16:07	2.3	19.5		15.9	23.3	40.7	157	72.3
09/02/2023 17:07	2.2	18.7		14.6	27.9	39.9	158	71.8
09/02/2023 18:07	2.5	17.2		18.2	24.0	38.4	159	70.9
09/02/2023 19:07	2.4	18.3		23.4	20.6	39.5	159	72.5
09/02/2023 20:07	2.1	19.0		17.8	23.9	40.2	152	73.4
09/02/2023 21:07	2.3	19.3		15.3	21.3	40.5	151	70.4
09/02/2023 22:07	2.4	19.7		16.6	25.5	40.9	155	72.5
09/02/2023 23:07		17.7		15.1	23.9	38.9	152	69.1
10/02/2023 0:07		18.1		16.4	28.1	39.3	148	69.5
10/02/2023 1:07		19.6		16.0	32.3	40.8	149	68.2
10/02/2023 2:07		13.4		14.6	18.5	34.6	155	66.5
10/02/2023 3:07		16.4		13.4	24.4	37.6	144	64.7
10/02/2023 4:07		17.1		14.1	27.0	38.3	151	65.6
10/02/2023 5:07		17.6		15.3	21.3	38.8	145	63.5
10/02/2023 6:07		17.3		14.3	24.4	38.5	158	65.3
10/02/2023 7:07		13.3		15.1	21.0	34.5	146	66.8
10/02/2023 8:07		17.9		15.2	26.4	39.1	166	69.5
10/02/2023 9:07		19.8		18.9	13.1	41.0	153	71.2
10/02/2023 10:07		15.8		18.7	12.5	37.0	151	74.6
10/02/2023 11:07		18.2		12.7	21.8	39.4	158	78.6
10/02/2023 12:07		20.2		19.5	14.8	41.4	164	74.6
10/02/2023 13:07		19.6		14.6	24.5	40.8	163	76.3
10/02/2023 14:07		22.8		17.0	28.5	44.0	193	75.2

Average	2.3	18.2	8.0	16.3	22.9	39.4	156	58.6
Maximum	2.5	22.8	8.0	23.4	32.3	44.0	193	78.6
Minimum	2.1	13.3	8.0	12.7	12.5	34.5	144.3	63.5
CO First 8 Hours	2.3							
Noise Day Hours	73							
Noise Night Hours	68							
Monitored By:	Muhammad Zubair, Field Officer							

(Head Office) Office # 731, Block – 2, Sector: D1,
Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz,
Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)

Reference Number: ESPAK/0069P/23/AA/0730/00087 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

Address: 1 Nursery Lane, Lawrance Road, Lahore

Validation Officer: Muhammad Nadeem, Research Officer

Nature of Sample: Ambient Air **Monitoring Location:** Near Shama Stop Point-2 (GPS: 31.541991°74.312906°)

Date of Sample Collection: 10/02/2023 **Grab / Composite:** Continuous - 24 Hours

Sample Collected/Sent By: Muhammad Zubair, Analyst (Field), ESPAK

Date of Completion of Analysis: 11/02/2023

S. No	Parameters	Limit Values (PEQS-24Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m³ (8 Hours)	4.4 mg/m³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO_2)	120 µg/m³	20.3 µg/m³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O_3)	130 µg/m³ (1 Hour)	10.2 µg/m³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m³	17.4 µg/m³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO_2	80 µg/m³	30.0 µg/m³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter $PM_{2.5}$	35 µg/m³	**40.1 µg/m³**	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM_{10}	150 µg/m³	**152 µg/m³**	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m³	**632 µg/m³**	High Volume Sampler (HVS)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)

Reference Number: ESPAK/0069P/23/AA/0730/00087 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

1. **Sample Analyzed By:** Muhammad Zubair
   Analyst (Field)
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

Environmental Services Pakistan ESPAK Tel: +924233154012-17

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

Client Name	Micro Tunneling Project WASA Lahore
Monitoring Address	1 Nursery Lane, Lawrance Road, Lahore
Co-Ordinates	31.541991, 74.312906
Monitoring Location	Near Shama Stop, Point 2
Parameter	Ambient Air and Noise Mointoring
Equipment Used	Environment S.A & Noise Meter
Sampling interval	60 minutes
Sampling duration	24 hours
Monitoring Date	10-Feb-2023 to 11-Feb-2023

Date - Time	CO	SO_2	O_3	NO	NO_2	$PM_{2.5}$	PM_{10}	Noise
	mg/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	dB(A)
10/02/2023 15:51	4.5	22.0	10.2	19.9	23.1	40.8	154.4	73.4
10/02/2023 16:51	4.4	21.6		17.0	45.6	40.7	156.0	70.1
10/02/2023 17:51	4.3	20.8		15.7	30.2	40.6	151.5	72.3
10/02/2023 18:51	4.6	19.3		19.3	26.3	40.9	150.6	71.5
10/02/2023 19:51	4.5	20.4		24.5	42.9	40.8	154.3	73.5
10/02/2023 20:51	4.2	21.1		18.9	40.2	40.5	154.8	74.1
10/02/2023 21:51	4.4	21.4		16.4	43.6	40.7	155.6	75.2
10/02/2023 22:51	4.5	21.8		17.7	47.8	40.8	149.5	72.3
10/02/2023 23:51		19.8		16.2	26.2	41.1	151.8	68.6
11/02/2023 0:51		20.2		17.5	30.4	41.2	152.7	67.5
11/02/2023 1:51		21.7		17.1	34.6	40.4	153.6	64.8
11/02/2023 2:51		15.5		15.7	20.8	39.3	147.8	62.1
11/02/2023 3:51		18.5		14.5	26.7	39.3	148.2	60.1
11/02/2023 4:51		19.2		15.2	29.3	39.3	147.8	60.1
11/02/2023 5:51		19.7		16.4	23.6	39.3	147.9	61.1
11/02/2023 6:51		19.4		15.4	26.7	39.6	148.0	60.1
11/02/2023 7:51		15.4		16.2	33.3	39.4	148.1	65.8
11/02/2023 8:51		20.0		16.3	28.7	39.7	151.3	68.1
11/02/2023 9:51		21.9		20.0	15.4	39.6	151.1	67.4
11/02/2023 10:51		17.9		19.8	14.8	40.1	153.2	70.1
11/02/2023 11:51		20.3		13.8	34.1	39.5	154.2	73.5
11/02/2023 12:51		22.3		20.6	17.1	40.7	153.6	74.6
11/02/2023 13:51		21.7		15.7	26.8	39.4	151.0	75.1
11/02/2023 14:51		24.9		18.1	30.8	39.7	161.6	74.9

Average	4.4	20.3	10.2	17.4	30.0	40.1	152	58.6
Maximum	4.6	24.9	10.2	24.5	47.8	41.2	162	75.2
Minimum	4.2	15.4	10.2	13.8	14.8	39.3	147.8	60.1
CO First 8 Hours	4.4							
Noise Day Hours	72							
Noise Night Hours	65							
Monitored By:	Muhammad Zubair, Field Officer							

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)

Reference Number: ESPAK/0069P/23/AA/0731/00088 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

Address: 1 Nursery Lane, Lawrance Road, Lahore

Validation Officer: Muhammad Nadeem, Research Officer

Nature of Sample: Ambient Air **Monitoring Location:** Main Blvd Gulshan-e-Ravi Point-3 (GPS : 31.549978°, 74.28123°)

Date of Sample Collection: 11/02/2023 **Grab / Composite:** Continuous - 24 Hours

Sample Collected/Sent By: Muhammad Zubair, Analyst (Field), ESPAK

Date of Completion of Analysis: 12/02/2023

S. No	Parameters	Limit Values (PEQS-24Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m³ (8 Hours)	3.3 mg/m³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO_2)	120 µg/m³	19.2 µg/m³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O_3)	130 µg/m³ (1 Hour)	9.0 µg/m³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m³	17.4 µg/m³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO_2	80 µg/m³	28.7 µg/m³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter $PM_{2.5}$	35 µg/m³	**42.2 µg/m³**	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM_{10}	150 µg/m³	**154 µg/m³**	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m³	**578 µg/m³**	High Volume Sampler (HVS)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)

Reference Number: ESPAK/0069P/23/AA/0731/00088 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

1. **Sample Analyzed By:** Muhammad Zubair
   Analyst (Field)
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

Environmental Services Pakistan ESPAK Tel:+924235154013-17

(Head Office) Office # 731, Block – 2, Sector: D1,
Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz,
Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017
RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

Client Name	Micro Tunneling Project WASA Lahore
Monitoring Address	1 Nursery Lane, Lawrance Road, Lahore
Co-Ordinates	31.549978, 74.28123
Monitoring Location	Main Blvd Gulshan-e-Ravi Point 3
Parameter	Ambient Air and Noise Mointoring
Equipment Used	Environment S.A & Noise Meter
Sampling interval	60 minutes
Sampling duration	24 hours
Monitoring Date	11-Feb-2023 to 12-Feb-2023

Date - Time	CO	SO_2	O_3	NO	NO_2	$PM_{2.5}$	PM_{10}	Noise
	mg/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	dB(A)
11/02/2023 15:51	3.4	20.9	9.0	19.9	21.8	43.9	156.0	69.7
11/02/2023 16:51	3.3	20.5		17.0	44.3	43.5	153.1	71.2
11/02/2023 17:51	3.2	19.7		15.7	28.9	42.7	151.8	74.0
11/02/2023 18:51	3.5	18.2		19.3	25.0	41.2	155.4	72.4
11/02/2023 19:51	3.4	19.3		24.5	41.6	42.3	160.6	73.5
11/02/2023 20:51	3.1	20.0		18.9	38.9	43.0	155.0	70.1
11/02/2023 21:51	3.3	20.3		16.4	42.3	43.3	152.5	70.4
11/02/2023 22:51	3.4	20.7		17.7	46.5	43.7	153.8	69.8
11/02/2023 23:51		18.7		16.2	24.9	41.7	152.3	62.4
12/02/2023 0:51		19.1		17.5	29.1	42.1	153.6	60.4
12/02/2023 1:51		20.6		17.1	33.3	43.6	153.2	59.4
12/02/2023 2:51		14.4		15.7	19.5	37.4	151.8	56.3
12/02/2023 3:51		17.4		14.5	25.4	40.4	150.6	55.2
12/02/2023 4:51		18.1		15.2	28.0	41.1	151.3	52.1
12/02/2023 5:51		18.6		16.4	22.3	41.6	152.5	50.1
12/02/2023 6:51		18.3		15.4	25.4	41.3	151.5	56.4
12/02/2023 7:51		14.3		16.2	32.0	37.3	152.3	56.8
12/02/2023 8:51		18.9		16.3	27.4	41.9	152.4	59.5
12/02/2023 9:51		20.8		20.0	14.1	43.8	156.1	60.1
12/02/2023 10:51		16.8		19.8	13.5	39.8	155.9	64.9
12/02/2023 11:51		19.2		13.8	32.8	42.2	149.9	65.8
12/02/2023 12:51		21.2		20.6	15.8	44.2	156.7	69.5
12/02/2023 13:51		20.6		15.7	25.5	43.6	151.8	72.5
12/02/2023 14:51		23.8		18.1	29.5	46.8	154.2	73.9

Average	3.3	19.2	9.0	17.4	28.7	42.2	154	58.6
Maximum	3.5	23.8	9.0	24.5	46.5	46.8	161	74.0
Minimum	3.1	14.3	9.0	13.8	13.5	37.3	149.9	50.1
CO First 8 Hours	3.3							
Noise Day Hours	68							
Noise Night Hours	58							
Monitored By:	Muhammad Zubair, Field Officer							

Environmental Services Pakistan ESPAK

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017
RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

NOISE MONITORING REPORT

Reference Number: ESPAK/0069P/23/N/0732/00094 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

Address: 1 Nursery Lane, Lawrance Road, Lahore

Validation Officer: Muhammad Nadeem, Research Officer

Nature of Sample: Noise

Date of Sample Collection: 09/02/2023 **Grab / Composite:** Continuous-24 Hours

Sample Collected/Sent By: Muhammad Zubair, Analyst (Field), ESPAK

Date of Completion of Analysis: 10/02/2023

Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Garhi Shahu Point-1 (GPS : 31.55552°, 74.355452°) - Day time	65 dB(A)	**73 dB (A)**	Exceeding Prescribed Limits
2	Garhi Shahu Point-1(GPS : 31.55552°, 74.355452°) - Night time	55 dB(A)	**68 dB(A)**	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Commercial Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)

- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

1. **Sample Analyzed By:** Muhammad Zubair, Analyst (Field)
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

Environmental Services Pakistan ESPAK

---------- End of Report ----------

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

NOISE MONITORING REPORT

Reference Number: ESPAK/0069P/23/N/0733/00095 **Date:** 17/02/2023

Name of Industry/Client: Micro Tunneling Project WASA Lahore

Address: 1 Nursery Lane, Lawrance Road, Lahore

Validation Officer: Muhammad Nadeem, Research Officer

Nature of Sample: Noise

Date of Sample Collection: 10/02/2023 **Grab / Composite:** Continuous-24 Hours

Sample Collected/Sent By: Muhammad Zubair, Analyst (Field), ESPAK

Date of Completion of Analysis: 11/02/2023

Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Near Shama Stop Point-2 (GPS: 31.541991°74.312906°) - Day time	65 dB(A)	**72 dB(A)**	Exceeding Prescribed Limits
2	Near Shama Stop Point-2 (GPS: 31.541991°74.312906°) - Night time	55 dB(A)	**65 dB(A)**	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Commercial Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)

• Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

1. **Sample Analyzed By:** Muhammad Zubair, Analyst (Field)
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

NOISE MONITORING REPORT

Reference Number:	ESPAK/0069P/23/N/0734/00096	**Date:**	17/02/2023
Name of Industry/Client:	Micro Tunneling Project WASA Lahore		
Address:	1 Nursery Lane, Lawrance Road, Lahore		
Validation Officer:	Muhammad Nadeem, Research Officer		
Nature of Sample:	Noise		
Date of Sample Collection:	11/02/2023	**Grab / Composite:**	Continuous-24 Hours
Sample Collected/Sent By:	Muhammad Zubair, Analyst (Field), ESPAK		
Date of Completion of Analysis:	12/02/2023		
Method/Equipment Used:	Sound Level Meter		

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Main Blvd Gulshan-e-Ravi Point-3 (GPS: 31.549978°, 74.28123°)- Day time	65 dB(A)	68 dB(A)	Within Prescribed Limits
2	Main Blvd Gulshan-e-Ravi Point-3 (GPS: 31.549978°, 74.28123°) - Night time	55 dB(A)	58 dB(A)	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Commercial Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)

- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

1. **Sample Analyzed By:** Muhammad Zubair, Analyst (Field)
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

Environmental Services Pakistan * ESPAK * Tel: +92(42)35154012-17

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Reference Number: ESPAK/0069P/23/DW/0735/00163 **Date:** 17/02/2023
Name of Industry / Client: Micro Tunneling Project WASA Lahore
Address: 1 Nursery Lane, Lawrance Road, Lahore
Validation Officer: Muhammad Nadeem, Research Officer
Nature of Sample: Water from Tap at Garhi Shahu
Date Sample Received: 11/02/2023 **Grab / Composite:** Grab
Date of Sample Collection: 10/02/2023
Sample Collected / Sent By: Muhammad Zubair, Analyst (Field), ESPAK
Date of Completion of Analysis: 16/02/2023

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	----	ND	SMWW 9221 B	----
2	Fecal Coliform Bacteria	Must not be detectable in any 100mL sample	ND	SMWW 9221 F	Within Limits
3	E. Coli	Must not be detectable in any 100mL Sample	ND	SMWW 9221 F	Within Limits
4	Color	≤15 TCU	ND	SMWW 2120 C	Within Limits
5	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Limits
6	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Limits
7	Turbidity	<5 NTU	0.9 NTU	SMWW 2130B	Within Limits
8	Total Hardness as $CaCO_3$*	<500 mg/L	380 mg/L	SMWW 2340C	Within Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	920 mg/L	SMWW 2540C	Within Limits
10	pH*	6.5-8.5	7.7	SMWW 4500H*B	Within Limits
11	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Limits
12	Antimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Limits
13	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits
14	Barium (Ba)	0.7 mg/L	0.3 mg/L	U.S. EPA-200.7	Within Limits
15	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Limits
16	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Chloride (as Cl^-)*	<250 mg/L	48 mg/L	SMWW 4500Cl^-B	Within Limits
18	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Cyanide (CN^-)	≤0.05 mg/L	ND	SMWW 4500 CN^- F	Within Limits
21	Fluoride (F^-)*	≤1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Limits
22	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Reference Number: ESPAK/0069P/23/DW/0735/00163 **Date:** 17/02/2023

Name of Industry / Client: Micro Tunneling Project WASA Lahore

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Manganese (Mn)	≤0.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
24	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nitrate (NO_3^-)	≤50 mg/L	ND	SMWW 4500NO_3^-B	Within Limits
27	Nitrite (NO_2^-)	≤3 mg/L	ND	SMWW 4500NO_2^-B	Within Limits
28	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	----
30	Zinc (Zn)	5.0 mg/L	ND	U.S. EPA-200.7	Within Limits
31	Phenolic Compounds (as Phenols)	NGVS	ND	SMWW 5530 C	----

DW-PEQS: Punjab Environmental Quality Standards for Drinking Water, 2016
SMWW: Standard Methods for the Examination of Water and WasteWater 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)
USEPA: United States Environmental Protection Agency
NGVS: No Guideline Value Set
ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 2 °C and 50 ± 10 % Relative Humidity conditions unless stated otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

1. **Sample Analyzed By:** Waqas Ahmad (Analyst (ICP-AES)); Abdul Aziz (Analyst (Chemical)); Muhammad Shahid (Analyst (Chemical)); Khizra Bano (Analyst(Microbiology)); Ghulam Mustafa (Analyst (Chemical))
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

Environmental Services Pakistan ESPAK

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Reference Number: ESPAK/0069P/23/DW/0736/00164 **Date:** 17/02/2023
Name of Industry / Client: Micro Tunneling Project WASA Lahore
Address: 1 Nursery Lane, Lawrance Road, Lahore
Validation Officer: Muhammad Nadeem, Research Officer
Nature of Sample: Tap Water at Shama Stop
Date Sample Received: 13/02/2023 **Grab / Composite:** Grab
Date of Sample Collection: 11/02/2023
Sample Collected / Sent By: Muhammad Zubair, Analyst (Field), ESPAK
Date of Completion of Analysis: 16/02/2023

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	----	**>8.0 MPN/100mL**	SMWW 9221 B	---
2	Fecal Coliform Bacteria	Must not be detectable in any 100mL sample	**2.6 MPN/100mL**	SMWW 9221 F	Exceeding Limits
3	E. Coli	Must not be detectable in any 100mL Sample	**1.1 MPN/100mL**	SMWW 9221 F	Exceeding Limits
4	Color	≤15 TCU	ND	SMWW 2120 C	Within Limits
5	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Limits
6	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Limits
7	Turbidity	<5 NTU	3.1 NTU	SMWW 2130B	Within Limits
8	Total Hardness as $CaCO_3$*	<500 mg/L	432 mg/L	SMWW 2340C	Within Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	**1182 mg/L**	SMWW 2540C	Exceeding Limits
10	pH*	6.5-8.5	7.6	SMWW 4500H*B	Within Limits
11	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Limits
12	Antimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Limits
13	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits
14	Barium (Ba)	0.7 mg/L	0.4 mg/L	U.S. EPA-200.7	Within Limits
15	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Limits
16	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Chloride (as Cl^-)*	<250 mg/L	100 mg/L	SMWW 4500Cl^-B	Within Limits
18	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Cyanide (CN^-)	≤0.05 mg/L	ND	SMWW 4500 CN^- F	Within Limits
21	Fluoride (F^-)*	≤1.5 mg/L	0.1 mg/L	U.S. EPA 9214	Within Limits
22	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4936351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 ISO/IEC 17025:2017
RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Reference Number: ESPAK/0069P/23/DW/0736/00164 **Date:** 17/02/2023

Name of Industry / Client: Micro Tunneling Project WASA Lahore

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Manganese (Mn)	≤0.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
24	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nitrate (NO_3^-)	≤50 mg/L	ND	SMWW 4500NO_3^-B	Within Limits
27	Nitrite (NO_2^-)	≤3 mg/L	ND	SMWW 4500NO_2^-B	Within Limits
28	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	----
30	Zinc (Zn)	5.0 mg/L	0.04 mg/L	U.S. EPA-200.7	Within Limits
31	Phenolic Compounds (as Phenols)	NGVS	ND	SMWW 5530 C	----

DW-PEQS: Punjab Environmental Quality Standards for Drinking Water, 2016
SMWW: Standard Methods for the Examination of Water and WasteWater 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)
USEPA: United States Environmental Protection Agency
NGVS: No Guideline Value Set
ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 2 °C and 50 ± 10 % Relative Humidity conditions unless stated otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

1. **Sample Analyzed By:** Waqas Ahmad (Analyst (ICP-AES)); Abdul Aziz (Analyst (Chemical)); Muhammad Shahid (Analyst (Chemical)); Khizra Bano (Analyst(Microbiology)); Ghulam Mustafa (Analyst (Chemical))
2. **Name of Chief Analyst with Seal:** Muhammad Arfan
3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

Environmental Services Pakistan ESPAK Tel:+924235154012-17

---------- End of Report ----------

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

PNAC LAB-213 RICI CERTIFIED RICI CERTIFIED RICI CERTIFIED IAS ACCREDITED

CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Reference Number: ESPAK/0069P/23/DW/0737/00165 **Date:** 17/02/2023

Name of Industry / Client: Micro Tunneling Project WASA Lahore

Address: 1 Nursery Lane, Lawrance Road, Lahore

Validation Officer: Muhammad Nadeem, Research Officer

Nature of Sample: Tap Water at Main Boulevard Gulshan Ravi

Date Sample Received: 13/02/2023 **Grab / Composite:** Grab

Date of Sample Collection: 12/02/2023

Sample Collected / Sent By: Muhammad Zubair, Analyst (Field), ESPAK

Date of Completion of Analysis: 16/02/2023

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	----	**>8.0 MPN/100mL**	SMWW 9221 B	---
2	Fecal Coliform Bacteria	Must not be detectable in any 100mL sample	**> 8.0 MPN/100mL**	SMWW 9221 F	Exceeding Limits
3	E. Coli	Must not be detectable in any 100mL Sample	**>8.0 MPN/100mL**	SMWW 9221 F	Exceeding Limits
4	Color	≤15 TCU	ND	SMWW 2120 C	Within Limits
5	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Limits
6	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Limits
7	Turbidity	<5 NTU	ND	SMWW 2130B	Within Limits
8	Total Hardness as $CaCO_3$*	<500 mg/L	136 mg/L	SMWW 2340C	Within Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	464 mg/L	SMWW 2540C	Within Limits
10	pH*	6.5-8.5	8.0	SMWW 4500H+B	Within Limits
11	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Limits
12	Antimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Limits
13	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits
14	Barium (Ba)	0.7 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Limits
15	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Limits
16	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Chloride (as Cl^-)*	<250 mg/L	98 mg/L	SMWW 4500Cl-B	Within Limits
18	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Cyanide (CN^-)	≤0.05 mg/L	ND	SMWW 4500 CN^- F	Within Limits
21	Fluoride (F^-)*	≤1.5 mg/L	0.5 mg/L	U.S. EPA 9214	Within Limits
22	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Limits

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Reference Number: ESPAK/0069P/23/DW/0737/00165 **Date:** 17/02/2023

Name of Industry / Client: Micro Tunneling Project WASA Lahore

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Manganese (Mn)	≤0.5 mg/L	0.04 mg/L	U.S. EPA-200.7	Within Limits
24	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nitrate (NO_3^-)	≤50 mg/L	ND	SMWW 4500NO_3^-B	Within Limits
27	Nitrite (NO_2^-)	≤3 mg/L	ND	SMWW 4500NO_2^-B	Within Limits
28	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	----
30	Zinc (Zn)	5.0 mg/L	ND	U.S. EPA-200.7	Within Limits
31	Phenolic Compounds (as Phenols)	NGVS	ND	SMWW 5530 C	----

DW-PEQS: Punjab Environmental Quality Standards for Drinking Water, 2016
SMWW: Standard Methods for the Examination of Water and WasteWater 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)
USEPA: United States Environmental Protection Agency
NGVS: No Guideline Value Set
ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 2 °C and 50 ± 10 % Relative Humidity conditions unless stated otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- **The report should be reproduced as a whole and not in parts.**
- **The responsibility of the ethical use of this report lies with the client.**
- **The values represent sample conditions when monitoring/testing was carried out.**
- **The report data is not intended to be used legally by the client.**
- **Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.**

1. **Sample Analyzed By:**

Waqas Ahmad	Abdul Aziz	Muhammad Shahid	Khizra Bano	Ghulam Mustafa
Analyst (ICP-AES)	Analyst (Chemical)	Analyst (Chemical)	Analyst(Microbiology)	Analyst (Chemical)

2. **Name of Chief Analyst with Seal:** Muhammad Arfan

3. **Signature of Incharge of the Environmental Laboratory:**

Name: Imran Malik
General Manager
Date: 17/02/2023

---------- End of Report ----------

(Head Office) Office # 731, Block – 2, Sector: D1, Shah Jilani Road, Township, Lahore, Pakistan, 54770
+92.42.3515 4012-16 | +92.42.3515 4017
(Islamabad Office) Office # 20, Rehmat Centre, I-8 Markaz, Islamabad, Pakistan | +92.51.4938351
www.espak.com.pk | info@espak.com.pk

ANNEXURE XVIII
Area of Influence (AOI) Maps

LAKSHAMI D/S
MUHAMMAD NAGAR D/S
GHAZI MOHALLA ETP D/S
JANKI DEVI D/S
LARECH COLONY D/S
HIGH COURT D/S
Govt. Abu Alkhiar Graveyard
Shaheen Complex
Nadra Mega Center
Queen Mary College
Sui Northern office
Paletti's hotel
Punjab Assembly Hall
Police station
Fida Dental Clinic
Euro Store
Cathedral school system
Sir Gangaram hospital
Governer House D/S
BIRD MARKET D/S
Astana Aaliya Qadriya
harbanspura D/S
Govt. Jinnah degree college for women
Study Cell Academy
Steps Prep
sadar D/S
shalimar D/S
INFANTRY ROAD D/S
Rescue 1122
IMAN MEER COLONY D/S
SHAMA D/S
RASOOL PARK D/S
Graveyard
ZAFAR ALI ROAD D/S

Legend

- JACKING SHAFTS
- RECEVING SHAFTS
- DISPOSAL STATION
- EXSITING FORCEMAIN
- LATERAL BY PROJECT
- LATERALS BY CANTONMENT LAHORE
- LATERALS BY WASA
- LINE A
- LINE B
- LINE C
- impacted Area
- Area of Impact

SENSITIVE RECEPTOR

- Historical Bulding
- Hospital
- Masjid
- Office
- School

LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE

EBA ECSP team — A Joint Venture

REVISION	REV.	DATE	DESCRIPTION
	04		
	03		
	02		
	01		

CONTROL	
DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

AOI MAP

SCALE 1:10,000

DATE :- AUG 2024

DRAWING No. FIGURE 1

REV:-

POONCH ROAD D/S
Rescue 1122
SHAMA D/S
PASCOL PARK D/S
SHADMAN D/S
Graveyard
ICHRA MORE D/S
Ichra LESCO
Yousaf School System
American Lyceum
Iran Consulate
Les Anges Montessori Academy
CENTER POINT D/S
ZAFAR ALI ROAD D/S
SHAREEF COLONY D/S
Edhi Home
Q BLOCK D/S
Resap Islamic School
NADRA Arms
Gurmani Foundation
Extraction Coffee
NAVTTC Regional
Govt. Training College
Family INN Hotel
PAC College
Pioneer Public School
GURUN NOAT D/S
Khan Colony D/S
Q BLOCK D/S
Fatah Abad D/S
INFANTRY ROAD D/S
Shalimar D/S
MIAN MEER COLONY D/S
Sofia HanY TRUST D/S
Abdul Rehman Road Lahore D/S

Legend

- JACKING SHAFTS
- RECEVING SHAFTS
- DISPOSAL STATION
- EXSITING FORCEMAIN
- LATERAL BY PROJECT
- LATERALS BY CANTONMENT LAHORE
- LATERALS BY WASA
- LINE A
- LINE B
- LINE C
- impacted Area
- Area of Impact

SENSITIVE RECEPTOR

- Historical Bulding
- Hospital
- Masjid
- Office
- School

LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE

EBA ECSP team — A JointVenture

REVISION			
04			
03			
02			
01			
REV.	DATE	DESCRIPTION	

CONTROL	
DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

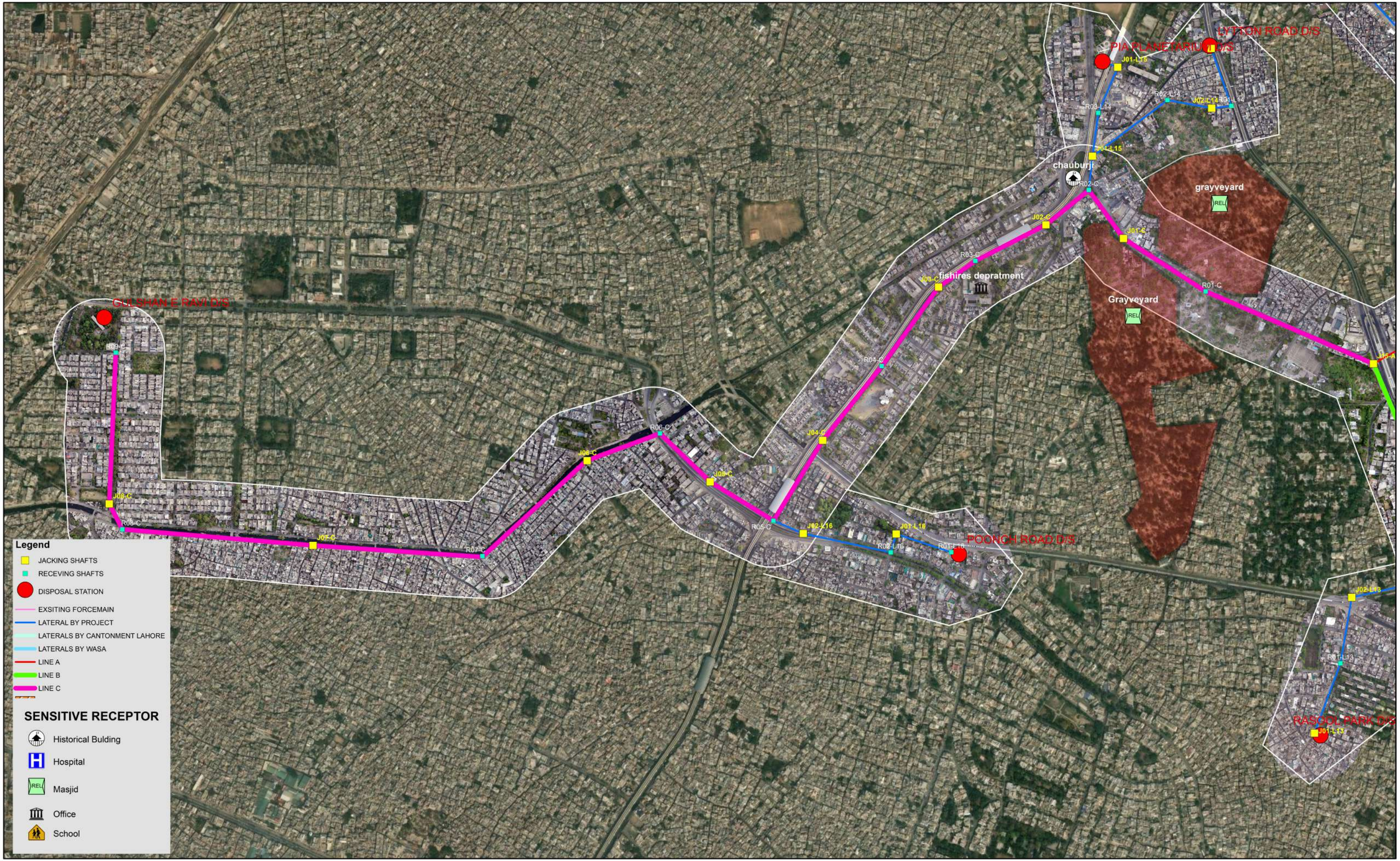
AOI Map

DATE :- AUG 2024

DRAWING No. FIGURE 1

SCALE 1:20,000

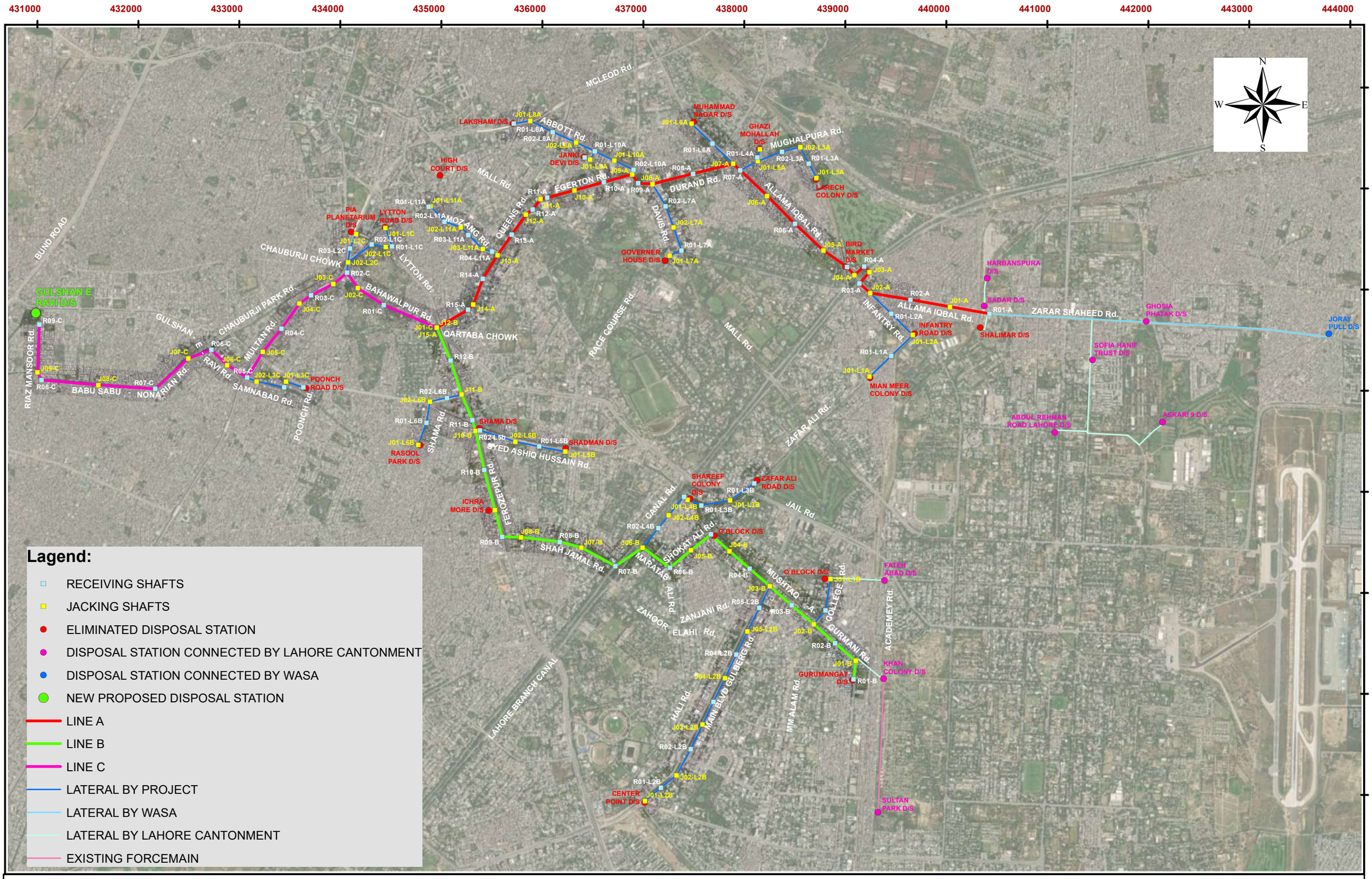
REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA A JointVenture	REVISION	04			CONTROL	DRAWN		AOI Map	SCALE 1:10,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 1
			REV.	DATE	DESCRIPTION		APPROVED			REV:-

ANNEXURE XIX
NEW ALIGNMENT



Legend:

- RECEIVING SHAFTS
- JACKING SHAFTS
- ELIMINATED DISPOSAL STATION
- DISPOSAL STATION CONNECTED BY LAHORE CANTONMENT
- DISPOSAL STATION CONNECTED BY WASA
- NEW PROPOSED DISPOSAL STATION
- LINE A
- LINE B
- LINE C
- LATERAL BY PROJECT
- LATERAL BY WASA
- LATERAL BY LAHORE CANTONMENT
- EXISTING FORCEMAIN

LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY

WATER AND SANITATION AGENCY, LAHORE

EBA ENGINEERING | ECSP | EGC | team consultants
A JointVenture

REVISION			
04			
03			
02			
01			
REV.	DATE	DESCRIPTION	

CONTROL	
DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

REVISED ALIGNMENT (PROPOSED)

SCALE 1:40,000

DATE :- AUG 2024

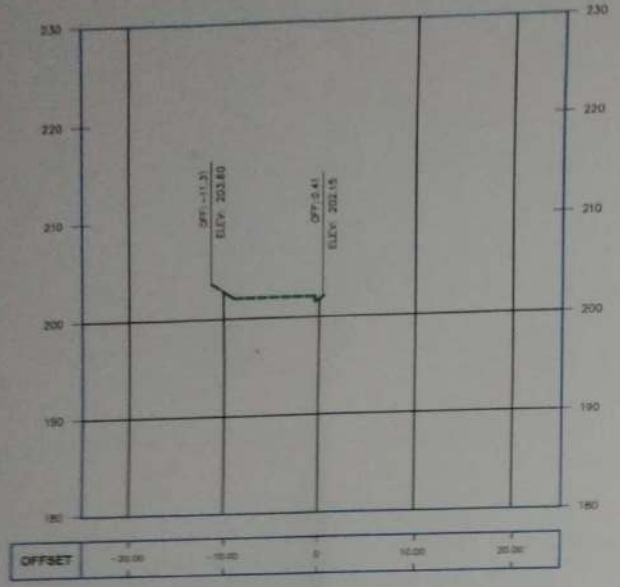
DRAWING No. FIGURE 7.11

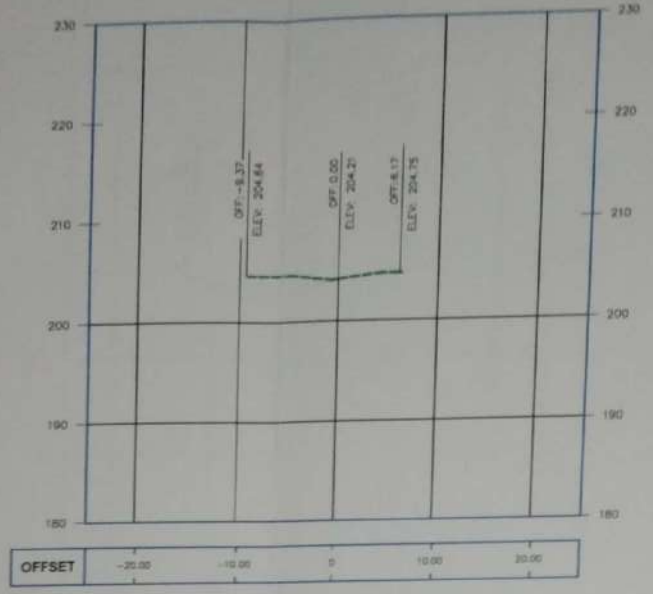
REV:-

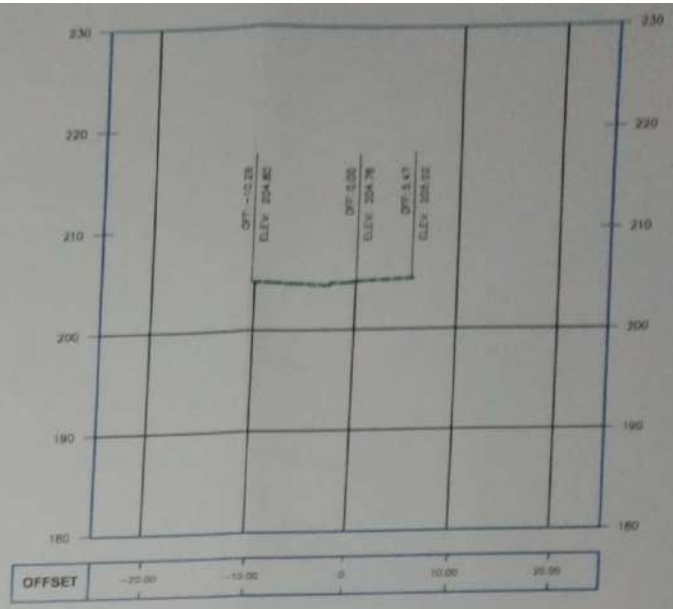
ANNEXURE XX

Cross-section of Outfall Drains

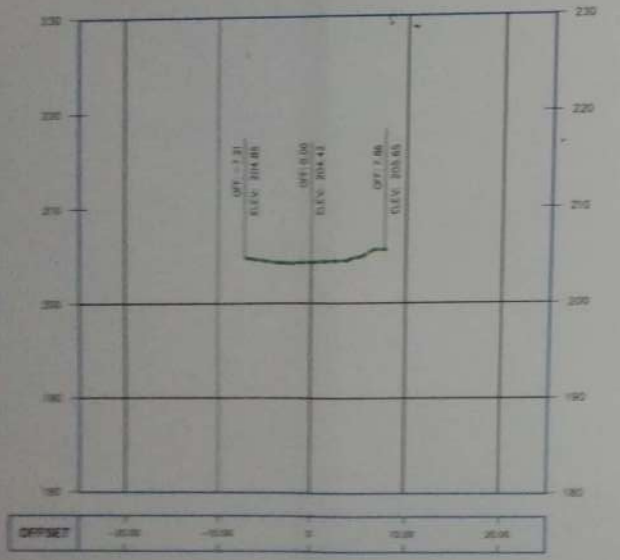
0+00.00,Nala 1







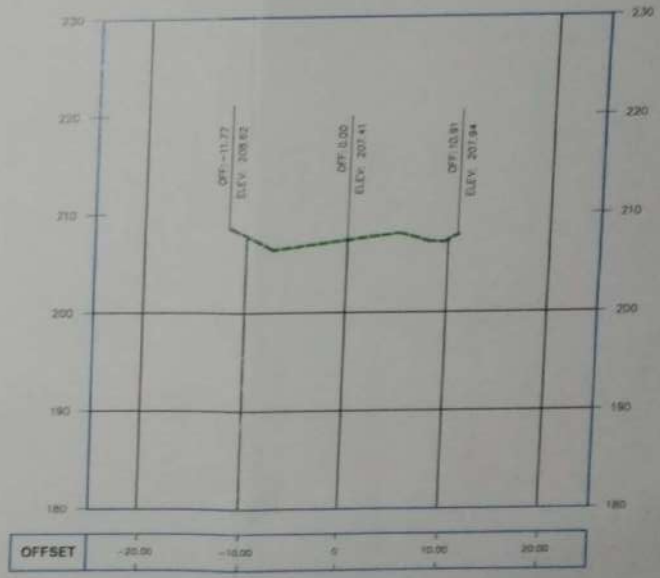
3+00.00,Nala 1



4+00.00,Nala 1



5+00.00,Nala 1



WATER AND SANITATION AGENCY, LAHORE

04			DRAWN	M. MURAD ALI
03			CHECKED BY	
02			RECOMMENDED	
01	20/12	REVISE AS PER WASA COMMENTS	CHIEF/MER	
REV.	DATE	DESCRIPTION	APPROVED	

Sewerage System from Larech Colony to Gulshan-e-Ravi, Lahore

CROSS-SECTION OF OUTFALL DRAIN (NALA-1, 00-500 m interval)

SCALE 1:500

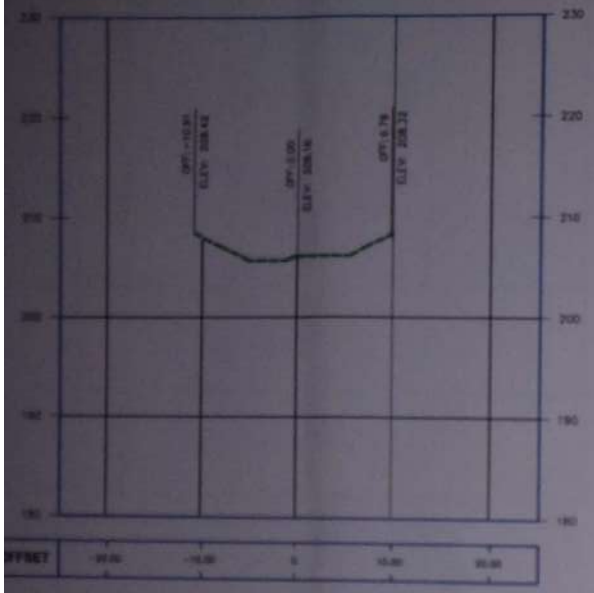
DATE:- FEBRUARY, 2022

DRAWING No. J-1-01

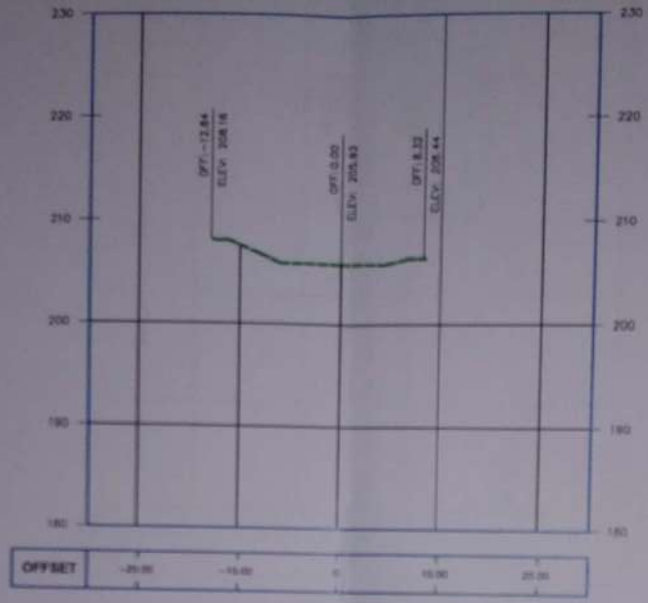
REV. :- 2

CamScanner
Scanned with CamScanner

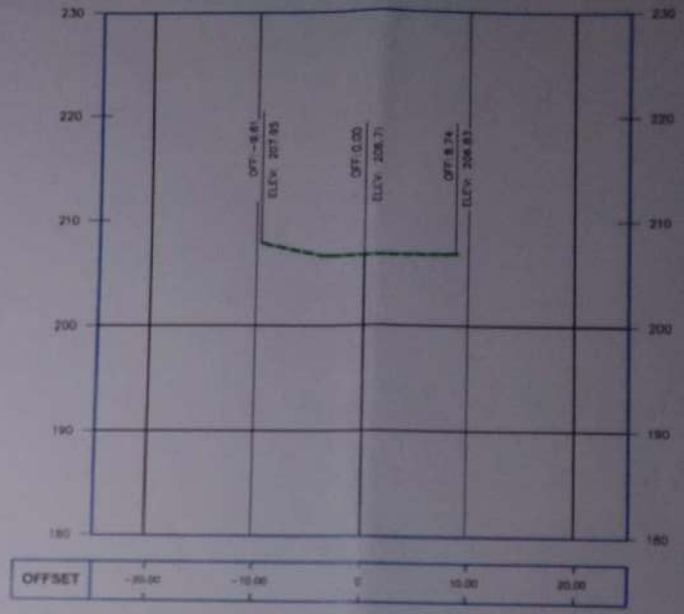
6+00.00,Nala 1



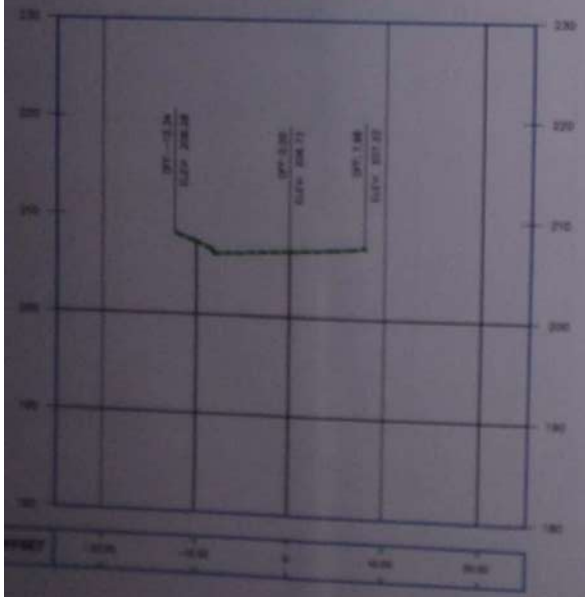
7+00.00,Nala 1



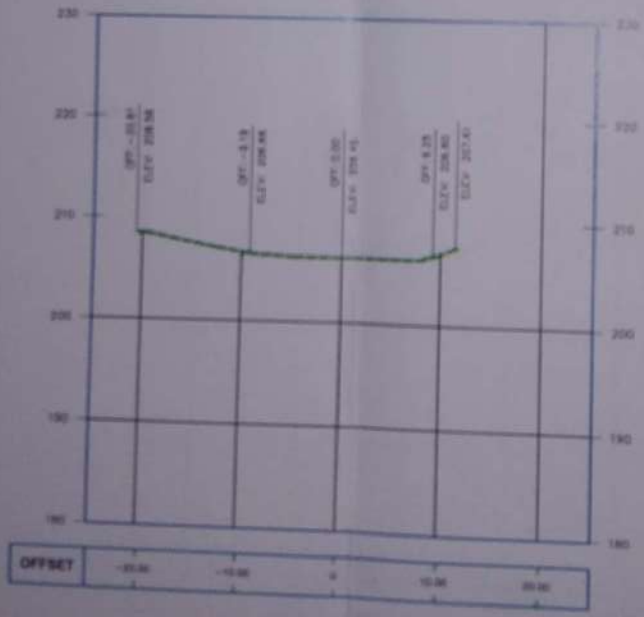
8+00.00,Nala 1



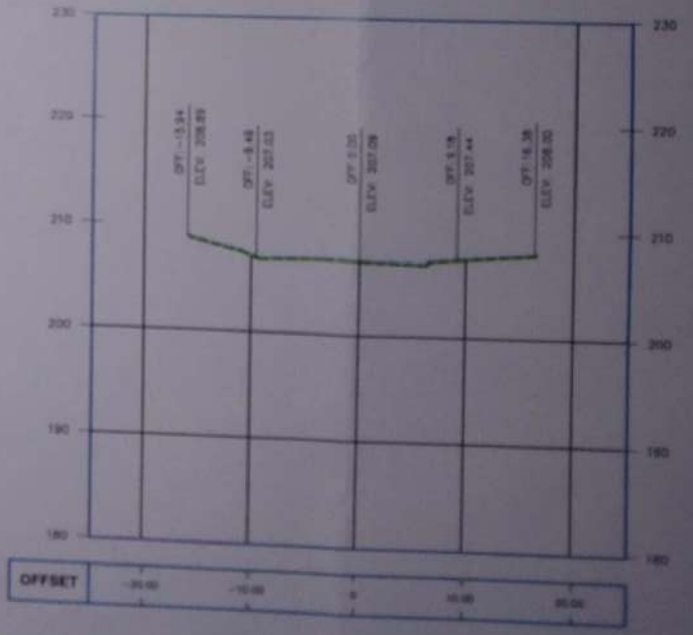
9+00.00,Nala 1



10+00.00,Nala 1



11+00.00,Nala 1



WATER AND SANITATION AGENCY, LAHORE

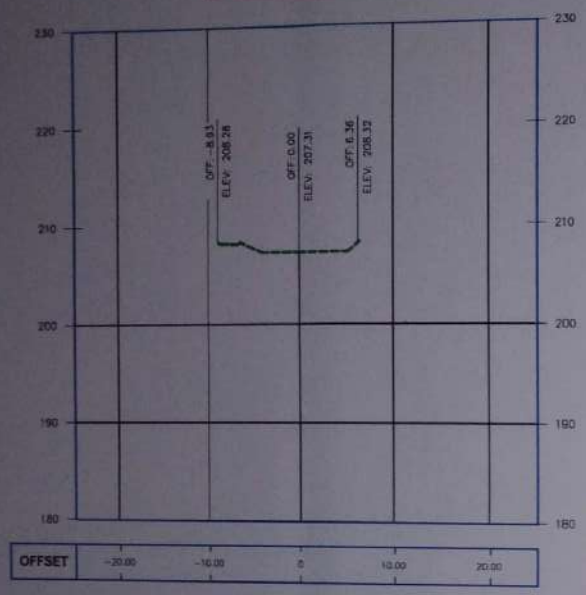
M. MURAD ALI

Sewerage System from Larech Colony to

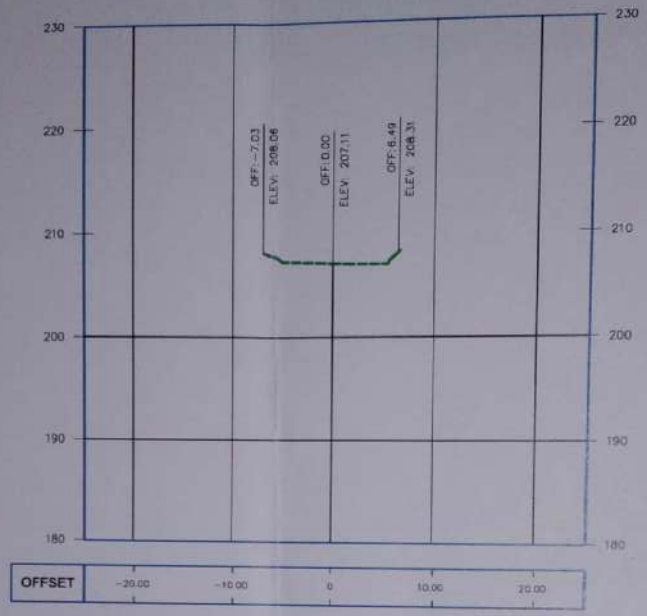
CROSS-SECTION OF OUTFALL DRAIN (NALA 1 & 2)

CamScanner
Scanned with CamScanner

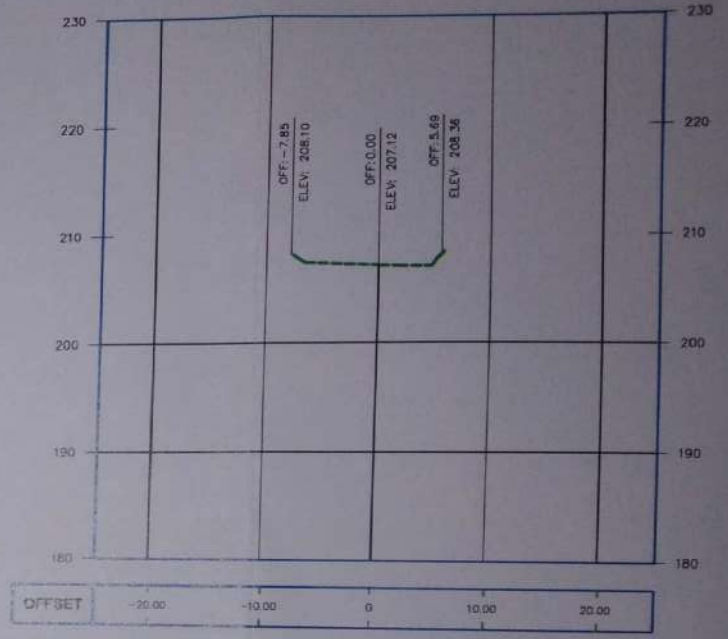
12+00.00,Nala 1



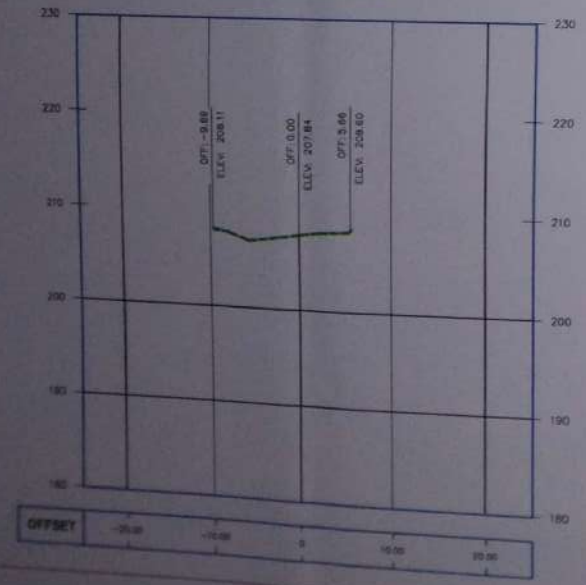
13+00.00,Nala 1



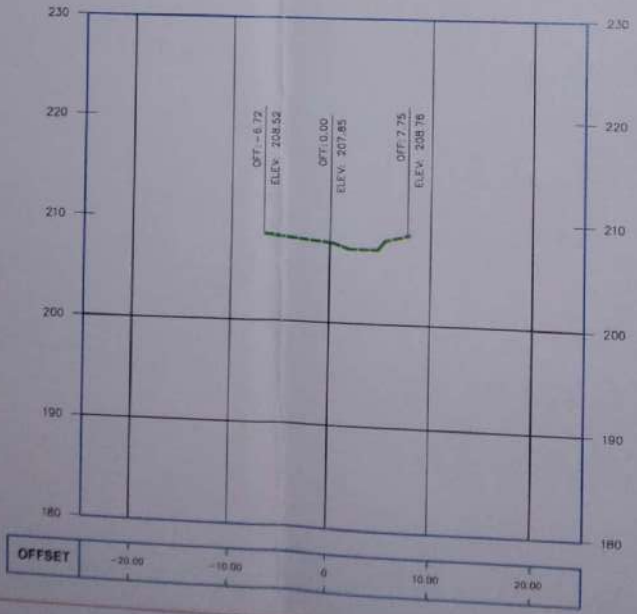
14+00.00,Nala 1



15+00.00,Nala 1



15+50.00,Nala 1



WATER AND SANITATION AGENCY, LAHORE

DRAWN M. MURAD ALI

CHECKED BY

Sewerage System from

CamScanner
Scanned with CamScanner

ANNEXURE XXI
SENSITIVE RECEPTORS MAPS



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team consultants — A JointVenture	REVISION				CONTROL		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
		04				DRAWN			
		03				CHECKED BY			
		02				RECOMMENDED			
		01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 1
		REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · CEC · team consultants — A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 2
			REV.	DATE	DESCRIPTION		APPROVED			REV:-

R02-L1

16 Feet

8 Feet

32 Feet

32 Feet

ROW=40+40

26 Feet

26 Feet

26 Feet

164 Feet

INFANTRY ROAD D/S

J02-L1

ROW=30

16 Feet

16 Feet

R01-L1

28 Feet

Legend

- JACKING SHAFTS
- RECEVING SHAFTS
- DISPOSAL STATION
- EXSITING FORCEMAIN
- LATERAL BY PROJECT
- LATERALS BY CANTONMENT LAHORE
- LATERALS BY WASA
- LINE A
- LINE B
- LINE C
- impacted Area

SENSITIVE RECEPTOR

- Historical Bulding
- Hospital
- Masjid
- Office
- School

LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE

EBA ENGINEERING ECSP CEC team consultants
A JointVenture

REVISION			
04			
03			
02			
01			
REV.	DATE	DESCRIPTION	

CONTROL	
DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

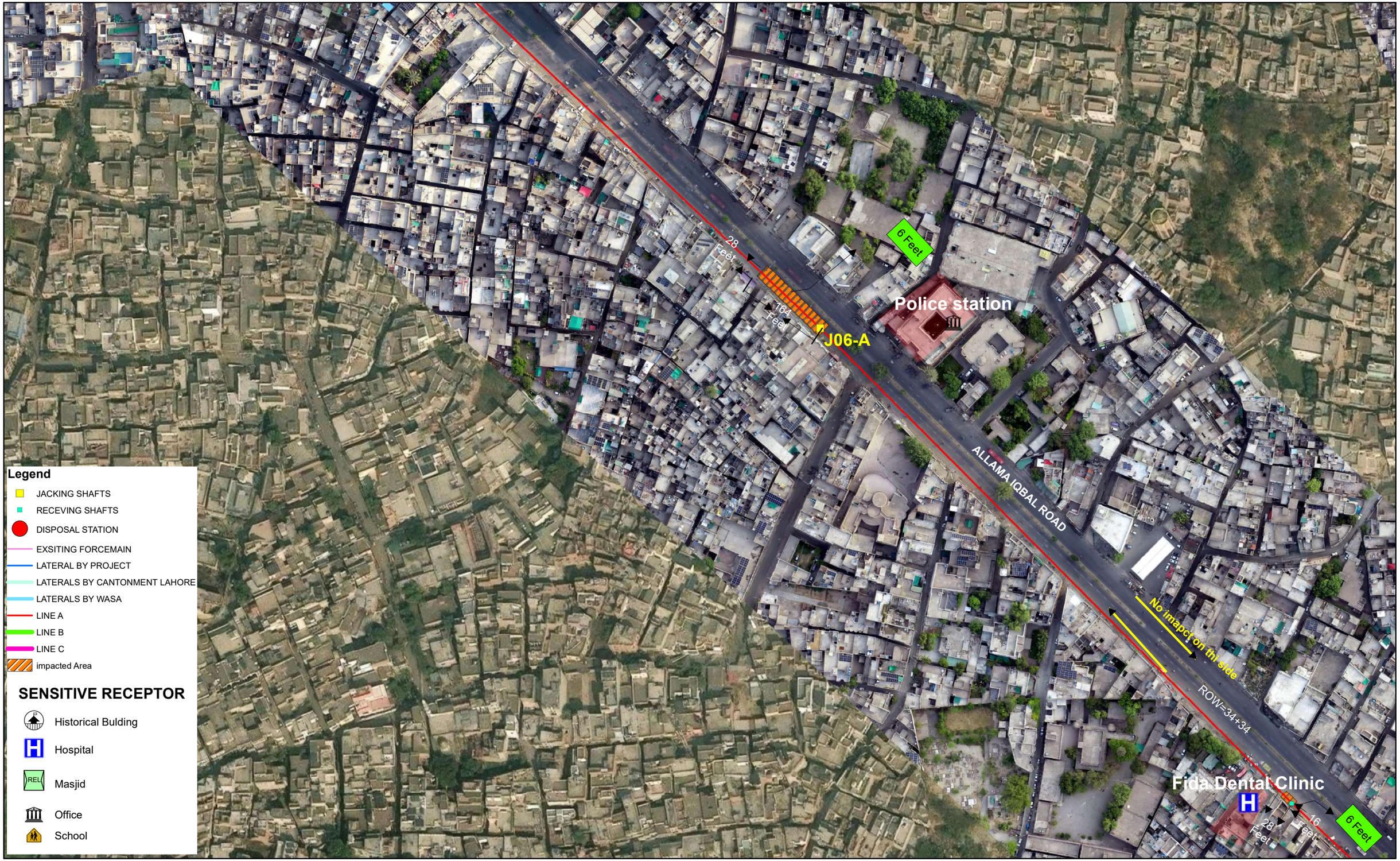
SENSITIVE RECEPTOR MAP

SCALE 1:2,000

DATE :- AUG 2024

DRAWING No. FIGURE 3

REV:-



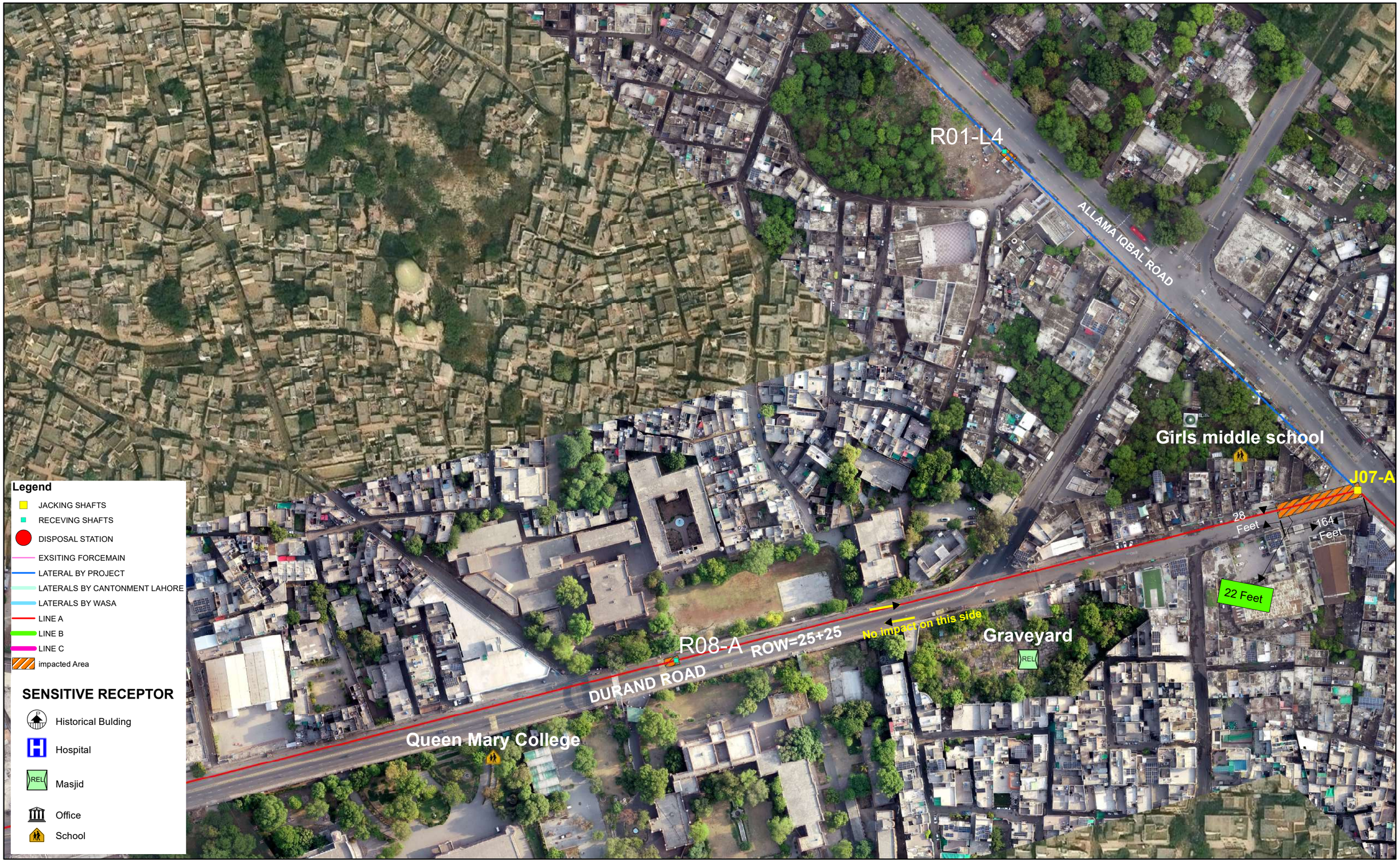
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, tcm — A Joint Venture	REVISION				CONTROL		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
		04				DRAWN			
		03				CHECKED BY			
		02				RECOMMENDED			
		01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 4
		REV.	DATE	DESCRIPTION		APPROVED			REV:-



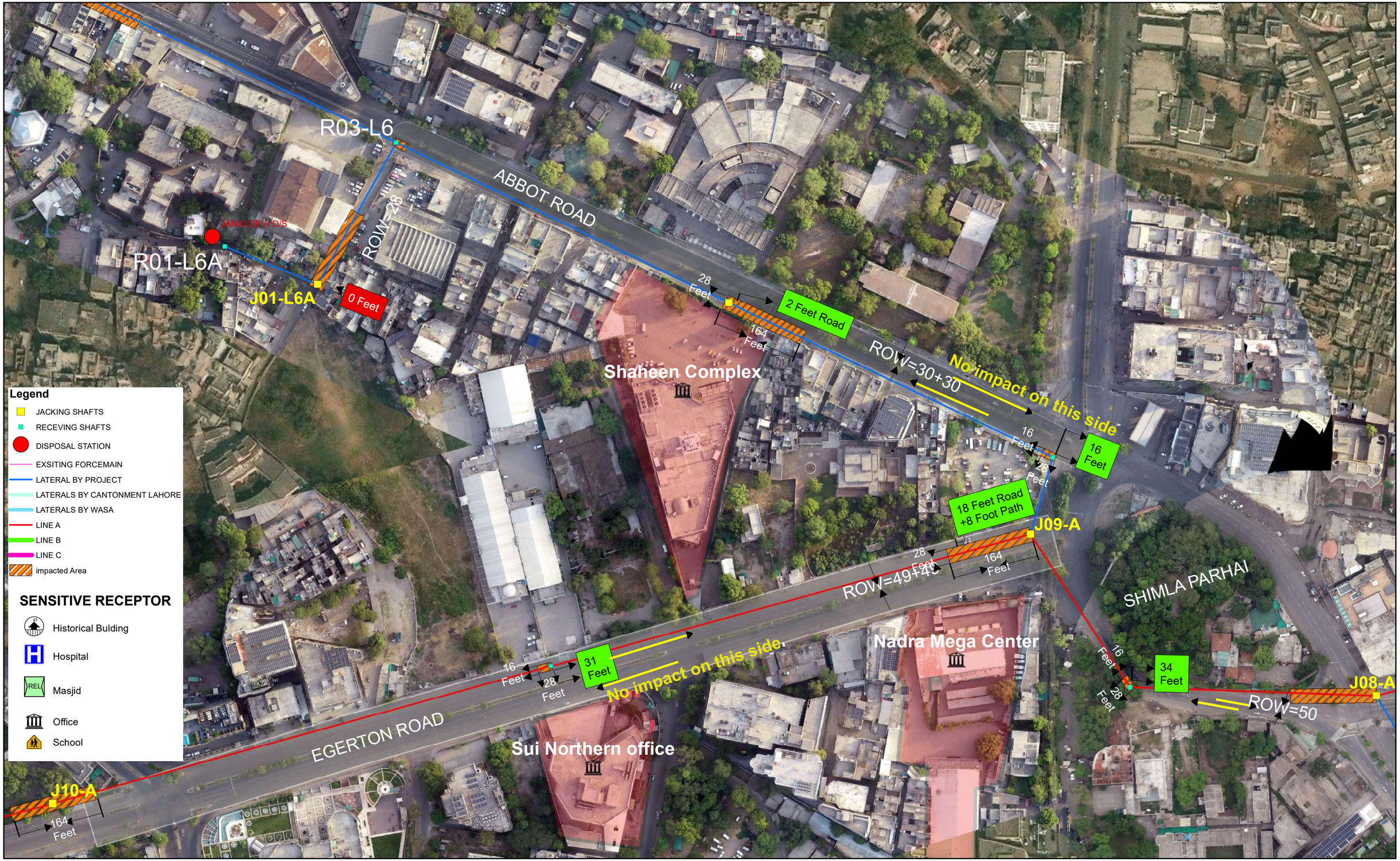
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · CEC · tcm — A JointVenture	REVISION	04			CONTROL: DRAWN	
			03			CHECKED BY	SENSITIVE RECEPTOR MAP — SCALE 1:2,000
			02			RECOMMENDED	
			01			CHD./VER.	DATE :- AUG 2024 — DRAWING No. FIGURE 5 — REV:-
			REV.	DATE	DESCRIPTION	APPROVED	



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · EEC · team consultants — A Joint Venture	REVISION				CONTROL		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
		04				DRAWN			
		03				CHECKED BY			
		02				RECOMMENDED			
		01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 6
		REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING ECSP CEC team consultants A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 7
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



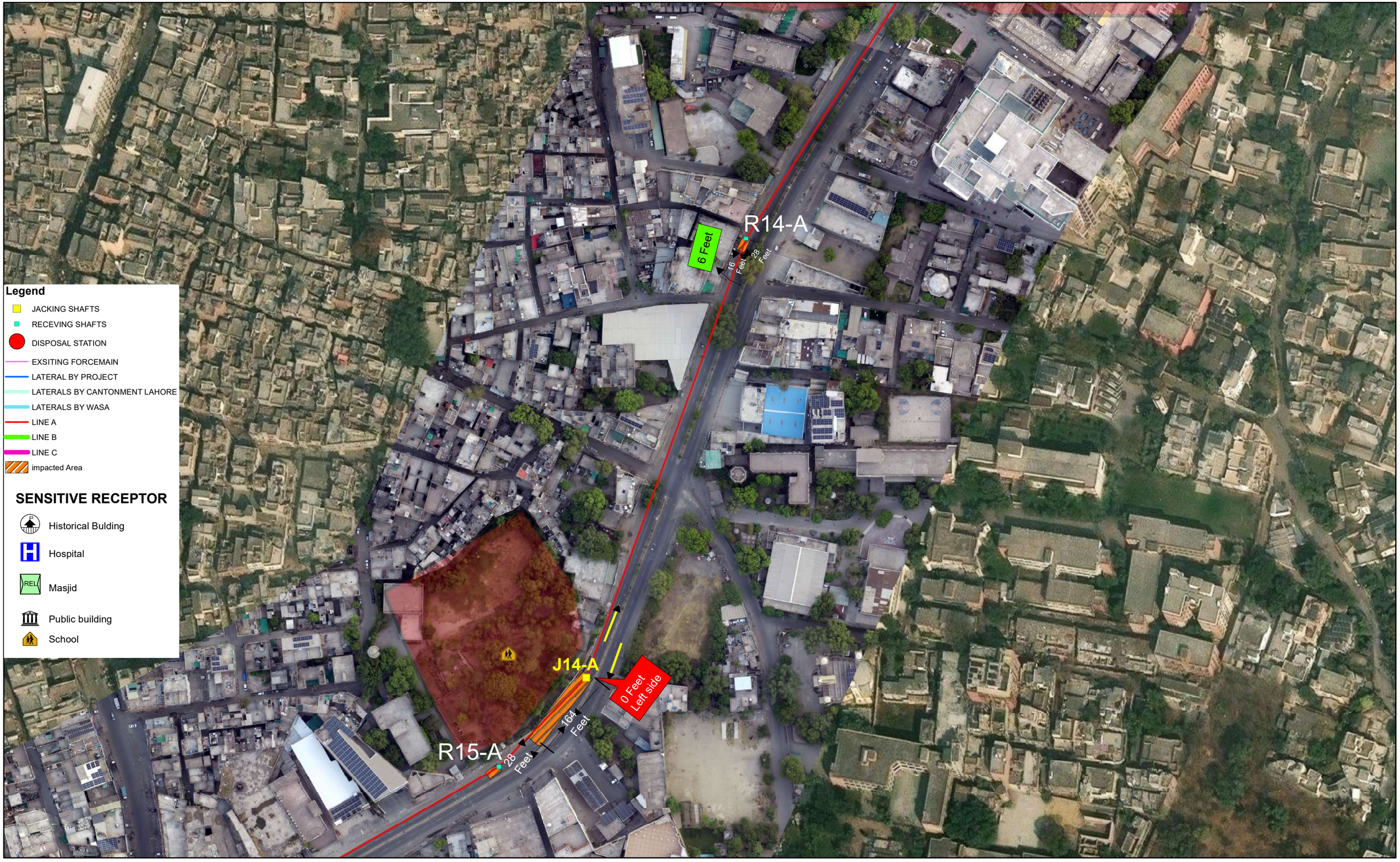
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, tcm — A JointVenture	REVISION	04			CONTROL: DRAWN	
			03			CHECKED BY	SENSITIVE RECEPTOR MAP
			02			RECOMMENDED	SCALE 1:2,000
			01			CHD./VER.	DATE :- AUG 2024 / DRAWING No. FIGURE 8 / REV:-
			REV.	DATE	DESCRIPTION	APPROVED	



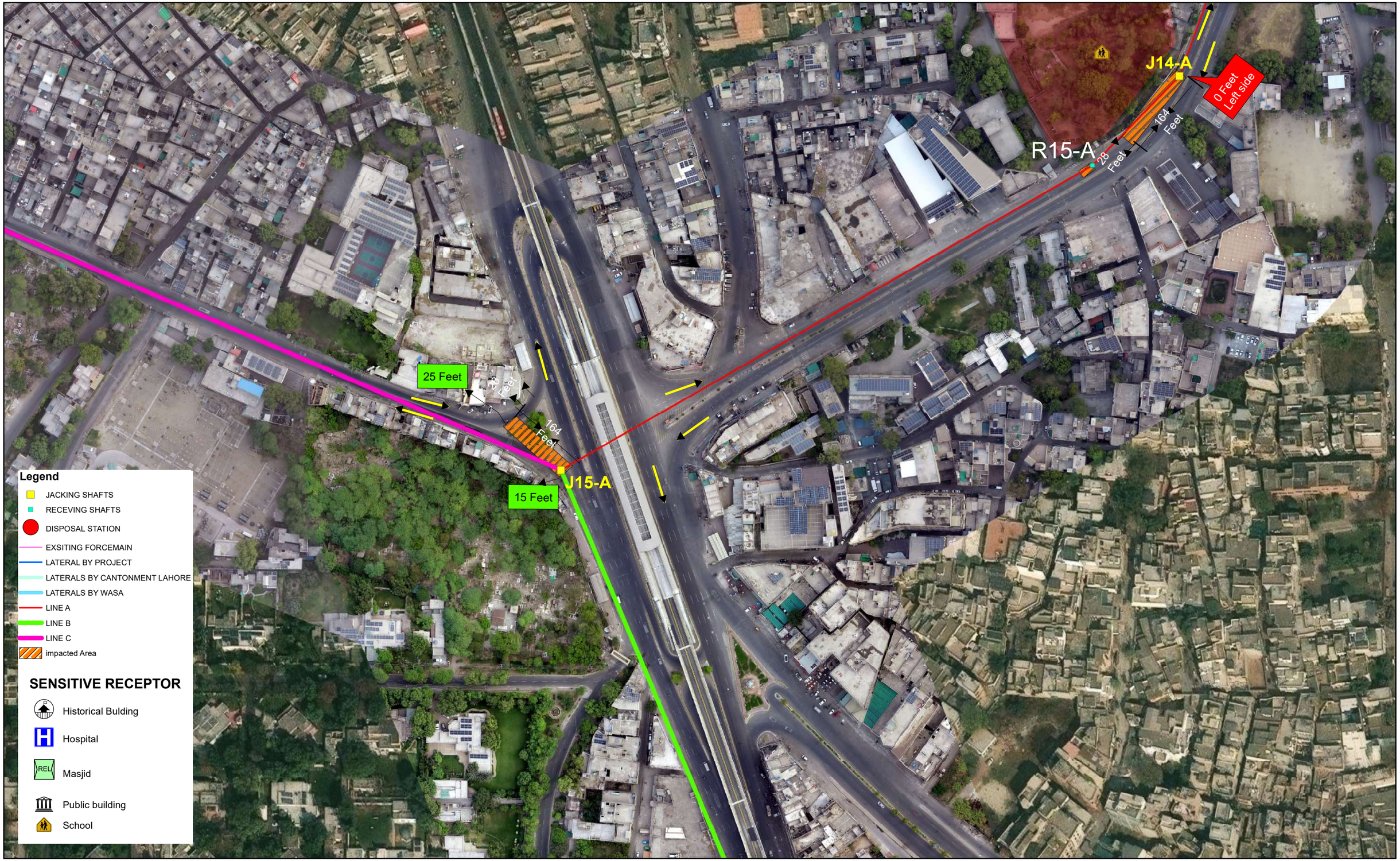
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · CEC · team consultants — A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 9
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE	WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING ECSP CEC team consultants A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP		SCALE 1:2,000
				03				CHECKED BY				
				02				RECOMMENDED				
				01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 10	REV:-
				REV.	DATE	DESCRIPTION		APPROVED				



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team — A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 11
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE **WATER AND SANITATION AGENCY, LAHORE**	EBA ENGINEERING ECSP CEC tcm consultants *A Joint Venture*	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP		SCALE 1:2,000
			03				CHECKED BY				
			02				RECOMMENDED				
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 12	REV:-
			REV.	DATE	DESCRIPTION		APPROVED				



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team consultants — A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 13
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE

EBA ENGINEERING ECSP CEC team consultants
A JointVenture

REVISION			
04			
03			
02			
01			
REV.	DATE	DESCRIPTION	

CONTROL	
DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

SENSITIVE RECEPTOR MAP

SCALE 1:2,000

DATE :- AUG 2024

DRAWING No. FIGURE 14

REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE **WATER AND SANITATION AGENCY, LAHORE**	EBA ENGINEERING · ECSP · CEC · team consultants A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 15
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



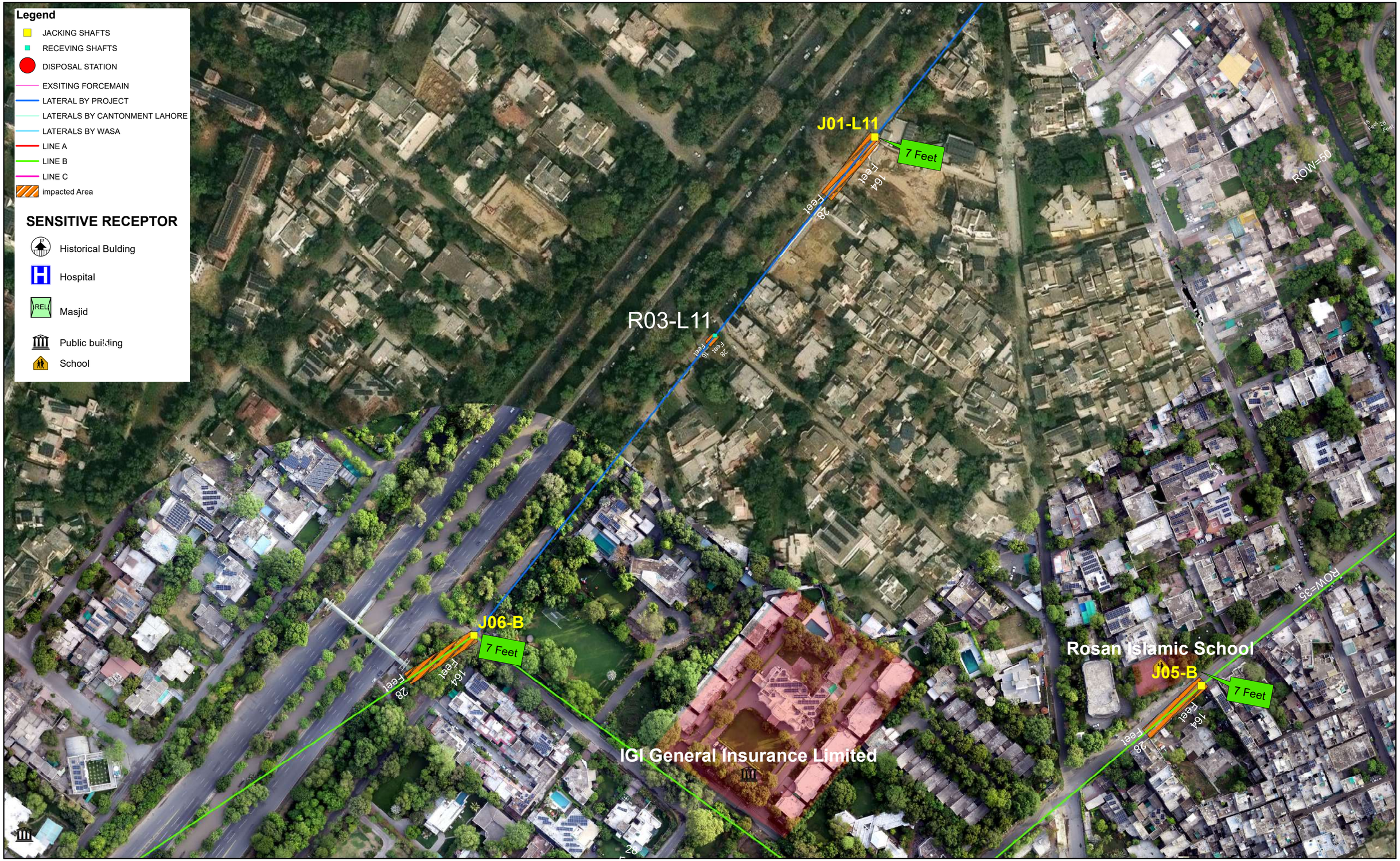
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team consultants — A Joint Venture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 16	REV:-
			REV.	DATE	DESCRIPTION		APPROVED			



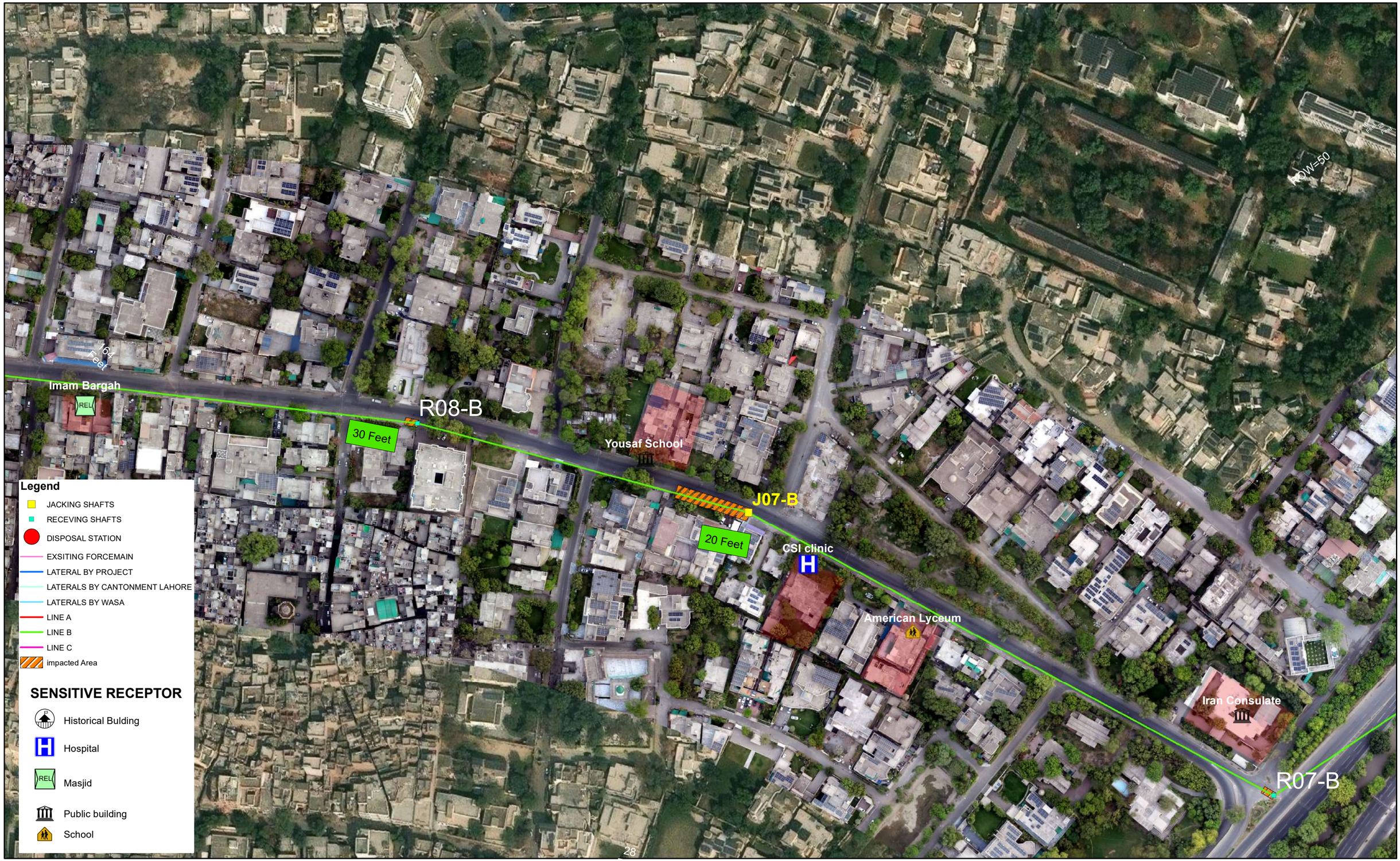
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · CEC · team consultants — A JointVenture	REVISION	04			CONTROL: DRAWN	SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03			CHECKED BY		
			02			RECOMMENDED		
			01			CHD./VER.	DATE :- AUG 2024	DRAWING No. FIGURE 17
			REV.	DATE	DESCRIPTION	APPROVED		REV:-



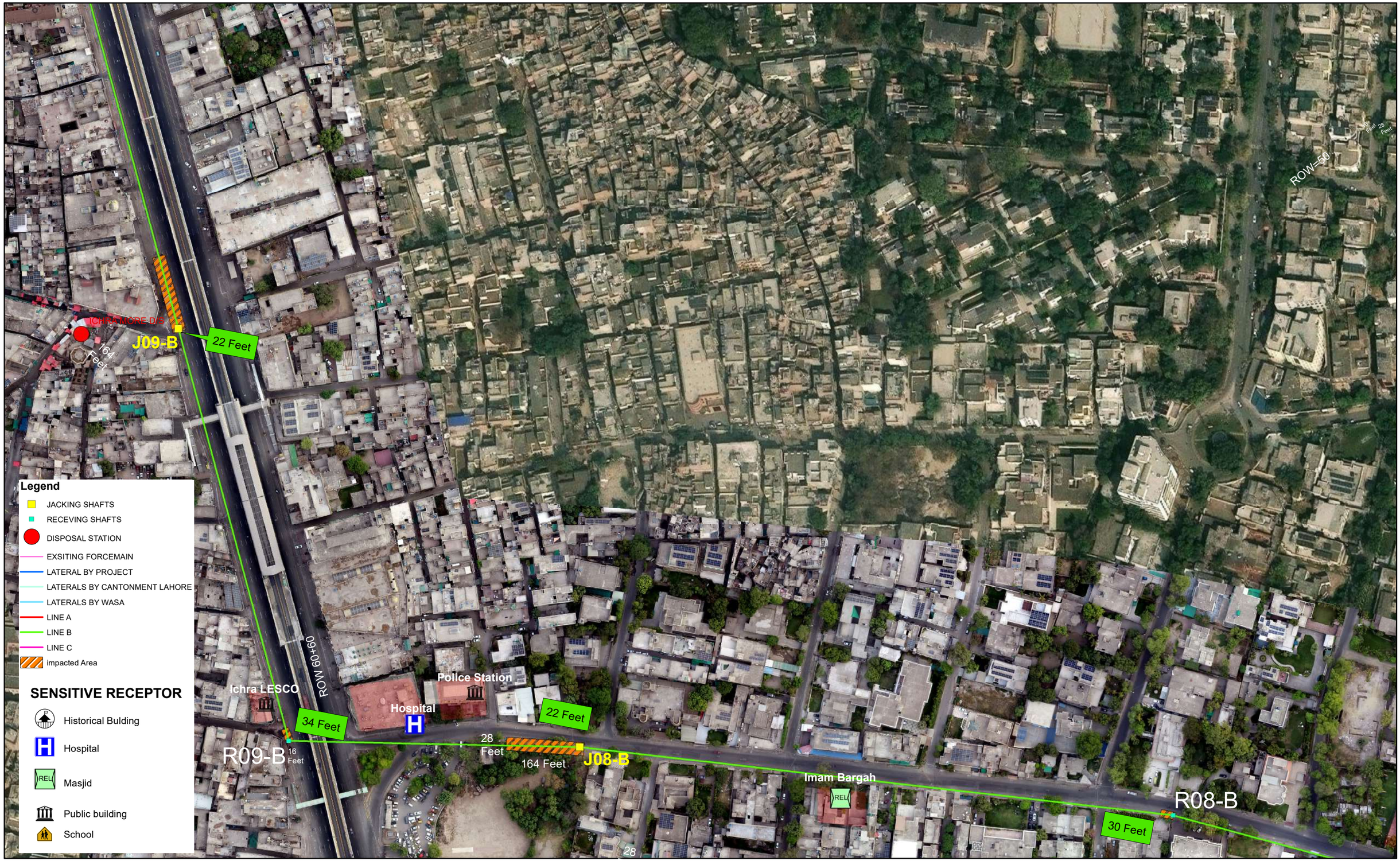
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team consultants — A Joint Venture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 18
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



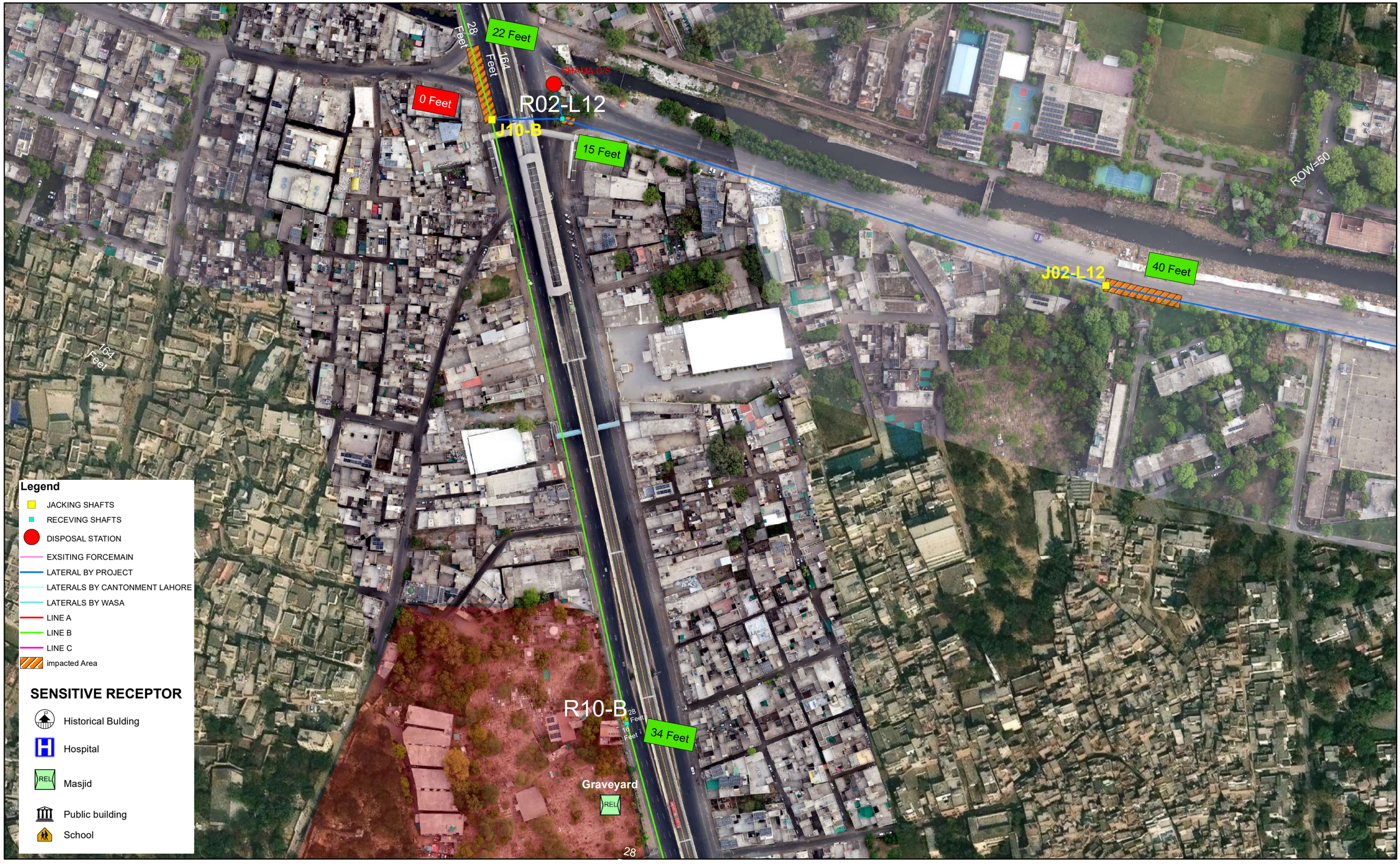
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team consultants — A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024 / DRAWING No. FIGURE 19	REV:-
			REV.	DATE	DESCRIPTION		APPROVED			



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · CEC · tcm — A JointVenture	REVISION				CONTROL		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
		04				DRAWN			
		03				CHECKED BY			
		02				RECOMMENDED			
		01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 20
		REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE		REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 21	REV:-
			REV.	DATE	DESCRIPTION		APPROVED			



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · EEC · team consultants — A Joint Venture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 22
			REV.	DATE	DESCRIPTION		APPROVED			REV:-

finshing deprtment

Graveyard

J01-C

0 Feet

164 Feet

R01-C

0 Feet

Graveyard

ROW=16+16

School

masjid

Grid station

25 Feet

8 Feet

164 Feet

15 Feet

28

Legend

- JACKING SHAFTS
- RECEVING SHAFTS
- DISPOSAL STATION
- EXSITING FORCEMAIN
- LATERAL BY PROJECT
- LATERALS BY CANTONMENT LAHORE
- LATERALS BY WASA
- LINE A
- LINE B
- LINE C
- impacted Area

SENSITIVE RECEPTOR

- Historical Bulding
- Hospital
- Masjid
- Public building
- School

LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, tcm — A Joint Venture	REVISION	04			CONTROL	DRAWN		SCALE 1:2,000
			03				CHECKED BY		
			02				RECOMMENDED		
			01				CHD./VER.		
			REV.	DATE	DESCRIPTION		APPROVED		

SENSITIVE RECEPTOR MAP

DATE :- AUG 2024

DRAWING No. FIGURE 23

REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, team consultants — A JointVenture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024 / DRAWING No. FIGURE 24	REV:-
			REV.	DATE	DESCRIPTION		APPROVED			



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING / ECSP / tcm — A Joint Venture	REVISION			CONTROL		SENSITIVE RECEPTOR MAP
		04			DRAWN		SCALE 1:2,000
		03			CHECKED BY		
		02			RECOMMENDED		
		01			CHD./VER.		DATE :- AUG 2024 / DRAWING No. FIGURE 25 / REV:-
		REV.	DATE	DESCRIPTION	APPROVED		



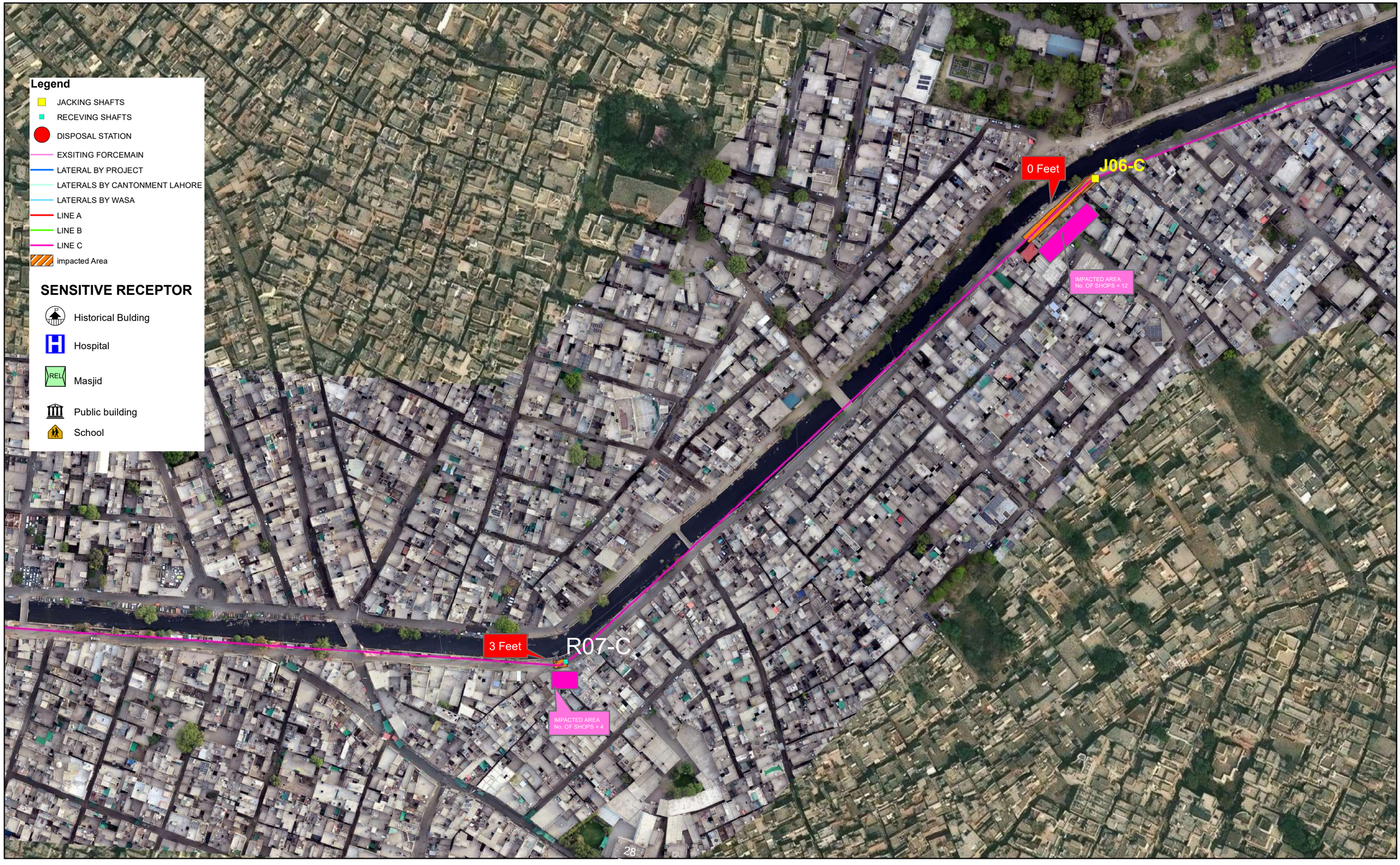
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · CEC · team consultants — A Joint Venture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 26
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



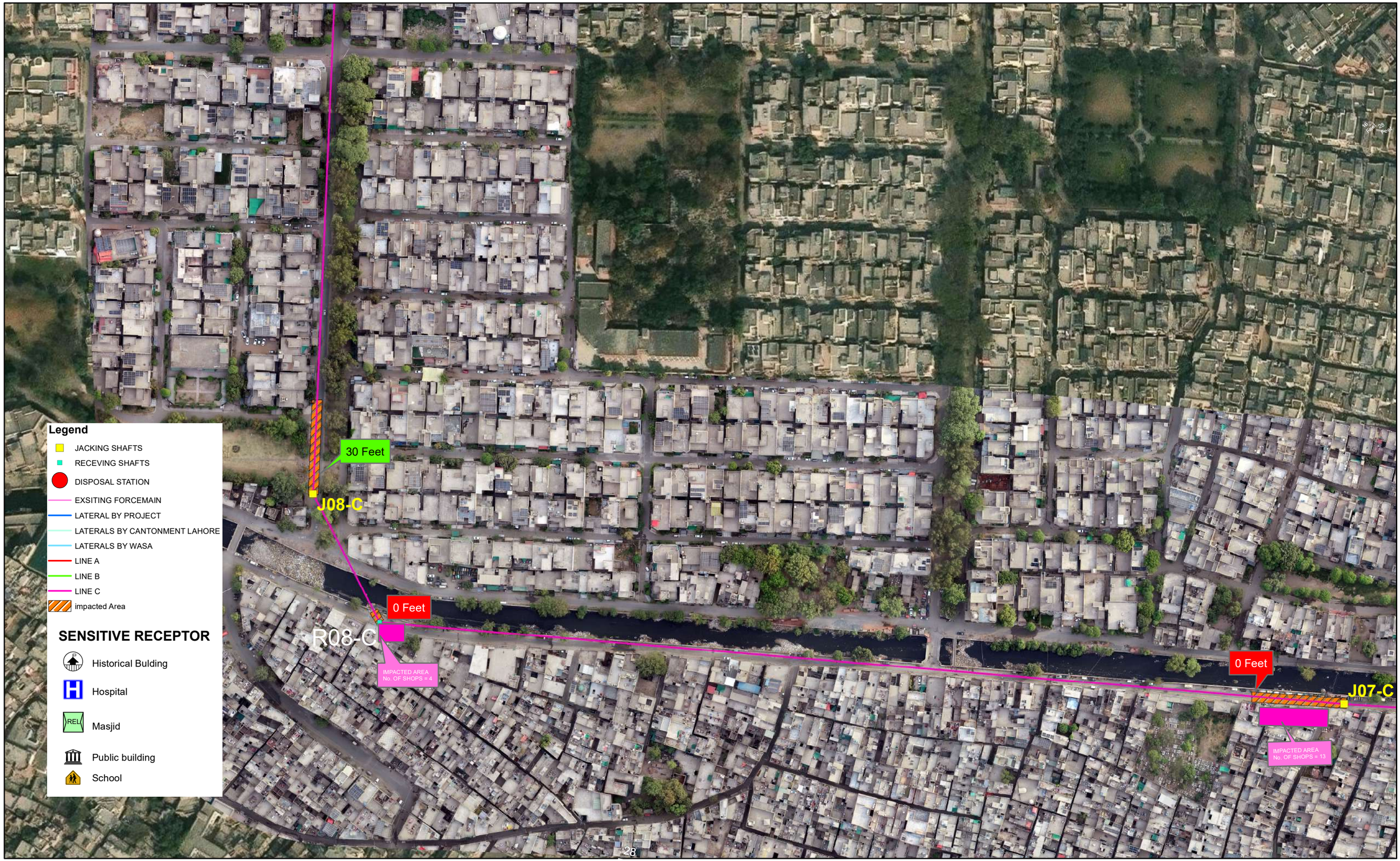
LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, CEC, tcm — A Joint Venture	REVISION	04		DRAWN		SENSITIVE RECEPTOR MAP — SCALE 1:2,000
			03		CHECKED BY		
			02		RECOMMENDED		
			01		CHD./VER.		DATE :- AUG 2024 — DRAWING No. FIGURE 27 — REV:-
			REV. / DATE / DESCRIPTION		APPROVED		



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · GEC · team — A Joint Venture	REVISION	04			CONTROL	DRAWN		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
			03				CHECKED BY			
			02				RECOMMENDED			
			01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 28
			REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WASA LAHORE — WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, ECSP, team — A JointVenture	REVISION				CONTROL		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
		04				DRAWN			
		03				CHECKED BY			
		02				RECOMMENDED			
		01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 29
		REV.	DATE	DESCRIPTION		APPROVED			REV:-



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING · ECSP · GEC · team consultants — A Joint Venture	REVISION				CONTROL		SENSITIVE RECEPTOR MAP	SCALE 1:2,000
		04				DRAWN			
		03				CHECKED BY			
		02				RECOMMENDED			
		01				CHD./VER.		DATE :- AUG 2024	DRAWING No. FIGURE 30
		REV.	DATE	DESCRIPTION		APPROVED			REV:-

ANNEXURE XXII

LIST OF PITS & SENSITIVE RECEPTORS TABLE

Sewerage System From Laerch Colony to Gulshan-E-Ravi (Through Trenchless Technology)

Preliminary Environmental Impacts

Alignment A (Sewer Line Dia 2400 mm)

Key: The Left Hand Side (LHS) of Sewer Line is determined on the flow of sewer from the disposal station to the downstream. LHS of road is also determined on the basis of flow of sewer from the disposal station to the downstream. Right Hand Side (RHS) is agianst the flow of sewer line.

S No.	Type of Pit (Jacking-J/ Recipient-R)	Road	Coordinate X	Coordinates Y	Trunk Sewer Line Dia (mm)	Pit Location LHS/RHS	Working Area		Right of Way (LHS)		Environmental Impacts					
							Length (meter)	Width (meter)	Road width (meter)	Footpath Average (meter)	Comments as Per Survey	Access Disturbance (No. of Shops/ Buildings)	Business Disruption (No. of Shops)	No. of Sensitive Receptors	No of Trees	No. of Poles
1	J01-A	Allama Iqbal Road	440427.5533	3490761.795	2400	LHS	50	8	10	3	This point is in front of the petrol pump. Alongside it, there is a street for Kangro School for Kids, and access to Jahangir Marquee will need to be ensured. One side of the road will be blocked, and the other side will be used for traffic. There is zero impact.	0	0	1	0	8
2	R01-A	Allama Iqbal Road	440082.5671	3490822.555	2400	LHS	8.5	5	10	3	There is no impact of any kind at this point. Half of the road will be used for work, and the other half will remain open.	0	0	0	0	2
3	J02-A	Allama Iqbal Road	439738.5392	3490883.145	2400	LHS	50	8	10	3	On the left side of this point, there are 10 to 15 shops, but for their access, a 15-foot shoulder and a 5-foot footpath are available. There is zero impact here	0	0	0	0	4
4	R02-A	Allama Iqbal Road	439492.6008	3490925.942	2400	LHS	8.5	5	10	3	This actual point is located right in front of the petrol pump's exit, which will create an issue with the exit. I **suggest** that if we shift this point 10 to 15 feet forward, the impact will be zero.	0	0	1	0	3
5	J03-A	Allama Iqbal Road	439245.9659	3490966.873	2400	LHS	50	8	10	3	This circular pit has a diameter of 18 feet. It is located on the left side of Infantry Road where it connects to Main Allama Iqbal Road near Mizan Bank. There is sufficient access for the shops. Only the first left turn from Infantry Road that connects to Allama Iqbal Road will be closed, while the second turn, which directly connects to Allama Iqbal Road, will remain open. There is zero impact here.	0	0	0	3	2
6	R03-A	Canal Road	439139.3255	3491061.079	2400	LHS	8.5	5	10	3	This circular pit has a diameter of 12 feet and is located at the center of the first turn of Allama Iqbal Road, which connects to Canal Road. This turn will be blocked, but the second turn of Allama Iqbal Road, which connects to Canal Road, will remain open. There is zero impact here.	0	0	0	0	1
7	J04-A	Canal Road	439240.7352	3491174.426	2400	LHS	50	8	20	3	At this point, we need a space of 28 by 164 feet. More than half of the road will be blocked, but one lane will remain open for traffic. There is zero impact on any building structures."	0	0	0	0	0
8	R04-A	Canal Road	439186.1779	3491230.499	2400	LHS	8.5	5	20	3	The circular pit has a diameter of 12 feet and is located opposite the disposal station on Canal Road. There is zero impact here.	0	0	0	0	0
9	J05-A	Canal Road	439090.0919	3491143.135	2400	LHS	50	8	20	3	The point for work is located at 28 by 164 fit space, further down the canal, before the bird market, in front of the spiritual center (Astana Aliya) at the chowk, on the left side. There are offices, a fire station, and the division headquarter of the City Dafah nearby, so there could be access issues. If we use the road for work, one side will be blocked, while the second side will remain open for traffic, which would minimize the impact to zero.	3	0	0	0	2
10	R05-A	Allama Iqbal Road	439018.2024	3491222.705	2400	LHS	8.5	5	10	3	Point at the disposat space available zero impact.	0	0	0	0	0
11	J06-A	Allama Iqbal Road	438782.562	3491386.329	2400	LHS	50	8	10	3	This point requires a 28 by 164 feet area, and it is located in front of Japan Auto Motor Spare Parts. One lane of the road and the shoulder will be used, which will have zero impact.	0	0	0	0	0
12	R06-A	Allama Iqbal Road	438527.7927	3491625.856	2400	LHS	8.5	5	10	3	This point in the frunt of city law college one side of the road will be closed but zero imact space available.	0	0	1	0	2
13	J07-A	Allama Iqbal Road	438280.3013	3491873.342	2400	LHS	50	8	10	3	This point in the frunt of lahore learning school . One side of the road will be blocked only pedistarian can pass not heavy trafiic zero impacts on bussiness.	0	0	1	0	0

14	R07-A	Allama Iqbal Road	438027.6637	3492115.548	2400	LHS	8.5	5	10	3	zero impact space available	0	0	0	0	0
15	J08-A	Allama Iqbal Road	437959.7333	3492179.766	2400	LHS	50	8	10	3	This circular pit of 18 feet is located in front of Green Pharmacy, opposite Ghari Shaho Bazar, on Allama Iqbal Road. There is 20 feet of space available for business use from the shoulder and footpath, with zero impact.	0	0	0	0	3
16	R08-A	Allama Iqbal Road	437889.3316	3492245.926	2400	LHS	8.5	5	10	3	This circular pit is located at Ghari Shaho Chowk, in front of Butt Sweets. Only one side of the chowk will be closed, and there will be no impact on business.	0	0	0	0	0
17	J09-A	Durand Road	437623.6	3492175.158	2400	LHS	50	8	8	2	At this point, we need a 28 by 164 feet area, but the ROW (Right of Way) is only 25 by 25 feet. If we use this area, the road will be completely closed, and the access to Butt Car Auto Service Shop will also be blocked.A **suggestion** is to shift this point slightly forward with a queen masonry wall. This would minimize the impact, and the business impact would be zero.	1	0	0	0	4
18	R09-A	Durand Road	437357.1676	3492106.865	2400	LHS	8.5	5	8	2	This point along the queen merry college wall there is zero impact.	0	0	1	0	0
19	J10-A	Durand Road	437093.4667	3492041.797	2400	LHS	50	8	8	2	The circular pit, which has a diameter of 18 feet, will not completely close the chowk. Only Davis Road, which connects to Queen Merry Road, will be closed. The rest of the chowk will remain open, and there will be zero impact on business.	0	0	0	0	0
20	R10-A	Edgerton Road	436947.1075	3492051.312	2400	LHS	8.5	5	10	2.5	There is space available zero bussines impact.	0	0	0	0	0
21	J11-A	Edgerton Road	436889.0195	3492140.662	2400	LHS	50	8	10	2.5	This is a circular pit with a diameter of 11 feet, located on the opposite road to the NADRA office. On the right side of the road, there is an empty plot that can be used for machinery. There will be zero impact.	0	0	0	0	0
22	R11-A	Edgerton Road	436609.486	3492064.2	2400	LHS	8.5	5	10	2.5	This point in the frun of Grandiel murquee wall space availbe zero bussines impact.	0	0	0	0	0
23	J12-A	Edgerton Road	436319.217	3491984.338	2400	LHS	50	8	10	2.5	This point in the opposite to falaties hotel enoughf face avail for bussiness. Zero impact.	0	0	0	0	0
24	R12-A	Edgerton Road	436049.2887	3491909.319	2400	LHS	8.5	5	10	2.5	This point along the assembly hall wall space available for work zero impact.	0	0	0	0	0
25	J13-A	Edgerton Road	435981.7193	3491894.388	2400	LHS	50	8	10	2.5	The diameter of this circular pit is 18 feet, and the road will be blocked. However, the point is located near a park, so there will be no impact on business.	0	0	0	0	0
26	R13-A	Queens Road	435903.5612	3491793.595	2400	LHS	8.5	5	10	3	This point at assembly hall chowk space availble zero bussiness impact.	0	0	0	0	0
27	J14-A	Queens Road	435838.1561	3491745.493	2400	LHS	50	8	10	3	There is circular pit which has 18 fitt dia this point at the front of rehman plaza road will be complete blocked for traffice only pedistarian can pass. Need to me ensure acess of the rehman palza and one streat .	2	0	0	0	0
28	R14-A	Queens Road	435697.4249	3491543.007	2400	LHS	8.5	5	10	3	There is required 16 by 28 fitt for working. Spce availble there is shoulder which is enough for work . No any building or bussiness impact.	0	0	0	0	0
29	J15-A	Queens Road	435556.6937	3491340.521	2400	LHS	50	8	10	3	This point with the gate of medical college but gate closed not in use. Point move along the wall of college road will be closed but no any building structure and bussiness impact.	0	0	0	0	0
30	R15-A	Queens Road	435409.1221	3491108.255	2400	LHS	8.5	5	10	3	point at the frunt of the latif motors if we use one lane of the raod and shoulder than there is zerom impact on bussiness and building structure.	1	0	0	0	0

31	J16-A	Queens Road	435315.7469	3490852.046	2400	LHS	50	8	10	3	There is no any bussiniess or structure impact.	0	0	1	0	0
32	R16-A	Queens Road	435265.0344	3490800.042	2400	LHS	8.5	5	10	3	There is no any bussiniess or structure impact.	0	0	1	0	0
Total												**7**	**0**	**7**	**3**	**31**

Sewerage System From Laerch Colony to Gulshan-E-Ravi (Through Trenchless Technology)

Preliminary Environmental Impacts

Alignment B (Sewer Line Dia 2400 mm)

Key: The Left Hand Side (LHS) of Sewer Line is determined on the flow of sewer from the disposal station to the downstream. LHS of road is also determined on the basis of flow of sewer from the disposal station to the downstream. Right Hand Side (RHS) is against the flow of sewer line.

Sr. No.	Type of Pit (Jacking-J/ Recipient-R)	Road	Coordinate X	Coordinates Y	Trunk Sewer Line Dia (mm)	Pit Location LHS/RHS	Pit Location LHS/RHS	Working Area				Environmental Impacts					
								Length (meter)	Length (feet)	Width (meter)	Width (feet)	Comments as Per Survey	Access Disturbance (No. of Shops/ Buildings)	Business Disruption (No. of Shops)	Sensitive Receptors	No. of Trees	No. of Poles
1	R01-B	Gurumangat Road	439082.1911	3487143.116	2400	LHS	LHS	8.5	28	5	16	This is a circular pit with a diameter of 10 feet, located next to the WASA disposal point. There is sufficient space, and there will be no impact at this location.	0	0	0	1	2
2	J01-B	Guru Mangat Road	439103.6865	3487326.704	2400	LHS						This is a circular pit with a diameter of 16 feet, located at the corner of Mother Teresa Orphan Child House. Only its wall will be impacted, and a small part of the road will be blocked.	0	0	1		
3	R02-B	Gurumangat Road	438964.7	3487445.464	2400	LHS						At this point, if we move forward, the entrance of a street will be impacted. It is **suggested** to move the machinery backward . This will result in zero impact, and half of the road will remain open for traffic.	1	0	0		
4	J02-B	Gurumangat Road	438826.5761	3487565.433	2400	LHS						Actual point is right next to the wall of the Deaf School, and the school's main gate will be blocked. Access of 4 to 5 houses will also be ensured. One street will be closed and access to a street opening on the road needs to be ensured.	6	0	1	0	5
5	R03-B	Gurumangat Road	438687.8941	3487687.69	2400	LHS	LHS	50	164	8	26	There is zero impact	0	0	0	10	0
6	J03-B	Gurumangat Road	438544.3833	3487812.224	2400	LHS	LHS	8.5	28	5	16	This point is opposite the mosque, on the left side of the road near Dr. Bashir-ul-Nisa. The road will be blocked for traffic, and only pedestrians will be able to pass. The entrance to the CERP office and a house will be affected, and there is senstivie reseptor Ignition Pro School.	2	0	2	8	4
7	R04-B	Gurumangat Road	438400.9301	3487936.751	2400	LHS	LHS	50	164	8	26	There is zero impact	0	0	0	0	1
8	J04-B	Mushtaq Ahmad Gurmani Road	438252.8246	3488065.317	2400	LHS	LHS	8.5	28	5	16	This is a circular pit with a diameter of 16 feet. Only Mushtaq Ahmed Gurmani Road, which connects to the main boulevard, will be blocked, but there is zero impact here.	0	0	0	0	0
9	R05-B	Mushtaq Ahmad Gurmani Road	438102.4088	3488195.362	2400	LHS	LHS	50	164	8	26	This pit is located on Mushtaq Ahmed Gurmani Road next to the PHA park. There is sufficient space here, so there is no impact.	0	0	0	0	4
10	J05-B	Mushtaq Ahmad Gurmani Road	437958.4801	3488320.745	2400	LHS	LHS	8.5	28	5	16	The road here is 28 feet wide and will be completely blocked, impacting access to 4 houses. I **suggest** shifting this point to the right side of the road, where 20–30 feet of space is available for the work, and the impact will be zero.	4	0	0	0	9
11	R06-B	Rana Shukat Mehmood Road	437812.0849	3488449.448	2400	LHS	LHS	50	164	8	26	At this point, the **ROW (Right of Way)** is 28 feet, with 10 feet of shoulders on both sides, while the required space is only 16 feet. Therefore, there will be no impact here.	0	0	0	0	3
12	J06-B	Rana Shukat Mehmood Road	437669.127	3488576.429	2400	LHS						There is zero impact . Point at chowk.	0	0	0	0	0
13	R07-B	Rana Shukat Mehmood Road	437471.5664	3488421.414	2400	LHS						On **Molana Shoukat Ali Road**, the **ROW (Right of Way)** is 30 feet, with 10-foot shoulders on both sides. There is zero impact here.	0	0	0	0	0

14	J07-B	Murtab Ali Road	437264.681	3488248.306	2400	LHS						There is zero bussiness or structure impact.	0	0	0	0	1
15	R08-B	Murtab Ali Road	437147.8271	3488351.013	2400	LHS	LHS	8.5	28	5	16	There is zero impact point at chowk on the Muratab Ali Road.	0	0	0	0	0
16	J08-B	Murtab Ali Road	437092.4995	3488364.626	2400	LHS	LHS	50	164	8	26	This is a circular pit with a diameter of 11 feet, located in the middle of the chowk. The chowk will be closed, but there will be no issues regarding access to houses or building structures.	0	0	0	0	0
17	R09-B	Murtab Ali Road	436994.1628	3488446.892	2400	LHS						There is zero impact point before canal road space availble.	0	0	0	0	0
18	J09-B	Shah Jamal Road	436723.261	3488265.529	2400	LHS						This is a circular pit with a diameter of 18 feet, located at the start of Shah Jamal Road in the chowk. There is ample space, so the impact is zero.	0	0	0	0	1
19	R10-B	Shah Jamal Road	436420.2108	3488441.757	2400	LHS						This is a circular pit with a diameter of 18 feet. There is sufficient space available for the work, and the impact is zero.	0	0	0	0	3
20	J10-B	Shah Jamal Road	436238.9341	3488501.743	2400	LHS						This is a circular pit with a diameter of 18 feet, located near the luxury apartments. If we place it at the actual point, there will be issues with access to 3 houses and 1 pan shop and Luxurry appartments.I **suggest** shifting the pit 30 feet ahead, which will result in zero impact on access.	4	0	0	5	4
21	R11-B	Shah Jamal Road	435891.9879	3488547.527	2400	LHS	LHS	50	164	8	26	This actual pit is coming in front of 2 houses, which will cause an access issue. I suggest shifting it slightly backward. This adjustment will result in zero impact on access.	2	0	0	0	0
22	J11-B	Shah Jamal Road	435731.9427	3488559.661	2400	LHS	LHS	8.5	28	5	16	This pit is opposite Ichra Police Station. There is ample space on the disposal station and traffic ground in this area, so there will be no impact.	0	0	0	5	0
23	R12-B	Ferozpur Road	435610.9641	3488544.873	2400	LHS	LHS	50	164	8	26	zero impact	0	0	0	0	0
24	J12-B	Ferozpur Road	435532.2735	3488812.949	2400	LHS	LHS	8.5	28	5	16	This pit is located in front of Ichra Bazar. We cannot move machinry it further ahead because there is a metro bus crossing underpass. Therefore, I **suggest** moving it backward, which will ensure there is no impact.	0	0	0	0	0
25	R13-B	Ferozpur Road	435460.4123	3489078.4	2400	LHS	LHS	50	164	8	26	This point in the front of the N.D Noro Din GOVT School . Enough space available for work zero impact on any building or houses.	0	0	1	0	0
26	J13-B	Ferozpur Road	435394.5682	3489344.695	2400	LHS	LHS	8.5	28	5	16	There is zero impact space available for traafic and shoops acess.	0	0	0	1	1
27	R14-B	Ferozpur Road	435336.6694	3489604.011	2400	LHS	LHS	50	164	8	26	This point below the metro crossing stairs . Zero impact space available for shoops and traffice.	0	0	0	0	0
28	J14-B	Ferozpur Road	435306.405	3489709.761	2400	LHS	LHS	8.5	28	5	16	There is zero impact half road will be blocked half free for traffice movement . Acess available for shoop through footpath. .	0	0	0	0	0
29	R15-B	Ferozpur Road	435201.1274	3489961.52	2400	LHS	RHS	50	164	8	26	This is a circular pit with a diameter of 15 feet, located at the corner turn of Ferozepur Road leading towards Samanabad. There is sufficient space available, and there will be no impact.	0	0	0	0	2
30	J15-B	Ferozpur Road	435100.2417	3490270.509	2400	LHS	LHS	8.5	28	5	16	If we place this pit at its actual position on the left side of the road, the shops will retain access, and only half of the road will be blocked, but access to one street will be impacted.**Suggestion**: If we shift the pit to the right side of the main road, there will be zero impact.	0	0	0	0	0
31	R16-B	Ferozpur Road	435020.1824	3490482.056	2400	LHS						This is circular pit with 11 fitt dia before the Bahawal Pure Road there is zero impact.	0	0	0	0	0
32	J16-B	Ferozpur Road	434954.6475	3490635.666	2400	LHS						point in the start of chowk . There is zero impact.	0	0	0	0	0
Total													**19**	**0**	**5**	**30**	**40**

Sewerage System From Laerch Colony to Gulshan-E-Ravi (Through Trenchless Technology)

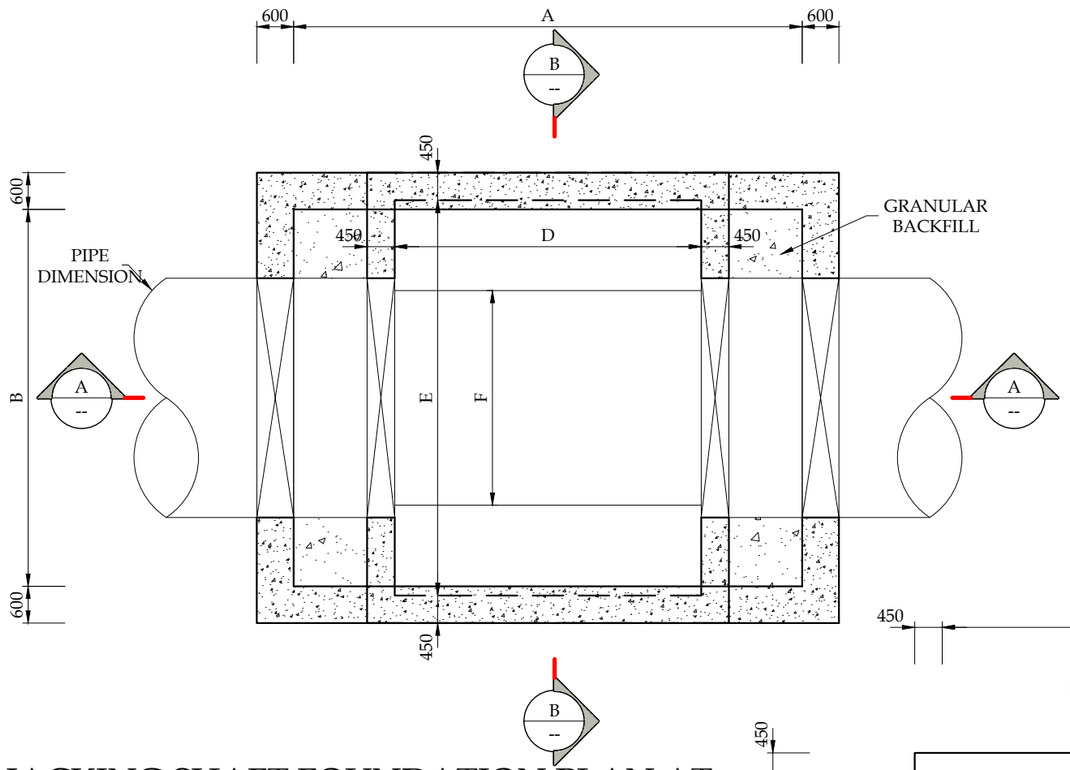
Preliminary Environmental Impacts

Alignment C (Sewer Line Dia 3500 mm)

Key: The Left Hand Side (LHS) of Sewer Line is determined on the flow of sewer from the disposal station to the downstream. LHS of road is also determined on the basis of flow of sewer from the disposal station to the downstream. Right Hand Side (RHS) is against the flow of sewer line.

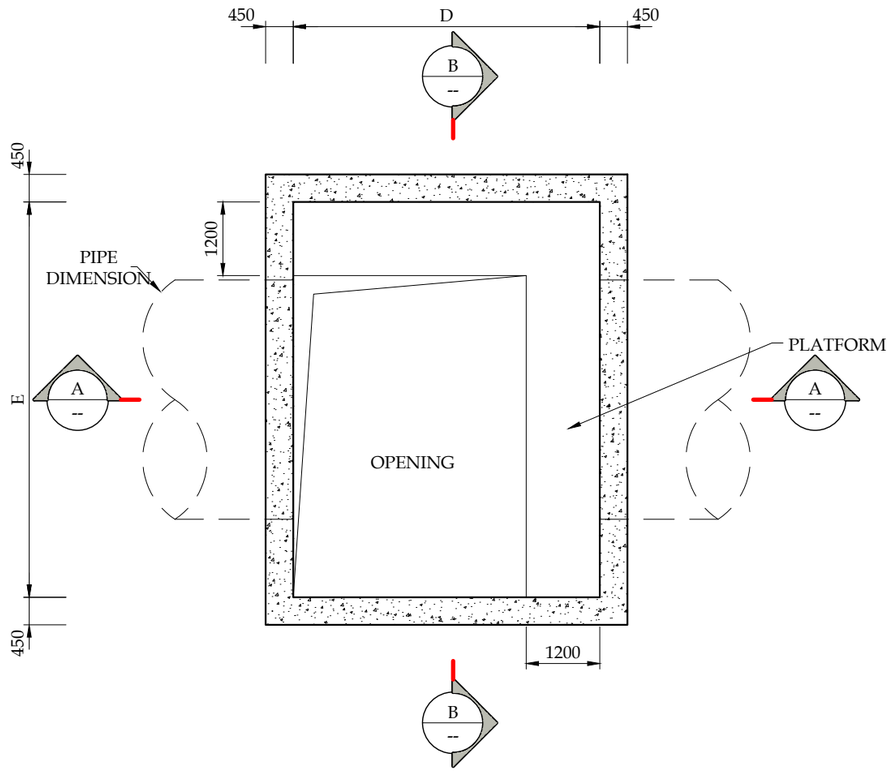
Sr. No.	Type of Pit (Jacking-J/ Recipient-R)	Road	Coordinate	Trunk Sewer Line Dia (mm)	Pit Location LHS/RHS	Working Area		Right of Way (LHS)		Environmental Impacts					
						Length (meter)	Width (meter)	Road width (meter)	Footpath Average (meter)	Comments as per survey	Access Disturbance (No. of Shops/ Buildings)	Business Disruption (No. of Shops)	Sensitive Receptors	No. of Trees	No. of Poles
1	R01-C	Bahawalpur Road	31.5520488 74.306622	3500	LHS	9	5	6	2	This point is located next to the wall of Meiyani Sharif Qabristan. There will be no impact on any building or business. One side of the road will be closed.	0	0	0	0	0
2	J01-C	Bahawalpur Road	31.550564, 74.309829	3500	LHS	60	12	6	2	This circular pit, with a diameter of 18 feet, will block one side of the road. It is located next to the wall of the cemetery (Qabristan), so there will be no impact.	0	0	0	0	0
3	R02-C	Chubaurji Chowk Multan Road	31.553401 74.305510	3500	LHS	9	5	8	4	This circular pit has a diameter of 13 feet. There will be no impact on business or structures, as 7 feet of the road will remain open for traffic.	0	0	0	0	0
4	J02-C	Bahawalpur Road	31.553483 74.305449	3500	LHS	60	6	6	2	This point is located in the green belt near Chaburji Chowk. The left side of the road will be closed, but traffic can use the service road to pass through. The traffic will continue smoothly on the entire road towards Chaburji Road. There will be zero impact.	0	0	0	0	0
5	R03-C	Multan Road	31.551609 74.301528	3500	LHS	9	5	8	4	zero impact	0	0	0	0	0
6	J03-C	Multan Road	31.5526773 74.303859	3500	LHS	60	6	8	4	zero impact	0	0	0	0	0
7	R04-C	Multan Road	31.548099 74.298083	3500	LHS	9	5	8	4	This point has a dia of 13 fit. There is no any impact on bussiness or structure.	0	0	0	1	0
8	J04-C	Multan Road	31.5508349 74.3002820	3500	LHS	60	6	8	4	There is no any impact only neend to ensure pooch clony enterance streat .	1	0	0	3	2
9	R05-C	Multan Road	31.546490, 74.296575	3500	LHS	9	5	8	4	There is a circular pit which has 13 fit dia. Zero impact on bussines and structure.	0	0	0	0	0
10	J05-C	Multan Road	31.546114 74.296205	3500	LHS	60	6	8	4	This pit is located on Multan Road, in the green belt before the Samnabad underpass. The first turn, which connects Multan Road to Samnabad Road, will be closed. However, traffic can still use the second turn. There will be no impact.	0	0	0	0	0
11	R06-C	Culshen-e-Ravi Road	31.546661 74.291005	3500	LHS	9	5	10	2	This pit is located after the underpass, directly in front of the Total Pump, with the divider separating the main road and the service road. The service road is 25 feet wide, and the shoulder is 8 feet wide. There will be zero impact.	0	0	0	0	2
12	JO-6	Babu Sabo Nonariyan Road	31.5468020, 74.29112848	3500	LHS	60	6	20	2	This a circular pit wich has 19 fit dia before start the nonaria drain corner with the shoop of leapards tcs shoop there is spce available no any building or bussiness impact	0	0	0	0	2
13	RO-7	Babu Sabo Nonariyan Road	31.5465047, 74.289933	3500	LHS	9	5	20	2	The receiving pit working area locates in RHS of Babu Sabo Nonariyan Road. The required width is available	0	0	0	0	0
14	JO-7	Babu Sabo Nonariyan Road	31.545644, 74.287969	3500	LHS	60	6	20	2	The jacking pit working area locates in RHS on Babu Sabo Nonariyan Road. The required width is available. .	0	0	0	0	0
15	RO-8	Babu Sabo Nonariyan Road	31.544742, 74.287159	3500	LHS	9	5	20	2	At this point, the road width is 22 feet, but we need 16 feet. The road will remain accessible for pedestrians but will not be used for traffic. There are three houses at this location, but their entrances will remain accessible.	3	0	0	0	0
16	J0-8	Babu Sabo Nonariyan Road	31.5434068, 74.285334	3500	LHS	60	6	20	2	At this point, the road width is 22 to 23 feet, but 20 feet of space is required for the work, which will completely block the road. Three commercial shops will be affected, and access to 10 houses will be an issue. The road will only remain accessible for pedestrians. A school locates here.	10	0	1	1	3
17	RO-9	Babu Sabo Nonariyan Road	31.543566, 74.281471	3500	LHS	9	5	20	2	At this point, the total road width is 23 feet, of which 15 feet is the road and 8 feet is the shoulder. For the work, we need 16 feet of space, leaving 7 feet available for passage	0	0	0	0	0
18	JO-9	Babu Sabo Nonariyan Road	31.543895, 74.277485	3500	LHS	60	6	20	2	At this point, the road width is 20 feet, and the shoulder is 14 feet. We need 20 feet of space for the work.	0	0	0	0	0
19	RO-10	Babu Sabo Nonariyan Road	31.544119, 74.273545	3500	LHS	9	5	20	2	At this point, the road width, including the shoulder, is 30 feet, and there is no impact	0	0	0	0	0
20	JO-10	Babu Sabo Nonariyan Road	31.544252, 74.273035	3500	LHS	60	6	20	2	At this point, the road width, including the shoulder, is 32 feet, and there is no impact. A green belt and a park are also present on this road, where the machinery for the work can be shifted.	0	0	0	0	0
21	RO-11	Babu Sabo Nonariyan Road	31.548783, 74.273231	3500	LHS	9	5	20	2	At this point, the 20 feet road width, is available. Access to a mosque and a house has to be ensured.	2	0	2	0	0
Total											**16**	**0**	**3**	**5**	**9**

ANNEXURE XXIII
PITS DESIGN



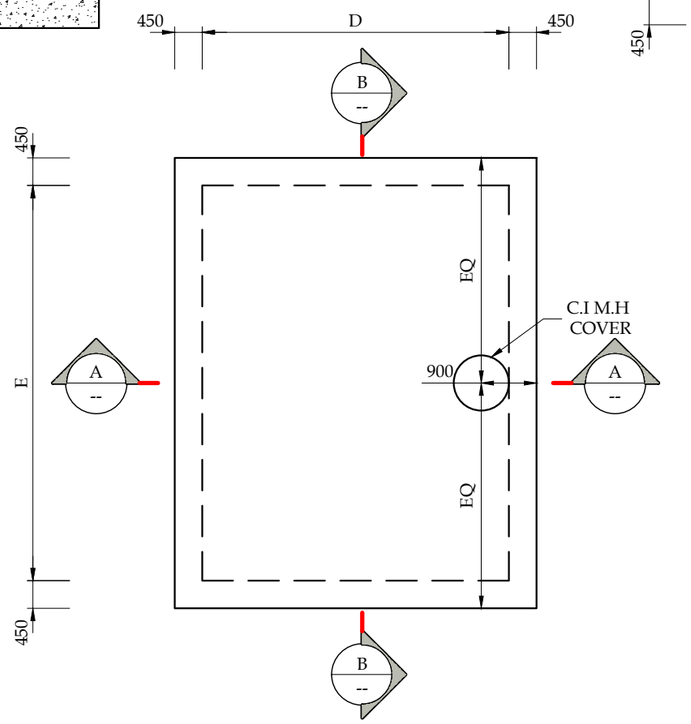
JACKING SHAFT FOUNDATION PLAN AT LEVEL-II, STAGE-II

Scale :- 1:100



JACKING SHAFT PLAN AT TOP OF THE SEWER PIPE, STAGE-II

Scale :- 1:100



JACKING SHAFT PLAN AT ROAD LEVEL, STAGE-II

Scale :- 1:100

EBA EGSP team — A Joint Venture

WASA

WATER AND SANITATION AGENCY, LAHORE

S.NO	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01		PRELIMINARY/CONCEPTUAL DRAWINGS	

DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

Title: JACKING SHAFT LAYOUT PLANS, STAGE-II

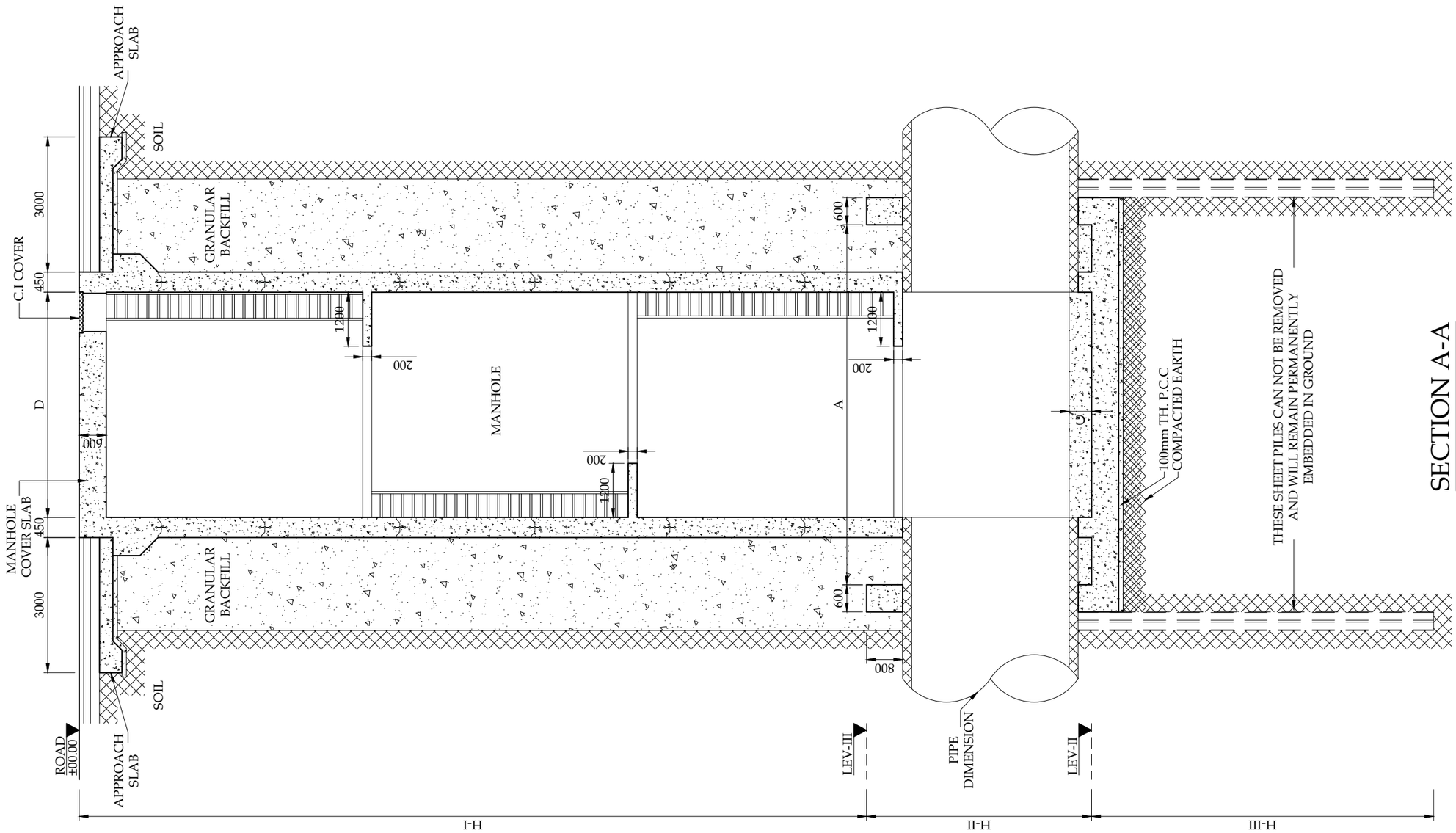
Project: Sewerage System from Larech Colony to Gulshan -e-Ravi, Lahore (Through Trench-Less Technology)

SCALE: N.T.S

DATE:- SEP, 2022

DRAWING No. 05

REV.:- 0



SECTION A-A

Scale :- 1:100

EBA ECSP CCC team
A Joint Venture

WASA

WATER AND SANITATION AGENCY, LAHORE

S.NO	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01		PRELIMINARY/CONCEPTUAL DRAWINGS	

DRAWN	
CHECKED BY	
RECOMMENDED	
CHD./VER.	
APPROVED	

Title: JACKING SHAFT SECTION, STAGE-II

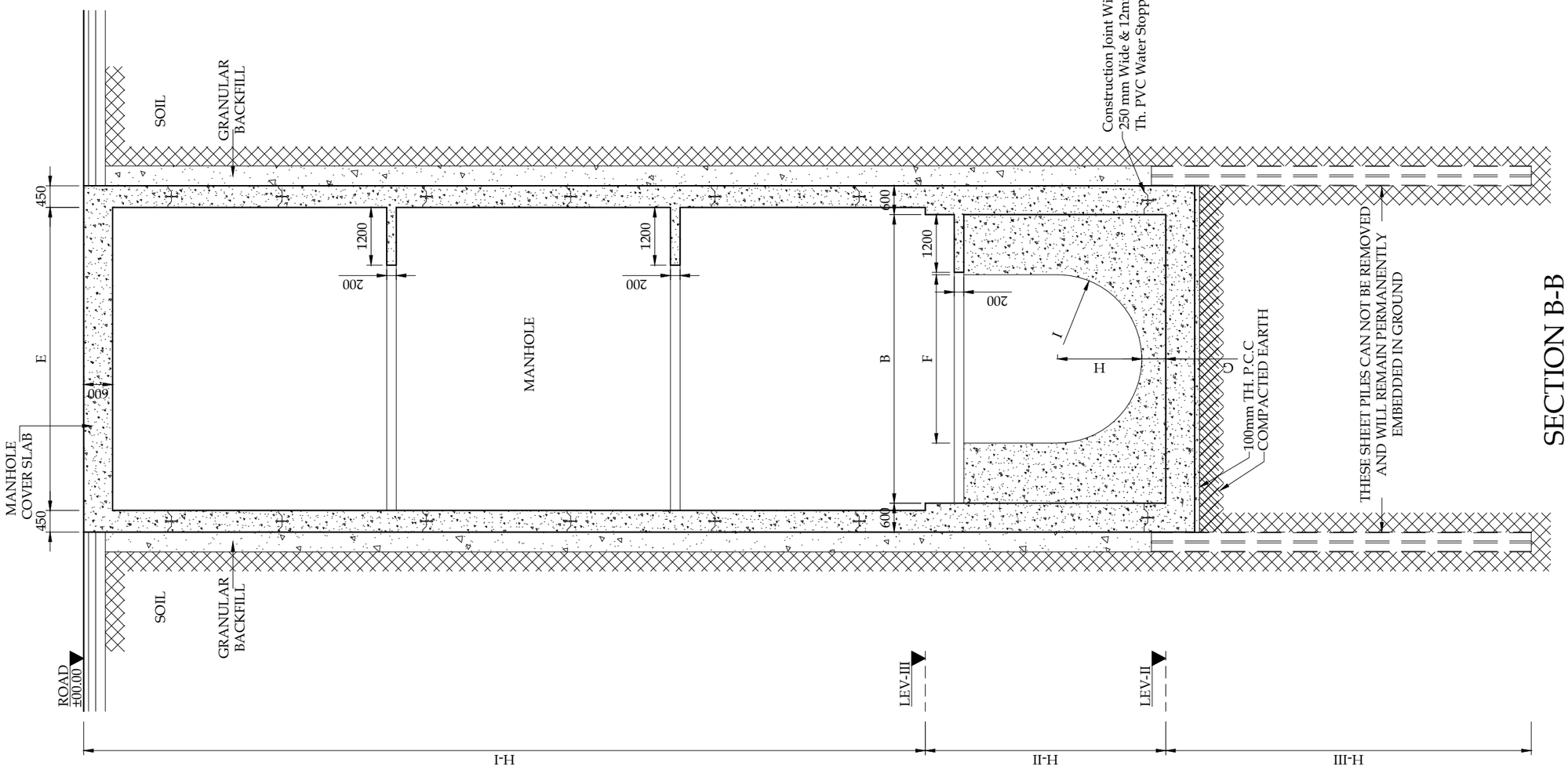
Project: Sewerage System from Larech Colony to Gulshan -e-Ravi, Lahore (Through Trench-Less Technology)

SCALE: N.T.S

DATE:- SEP, 2022

DRAWING No. 06

REV.:- 0



SECTION B-B

Scale :- 1:100

04				DRAWN	
03				CHECKED BY	
02				RECOMMENDED	
01		PRELIMINARY/CONCEPTUAL DRAWINGS		CHD./VER.	
S.NO	DATE	DESCRIPTION	APPROVED	APPROVED	

WATER AND SANITATION AGENCY, LAHORE

Title: JACKING SHAFT SECTION, STAGE-II

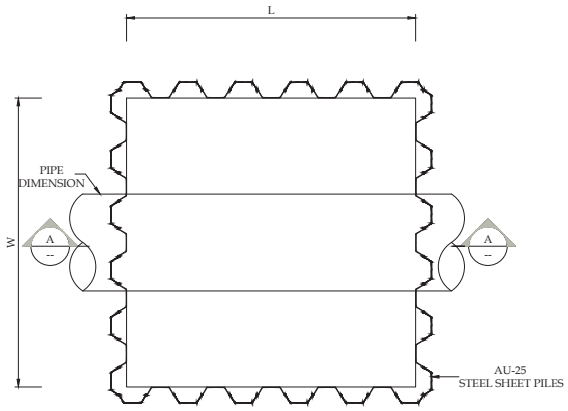
Project: Sewerage System from Larech Colony to Gulshan -e-Ravi, Lahore (Through Trench-Less Technology)

SCALE: N.T.S

DATE:- SEP, 2022

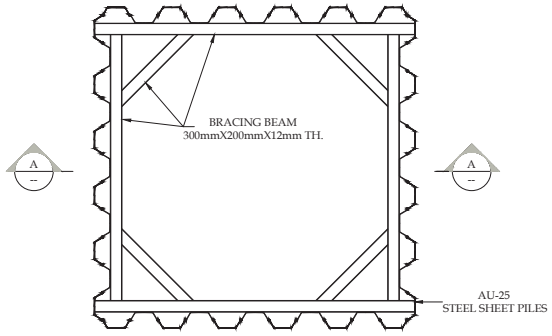
DRAWING No. 07

REV.:- 0



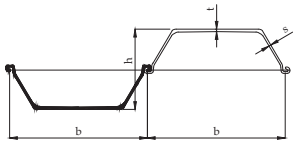
RECEIVING SHAFT PLAN AT
BED LEVEL, STAGE-I

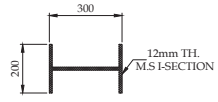
Scale :- 1:100



RECEIVING SHAFT BRACING PLAN AT
ROAD LEVEL, STAGE-I

Scale :- 1:100





BRACING BEAM

Section	Width	Height	Thickness		Sectional Area	Mass		Moment of Inertia	Elastic Section Modulus	Static Moment	Plastic Section Modulus	
	b mm	h mm	t mm	s mm	cm^2/m	single pile kg/m	wall kg/m	cm^4/m	cm^3/m	cm^3/m	cm^3/m	
AU[tm] Sections												
AU 25	750	450	14.5	10.2	188	110.4	147	56240	2500	1420	2866	

LAHORE WATER & WASTEWATER MANAGEMENT PROJECT - SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THROUGH TRENCHLESS TECHNOLOGY)

WATER AND SANITATION AGENCY, LAHORE

EBA ENGINEERING | EGSP | team — A Joint Venture

REV.	DATE	DESCRIPTION
04		
03		
02		
01		

DRAWN | CHECKED BY | RECOMMENDED | CHD./VER. | APPROVED

RECEIVING SHAFT (RECTANGULAR) LAYOUT PLAN
STAGE-I

DATE:- NOVEMBER, 2024

DRAWING No. LW - PEDR - 154

SCALE

REV:- 0

ANNEXURE-XXIV

Labor Management Plan

WATER AND SANITATION AGENCY LAHORE (LWASA)

LAHORE DEVELOPMENT AUTHORITY (LDA)

SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI IN LAHORE CITY (THROUGH TRENCHLESS TECHNOLOGY)

Labor Management Plan

December 2024

1 LABOR MANAGEMENT PLAN

1.1 GENERAL

The Labor Management Plan (LMP) has been devised to assess and manage risks associated with the labor force that is going to be deployed during the construction and operation phases of the proposed project. It covers procedures as a frame of reference for the personnel, guidelines for compliance with labor legislation and safety protocols, to promote fair and equitable practices for fair treatment with labors, to provide workers with accessible means to raise concerns and guide Tunnel Boring Machine (TBM) project staff who will ensure implementation of LMP.

The scope of LMP includes:

- Labor and contracts;
- Management of workers;
- Occupational Health and Safety; and
- Access of information and grievance mechanisms

Accordingly, the purpose of this LMP is to facilitate the planning and implementation of the Project by identifying the main labor requirements and the environmental and social (E&S) measures necessary to address the project-related labor issues. The LMP also sets out general guidance relevant to different forms of labor but also issues and concerns specific to the project. The LMP is applicable to all workers employed by the Project, regardless of their modality of hiring and the labor regime to which it belongs.

1.2 OVERVIEW OF LABOR USE IN PROJECT

It is estimated that a total of 750 personnel will be deployed. Nearly 70% (i.e. 525) personnel skilled and 30% (i.e. 225) unskilled labor will be hired. The project's required workforce can be characterized into direct workers, contracted workers and primary supply workers. Furthermore, the labor required for the project shall comprise both skilled and unskilled workforce. The workers shall work every day in three (03) shifts of eight (08) hours each.

1.2.1 Direct workers

The project's direct workers are those employed directly by TBM-WASA to work specifically in relation to the project. Direct workers will include the project-based staff (PMU) and the staff of the Project Management Unit (PMU) for implementing a wide range of the project activities. The PMU will be led by the Project Director (PD) and will include several senior and junior engineers with qualification in civil and sanitation engineering and/or other related fields, sub-engineers where required, unskilled labor and others.

The PMU will be tasked with:

- Overall responsibilities for project management, financial management, procurement, monitoring and evaluation and E&S management;
- Technical responsibilities to support departments involved in project implementation; and
- Support services (office manager, assistants, driver, others).

1.2.2 Contracted Workers

These workers can be those hired or deployed by the contractor or consultants for various project activities on contract basis. These may include:

- Skilled permanent staff of the contractor
- Skilled workers engaged by subcontractor
- Unskilled community workers engaged by contractor/subcontractor
- Project management and supervision support
- Independent monitoring consultants

1.2.3 Primary Suppliers

Primary suppliers are those suppliers who, on an ongoing basis, provide directly to the project goods or materials essential for the core functions of the project. Hence, for the proposed project, primary suppliers are not anticipated.

1.3 ASSESMENT AND MITIGATION OF KEY POTENTIAL LABOR RISKS

ASSESSMENT

The main labor risks associated with the project are assessed to be related to risk of accidents and incidents at the workplace (OHS risks), child labor and forced labor, labor influx and associated community health and safety risks, including Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH) risks, and communicable diseases and the overall capacity of the implementing agency to manage and mitigate the E&S risks.

1.3.1 Recruitment and selection of Workers

During recruitment and selection of workers for the proposed project, it is envisaged that unfair or unjust practices might be adopted such as discriminating among the applicants or workers while selecting on the basis of gender, race/ethnicity, or religion; bias towards specific groups and in job advertisements; cronyism for specific personnel; unfair interviews; lack of transparency and clarity in hiring policies; and miss-presentation of job terms.

1.3.2 Occupational Health and Safety Risks

The health and safety risks which could impact the project staff including PMU, consultants and construction workers are primarily associated with the construction and operation activities of the project. In particular, the various risks of injuries and accidents for workers are related to the excavation works. The typical risks include exposure to the physical hazards of using the construction equipment, working near the running traffic, working on and near scaffolding, tripping and falling, handling bentonite and slurry, burns, exposure to noise and dust, falling objects, traffic hazards associated with the operation of project-related vehicles, exposure to hazardous materials and exposure to electrical hazards related to the use of tools and machines as well as the prevalence of the incidence of respiratory diseases as a result of dust and emissions.

1.3.3 Community Health and Safety

The potential impacts shall be direct, such as being struck by moving vehicles within and outside the sub-project area and indirect through the decrease in air quality surrounding the sub-project area. The air quality will reduce because of increased dust generated from construction and on transport routes, as well as due to emissions from plants and vehicles. The impact will continue for the duration of the work.

1.3.4 Child Labor

The child labor risks may occur due to recruitment of individuals who, by virtue of age, would be exposed to tough and unfavorable working conditions and hazardous situation and may remain at risk to be subjected to impaired physical and social development. This may lead to further Occupational Health and Safety (OHS) risks and non-compliance with national or regional labor laws, which would ultimately dent the project's reputation and may lead to legal hurdles and penalties.

1.3.5 Forced labor

Forced labor is work exacted under the threat of penalty and for which the person has not offered himself or herself voluntarily. Forced labor can involve practices such as threats of dismissal or physical violence & the withholding of identity documents or wages. Debt bondage can arise where a worker takes a loan or wage advance from an employer or labor broker so that they can pay excessive recruitment fees. The size of the loan means that the worker is unable to pay off the loan and is effectively trapped. Forced labor can take many different forms and risks, some of which are relevant to proposed project, are as follow:

- Withholding or non-payment of wages
- Threats of dismissal to force workers to work overtime
- Locking in of workers at the workplace

1.3.6 Labor Influx

The focus of the project will be to localize the economic benefits with limited opportunities for outside workers to service work that require specialized/skilled labor that is not present in project localities. Large-scale labor influx is not expected due to the availability of local labor supply in the province and scale of works anticipated under the Project. Except for a limited number of managers, supervisors and skilled workers, majority of workers may be sourced locally or from nearby districts within the province. The priority for local labor (dependent on skill, experience capacity) is expected to minimize the risk of labor influx. Specific requirements to manage risks associated with labor influx, related to the interaction between project workers and local communities will be managed through contractual requirements.

1.3.7 Labor Disputes over Terms and Conditions of Employment

Labor disputes in a new construction environment are inevitable. Likely causes for labor disputes include demand for limited employment opportunities; labor wage rates and delays of payment; disagreement over working conditions; and health and safety concerns in work environment. In addition, employers such as contractors/subcontractors may retaliate against workers for demanding legitimate working conditions, or raising concerns regarding unsafe or unhealthy work situations, or any grievances raised, and such situations could lead to labor unrest.

1.3.8 Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH)

Although, the influx of workers will be minimal as discussed earlier, new workers (outside of their social spheres) may form close social relationships with local communities. This can lead to unacceptable and / or illegal behavior, ranging from unwanted aggressive advances, SEA/SH against women and children.

MITIGATION

Category	Workers Risk/Impact	Project Risk/Impact	Mitigation Measure	Responsible Party
Recruitment and Selection of Workers	Perception of unfair recruitment practices	Workers productivity, hindrance in project implementation, community tensions	• Formulation, approval (by PMU) and adoption of comprehensive Human Resource policy by the contractor • Defined selection criteria for each position • Equal opportunities for genders, exception where required • Maximized work opportunities for locals • Trainings for capacity building and skill enhancement for local work force	PMU contractors and Project Management Consultants (PMC)
Conditions of Employment/wages and benefits	Perceptions that wages/salaries and benefits are less for locals relative to outsiders	Workers productivity, hindrance in project implementation, community tensions	• The recruiters are obliged to follow contract agreements • Equal pay to all for equal work shall be paid • Provision of agreed upon benefits and wages as in the contract agreement • Assurance of timely payments to workers by contractors/recruiters	PMU contractors and PMC
Labor disputes, concerns, grievances and communication mechanisms	Disputes may arise among workers, especially those having different backgrounds. Workers may get perception of being misinformed and aggrieved.	Workers embark on various forms of actions. Workers take matters into their own hands, which results in conflict that affects workplace harmony.	• Effective and gender-sensitive grievance redress mechanism (GRM)/process should be formulated and provided to workers. • Disciplinary procedures/code of conduct should be set and followed. • Proper mobilization	PMU contractors and PMC

			and demobilization procedure should be followed. • Effective information dissemination to workers.	
OHS/HSE	Various risks of injuries and accidents for workers, physical hazards of using the construction equipment, working near running traffic, tripping and falling risk, handling bentonite, burns, exposure to noise and dust, falling objects, traffic hazards, and exposure to electrical hazards.	Workers productivity, hindrance in project implementation, delay in project completion, dent on project reputation in case of severe accidents or cases.	• The contractor shall deliver trainings to his crew regarding Health and Safety Environment (HSE) and OHS practices • The contractor shall fence the working area and unauthorized shall not be allowed to enter the construction areas • The contractor will hire an HSE officer with adequate experience to address the OHS concerns • The Contractor will display signboards and banners about traffic diversion at places on detour routes • The Contractor shall make available the first aid kit • Drivers will fix the net on containers while transporting stones etc. • Community liaison will be maintained during the construction stage • GRM will be established to address complaints related to safety hazards • The contractor will also prepare an emergency response plan to address events such as urban floods, fires, earthquakes, injury/death, and accidents	PMU contractors and PMC

Community health and safety	Risks such as being stuck by moving vehicle and decrease in air quality due to dust emission.	Community's grievances against risks, hindrance in project implementation, delay in project completion, dent on project reputation in case of severe accidents or cases.	• Contractor shall ensure that the construction sites are restricted from the entry of irrelevant people particularly children • Timely public notification on planned construction works • Seeking cooperation with local educational facilities for road safety campaigns • Provision of proper safety and diversion signage, particularly at socially sensitive receptors areas • Setting up speed limits in close consultation with the traffic police • During construction work, pedestrian and vehicular passages shall be provided for crossing near the settlement • Open trenches and deeply excavated shall be protected by a fence/barricade to avoid any accident	PMU contractors and PMC
Child labor	Recruitment of individuals who, by virtue of age, would be exposed to hazardous situations and be subject to impaired social development	Increased health and safety risk to workforce, potential non-compliance with national labor laws, and reputational risk to the project.	• Formulation and adoption of human resources and contracting procedures that cover recruitment and selection processes that specifically address issues associated with child labor.	PMU contractors and PMC
Forced labor	Withholding or non-payment of wages, threats of dismissal to force workers to work overtime, locking in of	Work stoppages/protest. There are serious financial, reputational, and legal costs associated with	• Take steps to ensure that all work is carried out voluntarily. • Anonymous grievances will be treated equally as	PMU contractors and PMC

	workers at the workplace, debt bondage	attempting for forced labor	other grievances, whose origin is known. • PMU will treat grievances seriously and take timely and appropriate action in response • GRM will be established to address complaints	
SEA/SH	SEA/SH risks for the communities as well as for the workers	-	• The routes/places used by the women will be avoided as far as possible. If unavoidable, alternate routes will be identified for the communities, if required, especially along routes frequented by women folk, such as route to the local well or water source • Campsites for construction will be 500 m away from the nearest community • Construction crew will avoid in entering villages and settlements • Communities will be informed and consulted before commencing works inside or near the communities • The construction crew will maintain strict code of conduct. Local norms will be respected • Project staff will receive training on the prevention of SEA/SH • Provision related to SEA/SH will be incorporated in the bidding document • Workers will be required to sign Code of Conducts (CoC) prepared by the	PMU contractors and PMC

			Contractors and reviewed and approved by PMU • Identification and mapping of the service providers	
Workers accommodation/camp management	Accommodation is considered sub-standard which leads to discontent amongst the residents and concerns about perceived health risks. Residents do not live-in harmony and the potential for conflict rises. Residents do not know how to complain or make a grievance	Workers have low morale, perception that project is unable to care about their welfare, which in turn affects motivation and productivity	• Build camps to the minimum specifications. The following plans should be applied as necessary: ➢ Minimum health requirements ➢ Operations accommodation ➢ Emergency Response Plan ➢ Security Management Plan • Implement an induction program to be attended by all residents that covers at least the following: ➢ Camp rules and regulations ➢ Code of conduct ➢ Camp grievance mechanism ➢ Camp disciplinary procedure ➢ Cultural awareness ➢ Health, safety and security ➢ First aid kits are adequately stocked	Contractor(s)

1.4 LEGISLATION

1.4.1 Labor Rights in the Constitution of Pakistan (1973)

The Constitution of Pakistan 1973 provides a framework of rights for labor force and contains provisions for the economic and social well-being of the people and for the promotion of social justice. The Constitution of Pakistan contains a range of provisions about labor rights found in Part II: Fundamental Rights and Principles of Policy. Fundamental rights, such as security of livelihood, prohibition of bonded labor, eradication of slavery, and the right of association, have been incorporated in the constitution in Part II. Thus, the constitution affirms the progress of labor legislation, which is conducive to change and to benefit the working class in the following articles:

- Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor;
- Article 17 provides for a fundamental right to exercise the freedom of association and the right to form unions;
- Article 18 proscribes the right of its citizens to enter upon any lawful profession or occupation and to conduct any lawful trade or business;
- Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone;
- Article 37(e) makes provision for securing just and humane conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment.

1.4.2 ILO Labor Conventions – Ratifications from Pakistan

The Government of Pakistan has ratified 36 ILO Conventions, including eight fundamental conventions, as of now. In the South Asian sub-region, Pakistan is the second country that has ratified all eight fundamental conventions as enshrined in the ILO Declaration on Fundamental Principles and Rights at Work. The ILO works in close collaboration with its tripartite constituents towards achieving Pakistan's decent work objectives.

The ILO Governing Body has identified eight "fundamental" Conventions, covering subjects that are considered to be fundamental principles and rights at work: freedom of association and the effective recognition of the right to collective bargaining; the elimination of all forms of forced or compulsory labor; the effective abolition of child labor; and the elimination of discrimination in respect of employment and occupation. These are listed below:

- Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87)
- Right to Organize and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labor Convention, 1930 (No. 29) (and its 2014 Protocol)
- Abolition of Forced Labor Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labor Convention, 1999 (No. 182)
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)

1.4.3 Federal Labor Laws

Labor legislation in Pakistan traces its origin to colonialism and have evolved through a continuous process of trial to adjust to changing socio-economic conditions, state of industrial development, level of literacy and social welfare. Laws related to labor rights and welfare are listed below:

- Factories act, 1934
- Industrial Relation Act, 2012
- Workman Compensation Act, 1923
- Minimum Wages Ordinance, 1961
- Payment of Wages Act, 1936
- Industrial & Commercial Employment Standing Orders Ordinance, 1968
- Shops & Establishment Act, 1969
- Maternity Benefit Ordinance, 1958
- The Mines Maternity Benefit Act, 1941
- Apprenticeship Ordinance, 1962
- Employees Old Age Benefit Act, 1976
- Prohibition of Employment of Children Act, 1938

- Employments of Children Act, 1991
- Bonded Labor Abolition Act, 1992
- Employees Cost of Living (relief) Act, 1973
- Companies' Profits (workers participation) Act, 1968
- Workers Welfare Fund Act, 1971
- Minimum Wages (Unskilled Workers), (Amendment) 2015
- The Disabled Persons (Employment and Rehabilitation) Act, 2015
- The Protection Against Harassment of Women at the Workplace Act, 2010
- Transgender Persons (Protection of Rights) Act, 2018

1.4.4 Provincial Labor Laws

1.4.4.1 The Worker's Compensation Act, 1923

This act provides financial compensation to workers or their dependents in case of work-related injuries, disabilities, or death. It aims to provide relief and support to workers affected by occupational accidents or diseases.

1.4.4.2 The Factories Act, 1934

This act ensures workplace safety and health by regulating working hours, providing for workers' welfare, and imposing penalties for non-compliance. It covers aspects such as building safety, machinery safety, and health and hygiene.

1.4.4.3 The Payment of Wages Act, 1936

This act regulates wage payments, including minimum wages, overtime pay, and deductions. It aims to protect workers from exploitation by ensuring timely and fair payment of wages.

1.4.4.4 The Punjab Maternity Benefit Ordinance, 1958

This ordinance protects the rights of female workers during pregnancy and childbirth. It provides for maternity leave, medical benefits, and protection against dismissal or discriminatory treatment.

1.4.4.5 The Provincial Employees' Social Security Ordinance, 1965

This ordinance provides social security benefits to insured employees, including old-age pensions, disability benefits, survivor benefits, and medical care. It aims to protect workers against economic hardship due to retirement, disability, or death.

1.4.4.6 The Punjab Industrial Relations Act 2010

This act regulates employment relationships, including hiring, firing, and working conditions. It provides a framework for resolving industrial disputes, prohibits unfair labor practices, and establishes procedures for collective bargaining and trade union registration.

1.4.4.7 The Punjab Restriction on Employment of Children Act 2016

This act prohibits the employment of children in hazardous occupations and regulates the employment of young workers. It aims to protect children from exploitation and ensure their education and well-being.

1.4.4.8 The Punjab Occupational Health and Safety Act 2019

This act ensures a safe and healthy work environment by regulating hazardous substances, providing for workers' training, and imposing penalties for non-compliance. It aims to prevent occupational injuries, diseases, and deaths.

1.4.4.9 The Punjab Minimum Wages Act 2019

This act establishes minimum wage rates for workers in various industries, aiming to protect workers from exploitation and ensure a fair standard of living.

1.5 LABOR MANAGEMENT PROCEDURES

1.5.1 Labor Procedures

These policies and procedures will be updated and modified, if necessary, after the allocation of the contracts of the different positions of the PMU. As specified in the national labor laws, the employment of project workers will be based on the principles of non-discrimination and equal opportunities. There will be no discrimination with respect to any aspects of the employment relationship, including recruitment, compensation, working conditions and terms of employment, access to training, promotion or termination of employment. The following measures will be followed by contractors and monitored by the PMU with support from Human Resource Department to ensure fair treatment of all employees:

- Recruitment procedures will be transparent, public, and non-discriminatory, and open with respect to ethnicity, religion, sexual orientation, disability or gender.
- Applications for employment will only be considered if submitted via the official application procedures established by the contractors.
- Clear job descriptions will be provided in advance of recruitment in the contract agreement with the workers/labor in their local languages and will explain the skills required for each post.
- All workers will have written contracts describing terms and conditions of work and will have the contents explained to them. Workers will sign the employment contract.
- Unskilled labor will be preferentially recruited from the surrounding communities, settlements and adjacent villages.
- Employees will be informed at least one month before their expected release date of the coming termination.
- The contracted workers will not be required to pay any hiring fees. If any hiring fees are to be incurred, these will be paid by the Employer.
- Depending on the origin of the employer and employee, employment terms and conditions will be communicated in two languages, in the national language and the language that is understandable to both parties.
- In addition to written documentation, an oral explanation of conditions and terms of employment will be provided to workers who may have difficulty understanding the documentation.
- It is noted that language-related problems are not expected, but if they are, interpretation will be provided for workers as necessary.
- All workers will be 18 years old or above for civil works. This will be a requirement in contracts with construction works contractors.

1.5.2 Occupational Health and Safety

PMU will have a designated Occupational and Community Health and Safety Specialist and an Environmental Representative for an agreed period. This specialist must have a minimum bachelor's degree in civil/environmental engineering/environmental sciences and certificate course in OHS (e.g., The National Examination Board in Occupational Safety and Health - NEBOSH) with a minimum of 5 years of experience as OHS professional in construction of infrastructure projects. Extensive knowledge of all OHS legislation, OHS guidelines and standards are required.

It is important that all staff must be given induction training so that they are aware of the hazards specific to the project and its activities. This is in addition to toolbox talks and other training needs identified during project implementation.

The PMU will ensure that all workers irrespective of any category should be provided with appropriate type of protective masks, helmet, overall and safety shoes, and safety goggles, protective clothing as well as other appropriate PPEs as per work job hazard analysis and method statements (such as working on live wires). The PMU and contractors must also ensure appropriate demarcation of workplace and notices for hazardous area where applicable; accident reporting, notification and investigation practices at each workplace required; safety sign and symbols displayed at workplace and ensure availability of first aid box; also identify and service agreement done with specialized hospitals for complicated accidental and health problems as well as specific details will be included in the emergency management plan.

1.5.2.1 Night Time shift

The work will commence on 24 hours basis. There will an eight hour night shift and female workers will not be allowed to work during these shifts. The contractor will assure a prior training of material handling and other work related activities and prepare standard operating procedures for the night shift. There will be bare minimum crew and activities like jack hammering, that produce vibrations and loud noise will be minimized during the night. The work area will be properly cordoned off, well lit and all the idle trenches or holes will be properly covered. It is recommended that a separate emergency response plan for night time incidents is prepared.

The Contractors will be required to prepare OHSMP in accordance with OHS standards mentioned in the bidding documents, OHS provisions of ESMP, compliance with local regulatory requirements, and AIIB EHS Guidelines. All OHSMPs shall have as a minimum requirement to include information and details on:

- Each person on the site who has a specific occupational safety and health responsibility in relation to the site and describes how those responsibilities are coordinated.
- Occupational health and safety induction training that will take place in respect to construction work on the site.
- Arrangements for managing occupational safety and health incidents on the site.
- Site safety rules and description of the arrangements for ensuring that all persons on or visiting the site are informed of the rules.
- Hazards to which a person at the construction site is likely to be exposed.
- Risk of injury or harm to a person resulting from those hazards.
- Means by which the risk may be reduced.
- Safe work method statements (if any) for the site.

1.5.3 Child Labor and Forced Labor

To prevent engagement of underage workers, the age employment scheme should be strictly observed by the hiring authority. Proper procedure in the screening, with age verification, shall be undertaken in the selection of direct workers to ensure that no child shall be employed in the implementation of the Project. Likewise, all contracts must have a provision as to the minimum age requirement and the hiring authority shall keep a labor registry of all hired workers.

1.5.4 Labor Influx/Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH)

All project workers will undergo relevant seminars and training to prevent risks of labor influx or SEA/SH issues. Project workers particularly those coming from other communities will be provided a lecture on the culture and history of the area to enable them to adapt to the community values and avoid any conflicts due to the dissimilarities of their cultural backgrounds.

The employment of project workers will be enforced by the contractor and based on the principle of equal opportunity and fair treatment, and there will be no discrimination with respect to any aspects of the employment relationship, such as recruitment and hiring, terms of employment (including wages and benefits), termination and access to training. The project shall comply with the national labor laws on gender equality in the workplace, which will include provision of maternity leave and nursing breaks and sufficient and suitable toilet and washing facilities, separate from men and women workers.

According to the Note on Good Practices to Combat SEA/SH in the Framework of Financing Investment Projects Involving major civil engineering works, all projects, whatever their risk level, should guarantee the minimum actions recommendations for addressing the risks of SEA/SH related issues. The initial SEA/SH mitigation measures have been developed and included in the ESMP during the design phase of the project activities in the target areas. These measures may need to be reviewed and revised by the contractor. Based on the SEA/SH risk assessment related to the planned activities of the project, these measures include the following:

- The workers camps will be constructed at two locations; (a) Disposal Station, (b) Pipe manufacturing factory. These sites will be fenced and will have minimum intrusion with the nearby community.
- Construction crew will avoid entering play grounds, community parks, graveyards etc..
- Communities will be informed and consulted before commencing works inside or near the communities.
- Strict code of conduct will be maintained by the construction crew. Local norms will be respected.
- Project staff will receive training on the prevention of SEA/SH.
- Provision related to SEA/SH will be incorporated in the bidding document,
- Workers will be required to sign Code of Conducts (CoC) prepared by the Contractors and reviewed and approved by PMU,

PMU will incorporate standardized environmental and social clauses including the requirement of SEA/SH mitigation measures and worker Code of Conduct in the tender documentation and contract documents, in order for potential bidders to be aware of environmental and social performance requirements that shall expected from them, are able to reflect that in their bids, and required to implement the clauses for the duration of the contract. PMU will enforce compliance by the contractors with these clauses. As a core contractual requirement, the contractor, sub-contractors and the third-party labor suppliers are required to ensure all

documentation related to environmental and social management, including the LMP, is available for inspection at any time by the PMU or its appointed representatives.

The contractual arrangements with each project worker must be clearly defined in accordance with national law. A full set of contractual requirements related to environmental and social risk and impact management will be provided in the ESIA/ESMP/Checklists. All environmental and social requirements will be included in the bidding documents and contracts in addition to any additional clauses, which are contained, in the Project environmental and social instruments.

Under no circumstances will PMU, Contractors, Primary suppliers or sub-contractors engage in forced labor nor child labor. Forced labor includes bonded labor (working against an impossible debt), excessive limitations of freedom of movement, excessive notice periods, retaining the worker's identity or other government-issued documents or personal belonging, imposition of recruitment or employment fees payable at the commencement of employment, loss or delay of wages that impede the workers' right to end employment within their legal rights, substantial or inappropriate fines, physical punishment, use of security or other personnel to force or extract work from project workers, or other restrictions that compel a project worker to work in a no voluntary basis.

1.5.5 Labor Disputes over Terms and Conditions

Fair, reasonable and lawful terms and conditions shall be applied in the contractual provisions of all project workers to prevent labor disputes. Moreover, there will be an efficient grievance redress mechanism to address any issues that may arise during existence of the contract. The guidelines provided later in the document shall be strictly observed to avoid disputes over terms and conditions of employment.

All the contractors who will be engaged for the project will be required to produce their grievance procedure as a requirement for tender, which at a minimum comply with these requirements. In addition, good international practice recommends that the procedures be transparent, is confidential, adheres to non-retribution practices and includes right to representation. After they are engaged, they will be required to produce proof that each worker has been inducted and signed that they have been inducted on the procedure.

1.5.6 Fatality and Serious Incidents

In the event of an occupational fatality or serious injury, the PMU shall report to the Bank as soon as becoming aware of such incidents, and not later than 48 hours, and inform the government authorities (where available) in accordance with national as well as Bank reporting requirements. Corrective actions shall be implemented in response to project-related incidents or accidents. The PMU or, where relevant the consultant, may conduct a root cause analysis for designing and implementing further corrective actions.

1.6 INSTITUTIONAL ARRANGEMENTS

1.6.1 Project Management Unit

LWASA has established a PMU for the project headed by a Project Director (PD) and consisted of professional staff supported by a team of consultants known as Project Management Consultants (PMC) to assist LWASA in the implementation of the Project, as well as in supervision and monitoring, including environment and social safeguards management.

PMU will incorporate environmental and social safeguards management requirements into the Contracts of PMC and EPC/DBL (Engineering, Procurement, and Construction/Design-Build)

Contractors at the appropriate stages of the Project implementation process. This will ensure that the Project is executed in compliance with the relevant environmental and social safeguards, in line with the Project's goals and objectives. PMU will ensure the implementation of this LMP. PMU will be responsible for carrying out the following tasks:

- The Overall responsibility for implementation of the Labor Management Plan.
- Oversee and supervise the environmental and social management of the project.
- Ensure that PMC deploys environmental and social staff for the implementation of LMP.
- Ensure through PMC that contractors prepare site-specific environmental and social management plans and implement them in true letter and spirit.
- Ensure through PMC that all HSE and Community Health and Safety measures outlined in the safeguard documents are implemented.
- Review and finalize periodical environmental and social safeguards monitoring reports received from PMC & contractor and submit them to AIIB.
- PMU will coordinate, update and seek necessary approvals regarding all necessary E&S activities from the Bank (AIIB) and local approving forums.
- Ensure that the contractor updates all environmental and social safeguards documents as per the detailed engineering design.
- PMU will also redress all the reported grievances through the proposed GRM Mechanism
- PMU to ensure that PMC and EPC contractor will perform their assigned roles and responsibilities as specified in their respective sections.

1.6.2 Project Management Consultant

As the PMC, the consultancy firm will be responsible for managing the entire process of procurement of the EPC/DBO contractor for LWASA (EA/Client/Employer). PMC will also be responsible for the effective supervision and assistance to PMU for project implementation, detail designing by EPC contractor, constructional works, environmental and social safeguards management. The detailed responsibilities of PMC will be same as explained in Institutional Setup for Implementation and Management of ESMP section of this ESIA report.

1.6.3 Contractor

The EPC/DBO Contractor will be responsible for carrying out the detailed engineering design of the project under the leadership of a full-time Team Leader/Resident Engineer. The Contractor will hire and engage social, gender, and environmental staff along with necessary support staff. The key tasks of the EPC/DBO contractors will include:

i. Review the existing ESIA, ESMP and LMP reports prepared during the preliminary design stage, and update them based on changes made in the detailed engineering design and site-specific requirement.
ii. Hire and deploy Environment and Social Expert, HSE Expert and Resettlement and Gender Expert. These experts will be responsible to implement all the actions proposed in environmental and social safeguard documents including ESMP, Resettlement Plan (RP), Livelihood Restoration Plan (LRP), Gender Action Plan (GAP), and Stakeholder Engagement Plan (SEP), as well as the GRM by all parties involved in the project after seeking due approvals from the PMU. They will conduct internal supervision and monitoring of these instruments throughout the project operations to ensure compliance and quality of services provided by the contractor. These specialists will prepare monthly and quarterly progress reports on the environment and safeguards, which will be submitted to the PMC for review and validation.
iii. The Environment and Social Experts of the contractor work in collaboration with the Environment and Social Specialists of the PMC throughout the project implementation in

environmental and social safeguards compliance. They will ensure that the contractor's activities are in line with the agreed-upon environmental and social management measures and that any grievances raised by aggrieved persons are addressed through the GRM in a timely and satisfactory manner.

iv. Develop site-specific Environment and Social Management and Monitoring Plans (ESMMP).

v. Disseminate Information (through Brochures or any other media/form) to APs and other stakeholders and implementing all these safeguards documents as disclosed by PMU/ AIIB.

vi. Prepare and implement addendums to the ESIA, RP, LRP, GAP and SEP, to mitigate unforeseen impacts, when required, based on changes in the project design during the execution stage.

vii. Prepare all requisite reports on environmental and social safeguards implementation and submit them to PMC.

EPC will also address the comments received from PMU/AIIB on E&S Documents

1.6.4 Asian Infrastructure Investment Bank (AIIB)

AIIB provides technical guidance to PMU/LWASA and the consultants; supervises the preparation, updating, and implementation of RP; reviews and approval of RP, internal and external monitoring reports, and corrective action plan if needed for any identified gaps and provides guidance and required remedial/corrective actions targeting full compliance of the project with safeguard requirements as per ESF.

1.6.5 Monitoring and Evaluation

The PMU will report on the status of implementation of the above policies and procedures on a quarterly basis. The PMU will closely monitor labor and occupational health and safety performance of the project and report to the AIIB on a quarterly basis.

PMU will monitor the performance of contractors in relation to contracted workers, focusing on compliance by contractors with their contractual agreements (obligations, representations, and warranties). This may include periodic audits, inspections, and/or spot checks of project locations or work sites and/or of labor management records and reports compiled by contractors.

Contractors' labor management records and reports may include: (a) a representative sample of employment contracts or arrangements between third parties and contracted workers; (b) records relating to grievances received and their resolution; (c) reports relating to safety inspections, including fatalities and incidents and implementation of corrective actions; (d) records relating to incidents of non-compliance with national law; and (e) records of training provided for contracted workers to explain labor and working conditions and OHS for the project.

1.6.6 Grievance Redress Mechanism

PMU and its contractors will establish a special purpose GRM (it should be separate GRM from overall GRM) for the project workers to address labor or workplace-related concerns consistent with the applicable national and provincial laws and AIIB guidelines. The workers' GRM will leverage existing procedures and systems and will be established in early stages of the project and will serve throughout the project implementation.

Typical workplace grievances include demand for employment opportunities; labor wage rates; delays of payment; disagreement over working conditions; and health and safety concerns in the work environment. A GRM structure will be established for project workers (direct workers and contracted/supply workers). Handling of grievances should be objective, prompt and responsive to the

needs and concerns of the aggrieved workers. The workers' GRM will also allow for anonymous complaints to be raised and addressed. Individuals who submit their complaints or grievances may request that their names be kept confidential, and this should be respected. Different types of workers (including all direct workers and contracted workers, and where relevant, their organizations) may approach the workers' GRM for the following key reasons, among many others:

- Demand for employment opportunities;
- Labor wages rates and delays in payment of wages;
- Disagreements over working conditions;
- (Gender Based Violence) GBV/SEA/SH in the workplace; and
- Health and safety concerns in work environment.

Information about the existence of the grievance mechanism will be readily available to all project workers (direct and contracted) through notice boards, the presence of "suggestion/complaint boxes", and all pertinent information, such as: the designated call centers, hotline numbers, email addresses, office work hours, comment/complaint forms, suggestion display boxes, stipulated timeframes to respond to grievances; info on a register to record and track the timely resolution of grievances; the responsible department to receive, record and track resolution of grievances, and other means as needed.

The complainant will be able to use mobile-phone based applications, and in-person centers/mechanism for complaint registration and resolution. The grievance will be addressed through each area of feedback value chain: (i) uptake, (ii) sort and process, (iii) acknowledge and follow up, (iv) verify, investigate and act, (v) monitor and evaluate, and (vi) provide feedback to the complainant to ensure effectiveness.

Grievance handling will be transparent and aggrieved workers will be informed within 10 days of their grievance application, either with a respective solution or with a request of extension; The aggrieved worker will have the option to refer to a grievance log with key information that will be established by the PMU and quarterly reported upon. If not satisfied with the outcome of the contractor level, the aggrieved party will be able to access Grievance Redress Committee (GRC), PMU level. The GRC will be responsible for the redress mechanism in the areas of labor, environmental and social aspects and project management. The mechanism for resolving workers' grievances will be described in the context of staff induction training, which will be given to all project workers. The mechanism will be based on the following principles:

- The process will be transparent and will allow workers to voice their concerns and file grievances. At the time of recruitment and prior to actual work engagement, these workers will be informed of the grievance mechanism and the measures to be put in place to protect them against any reprisal, discrimination or biased action on their grievances. Grievance mechanism shall be made easily accessible to all project workers.
- There will be no discrimination against those who express grievances, and all grievances will be treated confidentially.
- Anonymous complaints will be treated in the same way as other complaints, the origin of which is known.
- Management will deal with grievances seriously and take appropriate action in a timely manner and deadlines for responding to complaints;
- Information on the existence of the grievance mechanism will be readily available to all project workers (direct and contractual) through bulletin boards, suggestion and complaint boxes and other means as required.

- This mechanism for project workers will not prevent them from using the conciliation procedure provided for by the Labor Code. The E&S Specialists will monitor the recording and settlement of grievances by workers and report to the PMU in its monthly progress reports. The GRM focal point, the environment and social development specialists who will be responsible for the GRM of the project will follow the process.
- The GRM will have separate procedures specifically for the purpose of confidentially receiving grievances related to SEA/SH. All SEA/SH related complaints, with the survivor's consent, will be referenced to the project identified service provider who will further manage the case in a survivor-centric approach and will report back to the project GBV GRM once the case is solved. In addition, the
- ESIA/ESMP/Checklists will identify additional mitigation measures, including the contractors' ESMP or contractors specific LMP, where required. This will include engagement with communities on gender related risks, grievance and response measures available, as identified in the manual. All GBV/SEA related complaints will be reported to the Bank (AIIB) within 48 hours of receipt by the Contractor, the GRM or any related project entity.
- The PMU will, with support from consultants, identify institutions and services providers who are actively engaged in prevention of gender-based violence, sexual exploitation and workplace sexual harassment in order to establish a manual for referencing any potential survivors.
- PMU and the contractor are usually not equipped to handle complaints or provide relevant services to survivors, but will reference any person to relevant service providers, including health facilities, law enforcement agency's gender unit or others, as relevant using the information on available services.

1.6.7 Grievance Resolution Mechanism

All concerned responsible staff shall hold regular meetings with the project workers to discuss any work-related issues and concerns. Every grievance raised by a worker will be documented with the actions undertaken by the PMU and contractors to address such grievance. The aggrieved worker may raise any issue anonymously through a letter, which shall be submitted to his/her immediate supervisor's office. Any grievance which are left unattended by the contractor can be submitted by the worker to the PMU, in which case actions shall be taken to resolve the issue. Any labor dispute shall be first resolved through mediation, conciliation and arbitration, in order to provide an efficient procedure in the settlement of disputes and to promote autonomy and freedom of the parties to make their own arrangements to resolve their grievance.

PMU will ensure that the contractors are legitimate and reliable entities and that they have procedures established for management of labor in compliance with this LMP. Contracts with contractors will include a provision on the obligation to comply with current legislation on labor and protection at work. During selection of contractors, PMU can ask to be provided with an insight into additional documentation, including, without limitations, the following: Information in public records, for example, corporate registers and public documents relating to violations of applicable labor law, including reports from labor inspectorates and other enforcement bodies;

- Business licenses, registrations, permits, and approvals;
- Documents relating to a labor management system, including OHS issues, for example, labor management Plans;
- Identification of labor management, safety, and health personnel, their qualifications, and certifications;
- Workers' certifications/permits/training to perform required work;

- Records of safety and health violations, and responses;
- Incident, accident and fatality records and notifications to authorities;
- Records of legally required worker benefits and proof of workers' enrolment in the related programs;
- Worker payroll records, including hours worked and pay received; and
- Identification of occupational health and safety committee members and records of meetings.

ANNEXURE-XXV

PUBLIC CONSULTATION SURVEY INSTRUMENT

SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI IN LAHORE CITY (THROUGH TRENCHLESS TECHNOLOGY) FEASIBILITY STUDY FOR ALTERNATE OPTIONS

PUBLIC CONSULTATION SESSION

Questionnaire ID #	
Name of Facilitator(s)	
Date of Public Consultation Session	
Location (Name with GPS Coordinates)	

A. DETAIL OF SETTLEMENT/COMMERCIAL AREA

1.	Name of Settlement/Commercial Area	
2.	Name of Road	
3	Name of Union Council	
3.	Name of Town	
4.	Total Commercial Area in Length	
5.	Geographical Location of the Settlement/Commercial Area (Coordinates)	

B. ETHNIC AND DEMOGRAPHIC STRUCTURE

6. Which languages are spoken in the Settlement/Commercial Areas (write the name of the language)

a.		**b.**		**c.**	

7. Detail of Affected Commercial Entities

Sr. No	Types of Business	No. of Shops	Population	
			Male	Female

D. SOCIALAMENITIESS AVAILABLE TO THE SETTLEMENT/COMMERCIAL AREA

8. Detail of social amenities.

Sr. No.	11. Description	12. Nos.	13 Av. Distance from Settlement (KM)	14. Level of Satisfaction (Excellent=1) (Good=2) (Poor=3)
a.	Electricity			
b.	Water Supply with house connections			
c.	Water Filtration Plant			
d.	Primary School (Boys)			
e.	Primary School (Girls)			
f.	Secondary/Higher Secondary School (Boys)			
g.	Secondary/Higher Secondary School (Girls)			
h.	Dispensary/ Basic Health Unit			
i.	Hospital			
j.	Mosque			
k.	Market			
l.	Cemetery (Graveyard)			
m.	Telephone connections			
n.	Disposal of Solid Waste			
o.	Sewerage/ Disposal of Waste Water			
p.	Gas			
q.	Recreational Place			
r.	Irrigation scheme/ water channels			
t.	Access Road			

E: CULTURAL HERITAGE AND INDIGENOUS PEOPLE

9. Is there any Historic/Architectural land/site within the Settlement/ Village area:

YES NO

If yes: what is it? What is its importance? _____

10. Are there any Indigenous People living in the area or nearby locations? Yes/No

If yes provide details

F. SOCIO-CULTURAL ASPECTS

11.	State of social harmony and cohesion amongst various castes/groups	Strong	Normal		Weak
12.	Is there any conflict/ clash amongst the castes/groups?			Yes=1	No=0
13.	If yes, describe the nature of the conflicts				
14.	Who resolves these conflicts	Community	Religious Leaders	Judiciary	Other

G. WOMEN'S PARTICIPATION AND ROLE IN BUSINESS ACTIVITIES

15. Women's participation and decision-making in business

S. No.	Activities	Participation Extent (%)	Decision Making Extent (%)
a.	Sales		
b.	Stock		
c.	Farm/Crop activities		
d.	Labor work		
e.	Government employment		
f.	Private employment		
g.	Livestock rearing		
h.	Traditional work		
i.	Sale & Purchase of properties		
j.	Social obligations (marriage, birthday & other functions)		
k.	Local representation (councilor/political gathering)		

H. INFORMATION ABOUT NON-GOVERNMENT ORGANIZATIONS

16.	Is there any Non-Governmental Organization (NGO)/Community Based Organziation 9CBO) working in your village/area?	Yes	No	Do not Know
a.	If not, do you think there should be a Ngo/CBO in your village/area?	Yes	No	Do not Know
b.	If yes, please provide the following details of NGO/CBO			

S. No.	Name of NGO/CBO	Area of Interest	Status Local/National /International	Main Functions

I. INFORMATION ABOUT PROJECT

17.	Do you have any information that the construction of sewerage will take place on the road/settlement?	Yes	No	Do not Know
18.	If yes, from where do you learn about the project?	Government	Locally	Other Sources (Specify)
19.	What information has been provided to you for the project?			
20.	Can you describe what impact/benefits the project would bring to local areas?			
21.	Do you have any grievances related to the project?			
22.	Has to contact any government entity to register your grievance?			

J. PRESSING NEEDS / COMMUNITY PROBLEMS

23. What are the main problems your HH is facing? Give in order of importance

S.No.	Priority	Problems
a.	First	
b.	Second	
c.	Third	
d.	Fourth	
e.	Fifth	

K. PERCEPTION ON PROJECT

24. Perceptions of the Respondent on the Projects

Sr.no	Possible Impacts	Increase	Decrease	No Affect
a.	Employment Opportunities			
b.	Mobility (Access to Resources)			
c.	Income Generation Activities			
d.	Unemployment			
e.	Living Standard			
f.	Facilities/amenities			
j.	Forestation			
k.	Deforestation			
i.	Livelihood			
l.	Income			
m.	Other specify			

L. GENERAL OBSERVATIONS

25.	**Any comments you would like to make? (Not specifically related to a question).** ....

ATTENDANCE SHEET

Sr. No.	Name of the participant	Fathers' Name	Education / Profession	Contact # and CNIC #	Signature/ Thumbmark

Sr. No.	Name of the participant	Fathers' Name	Education / Profession	Contact # and CNIC #	Signature/ Thumbmark

ANNEXURE-XXVI
EXTENSION IN EPA NOC/APPROVAL

GOVERNMENT OF THE PUNJAB
ENVIROMENTAL PROTECTION AGENCY
National Hockey Stadium, Gate No. 10
Ferozpur Road, Lahore

No. DD(EIA)/EPA/F-95(EIA)/2016/207
Dated: 13 / 03 /2025

To

The Project Director (LWWMP),
WASA, LDA, Lahore,
Zahoor Elahi Road, Gulberg-II, Lahore.

Subject: **DECISION OF EPA, PUNJAB REGARDING PROJECT "LAYING OF SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE BY WASA"**

Refer to the request received in EPA Punjab regarding Extension in validity period of Environmental Approval for Constructional Phase issued to the subject project.

2. I am directed to intimate you that the Environmental Approval for Constructional Phase issued vide EPA Punjab letter vide No.DD(EIA)/EPA/F-95(EIA)/2016/60, dated 07-02-2022, is valid for another three (03) years from 07-02-2025 to 06-02-2028, under Regulation 16 (3) of IEE/EIA Regulation, 2022, read with Section 12 of PEPA, 1997(Amended-2012), with the same terms and conditions.

ASSISTANT DIRECTOR (EIA)
EPA, PUNJAB

C.C:

i. The Deputy Director (Environment), District Lahore, for information, please.
ii. PA to Director General, EPA, Lahore.
iii. One Window Cell, EPA, Punjab.

ANNEXURE-XXVII
PV SOLAR SYSTEM SPECIFICATIONS

Minimum Technical Specifications Requirement for Solar Panel and Allied Equipment

Note- The technical specifications of the solar panel & allied equipment must fulfill the standard requirements (PSSHIES) as per the import policy S.R.O 604(1)/2019, Dated 28Th May, 2019 verifiable test certifications for the required standard must be provided with the technical proposal. In case of discrepancy, the mentioned S.R.O shall prevail.

This document provides minimum technical requirement for solar panels and allied equipment. All products should be compliant to relevant IEC standard/specification; however, other international standard may be used where, IEC relevant standard is not available, as per project requirement.

I. Solar PV Panels

Sr. No	Parameters	Min, Specifications- Required
1	**Module Make**	Tier 1, Brand should be verifiable for the procurement year
2	**PV Module Capacity**	400 Watts or above (as per design)
3	**PV Module Type**	Poly- crystalline/Monocrystalline
4	**Cell Quality**	A Grade (verifiable)
5	**Module Efficiency**	18% or Higher
6	**Power Tolerance**	Must be 1-3% or more
7	**Operating Cell Temperature**	-40^0 C to 85^0 C
8	**Temperature Coefficient**	0.40% /^{0}C or Less
9	**Bypass Diode**	As per design
10	**Bus Bar**	4 or Higher
11	**Certification**	IEC 61215, IEC 61730, IEC61439, IEC60947-3 as amended to date. PID free
12	**Frame**	Must withstand 5400 PA impulse load
13	**Junction Box**	IP 67 or better
14	**Cable**	4 mm^2(IEC),1000mm or higher (as per design)
15	**Connectors**	MC4 or Comparable weatherproof
16	**Front Cover**	3.2mm thick prism type tempered glass or higher
17	**Product Warranty and Guarantee**	10 years' product replacement warranty. Power output within 10 years shall not fall below 90 % and power output within 25 years shall not fall below 80%
		10 years' full replacement of module, if the major components malfunctioning. PV module performance guarantee 25 years or more . Type of performance guarantee shall be linear after 1st year.

II. On-Grid Solar Smart Inverter

Sr. No	Parameters	Min, Specifications- Required
1	**Inverter Make**	1 GW or above deployment in last two years. Renowned and verifiable brand having successful performance history in similar climatic conditions.
2	**Inverter Type**	Grid Synchronized pure sine wave. Also able to synchronize with generators on site.
3	**Output Voltage Range**	230Vac/400 Vac +-5% for string/micro inverters. For central inverters selects as per design.
4	**IP Protection**	IP 65 or better (IEC60529)/outdoor use with natural heat sink.
5	**Stand by Power consumption**	Max3 Watt.
6	**EU/CEF efficiency Euro-eta**	≥95% or above
7	**Protections**	Short-circuiting Surge protection Pv reverse polarity protection Anti- islanding protection Leakage current protection High Insulation input Over voltage (pV) (if built-in) Harmonies filter as per IEC standards output Over voltage (AC)
8	**Operating temperature for Ambient**	-5C to 55^{o} C
9	**Communication**	With Remote Monitoring Features, Mobile App, Web server user interface, cloud connected Real time system Monitoring, Alerts, Faults and Warning data Display, System Statistics-System Parameters PV predicted Values, forecasted values, Load Data, Energy, etc. Data, Net metering Data Control
10	**Humidity**	10-90%R11
11	**THD**	≤3%, As per IEC 61000-3-2 (as amended to date)
12	**Guarantee**	5 years replacement guarantee
13	**Warranty**	10 year or above transferable warranty from the original inverter manufacturer shall be provided or as defined in the RFP.
14	**Input Voltage Range**	150-950 V or above (depending upon the selected design)
15	**Power Factor**	0.9 leading to 0.9 lagging (Grid Code Compliant)
16	**Minimum Applicable Standards and Compliances**	IEC62109-1, IEC: 62109-2, IEC61683, IEC62116, IEC61727, UL1741/1EEE:1547, 60068-2, (as amended to date).

III. Hybrid Solar Inverter

Sr. No	Parameters	Min. Specifications- required
1	**Inverter Make**	500MW or above deployment in last five years. Renowned and verifiable brand having successful performance history in similar climate conditions, Pure Hybrid Inverter
2	**Inverter Type**	Grid Synchronized Pure Sine Wave, Hybrid
3	**Phase**	3 Phase IN/3 Phase OUT. Also able to synchronize with generators on site.
	PV INPUT	
4	**Max DC input Voltage**	900 VDC
5	**Minimum MPPT Range**	250-850 VDC
6	**Reverse Polarity Protection**	Yes
7	**Photo Voltaic array isolation control**	Yes
8	**AC Grid Connection**	Three Phase
9	**Management**	Intelligent Energy Management System
	AC INPUT	
10	**Minimum AC Input Voltage Range**	180-260-VAC per Phase
	GRID OUTPUT	
11	**Nominal Output Voltage**	230 VAC (P-N)/400 VAC (P-P) +/-5%
12	**Output Voltage Range**	184-265 VAC per Phase
	ENVIRONMENTAL	
13	**Ambient Temperature Range**	-5^{o} C to +55^{o} C
14	**Relative Humidity**	4 to 100% condensing
15	**Acoustic Noise Emission level**	<50 dB@1n
16	**Safety and EMC Standard**	IEC/EN 62109, IEC/EN62109-2, IEC 62477-1, EN61000-6-3, EN61000-3-2, EN 61000-3-3, EN61000-3-11, EN61000-3-12(as amended to date)
17	**IP Protection**	IP 20 or better
18	**Frequency**	50Hz+/-3%
19	**Standby Power Consumption**	Max 3 watt
24	**Max.efficiecncy/Euro-eta**	95% or above.
25	**Protections**	Short-circuiting Surge protection PV reverse polarity protection Anti- islanding protection

		Leakage current protection High Insulation input Over voltage (PV) (if built-in) Harmonics filter as per IEC standards output Over voltage (AC)
26	**THD**	≤3%, As per IEC 61000-3-2 (as amended to date)
27	**Genset**	Compatible with auto start/stop features
28	**Communication**	With Remote Monitoring Features, Mobile App, web server user interface, cloud connected
29	**Guarantee**	3 years replacement guarantee
30	**Warranty**	5 year or above transferable warranty from the original inverter manufacturer shall be provided or as defined in the RFP.

IV. Charge Controller

1. IEC: 62509
2. Maximum Power point Tracking (MPPI) tracing efficiency >95%
3. External/Built-in Charge Controller with Hybrid Inverter
4. Minimum 2 Independent MPPTs.
5. Warrenty-5 Years Transferable from the original Manufacture.

V. Smart Energy Storage

Minimum Technical Specification of Energy Storage System.

1. 15 Years Life
2. Manufacturing date of batteries must not be more than 6 months old at the time of installation
3. High Energy, compact packs
4. Elegant, highly compact and energy dense.
5. Battery management unit (BMU), BMS (battery management system)
   Controls cell temperature, over charging, DOD voltage levels& cell charging Current.
6. Fast and efficient charging
7. Extended Cycle Life minimum 5000 cycles as 80% DoD.
8. Temperature control unit.
9. IEC 61427 Certified.
10. Warrenty-5 Years

The following technical data but not limited to these only shall be provided, wherever applicable for such as inverter, charger controller batteries;

Sr. No	**Characteristic**
1	Manufacture Name & Country of Manufacturing
2	Type/Model Number/Date of Manufacturing
3	Datasheet
4	Relevant International certifications

5	Warranties
6	Installations Guide
7	Operating Manual

VI. Solar PV Panel Mounting Structure

Sr. No	Parameters	Min, Specifications- Required
	Following are tentative outlines, actual design will be site dependent and may varies;	
1	**Roof Structure Material**	Hot Dip Galvanized (Min 90 Micron) or Aluminum frame, with more than 20 years of proven life.
2	**In Case of Pole Mounting**	The height of the pole shall not be less than (3) meters. Also be used for parking purpose, strong supporting structure, Made of Stainless steel or Hot dip Galvanized iron with minimum galvanization of 90 microns.
3	**Theft Protection**	The mounting Structure must come with an anti-theft protection to impede demounting of modules
4	**Material Gauge**	SWG14 or better /as per design, fasteners (Nut, Bolts, Clamps) must be of stainless-steel type.
5	**Material And Wind loading**	• Mounting structure to support the module must be made on durable material, resistant to sandstorms high wind speeds (up to 40 m/s) • Corrosion (passing the salt spray test IEC 61701 among other verification) and UV induced degradation • The material must be compatible with the module frame material so as to avoid any adverse electrolytic/galvanic effects.
6	**Civil Work**	• Structure should support the existing roof top/ground mounting. The design shall be able to with stand the maximum wind loading requirements of 40m/design shall be supported with proper calculations. • The stability of the supporting structure after installation shall be guaranteed by the bidder • To avoid the drilling in roofs, use appropriate arrangement to strengthen the structure without damaging the roofs • Point dead-loads on rooftop surface must be avoided • Additional beams can be casted to avoid drilling on roofs. • Existing Water drainage must not be considered; separate water channels must be maintained for water drainage • The supporting structure must be grounded for short circuit and lighting protection through independent earthing.

VII. Cabling, Combiner Boxes and Earthling

1. All exposed wiring (with possible expectation of the module interconnects) must be covered in conduits/duct. Wiring through roofs walls and other structures must be protected through the use of bushings Wiring through roofing must form a waterproof seal (applicable for wiring only)
2. For conduits and ducts, flexible PVC material with suitable size must be used so that 3/4 spaces in a conduit should be empty.
3. Field installed wiring must be joined using terminal and screw connectors. Soldering or crimping in the field must be avoided, if at all possible, wire nuts are not allowed. The current carrying capacity of the joint must not be less than circuit current rating. All Connections must be made in junction boxes. Fittings for lights switches and polarity sensitive socket outlets may be used as junction boxes where practical.
4. All wiring shall be color coded as per IEC standards and labelled at termination point.
5. No Conduit or fitting shall be attached directly to any other non-supportive surface.
6. Especially avoid installing the conductor direct over the roof, there must be a distance not less than 2 inches between the roof surface and the conduit.
7. Cables must be joined by the use of junction boxes, screw connectors and block connectors MC4 or equivalent connectors must be used for PV joints.
8. All wires must be terminated with proper end sleeves and wire thimbles with different colors for positive and negative polarity
9. Size, voltage grade and manufacturer name should be printed on every cable
10. Cable voltage drop specification are as follows and be verified through software simulations/calculations.
11. Earthling as per NEPRA net metering rules for all sites.

Sr. No	Parameters	Min, Specifications- Required
1	**Solar PV to Inverter**	Voltage drops less than 2% in Coated (standard and Flexible) 99.9% pure copper fire resistive insulation
2	**Grid/I,V Distribution Board to Inverter**	Voltage drops less than 2% 99.9% pure copper fire resistive insulation

Solar PV Combiner Box (Junction Box)

Sr. No	Parameters	Min, Specifications- Required
1	**Soar PV Input**	As per Design
2	**Solar PV Max Input Voltage**	1000VDC (IEC) or Higher
3	**Number of solar PV Array Inputs**	As per design
4	**Protections**	Lightening Protection DC over Voltage protection Short circuit protection Fuse/Breaker protection AC & DC disconnecting switch
5	**Protection Class**	IP66 or better
6	**Relatives Humidity**	10-90%

VIII. Enclosure Cabinet for Inverters and Batteries

1. The hybrid inverters, batteries, charge controller and any protection devices such as fuses and circuit breakers shall be mounted in an enclosure cabinet should be theft proof.
2. The enclosure cabinet along with the components shall be installed inside the building; The selection of the required space shall be made by the contractor, approved by the employer.
3. The cabinet shall have maximum three compartments.
4. Inverter and charge controller.
5. Protection devices, breakers /fuses, isolation switch.
6. Battery/ electricity storage system.
7. Adequate natural ventilation shall be present for efficient cooling and prevent excessive heat build –up, the compartment design shall ensure that each component will be operating within its operating temperature.
8. The enclosure shall be made of M.S sheet with 18 SWG or better, powder coated to matt finish.
9. The IP rating of the enclosure cabinet shall be IP 54 or Higher.

IX. Lightning/Air termination rod and surge protection devices;

Sr. No	Parameters	Min, Specifications- Required
1	**Air termination rod material**	99% pure copper
2	**Air termination rod Length**	As per design
3	**Earthling Pit**	Less than 2 ohm (NEC codes) 99% pure copper plate/rod size & weight of plate /rod varies from site to site.
4	**Air termination rod diameter**	As per design
5	**Air termination rod**	As per design
6	**Cable for structure**	2.5 mm^2 or higher ,99.99% pure (strip or single Conductor)
7	**Cable for Inter counting/Grounding metal structure**	6mm^2 or higher, 99.99% pure copper
8	**Insulated spacer**	As per design
9	**Cable Bracket**	As per design
10	**Stand – fan- Fix system**	As per design
11	**Recommended method for calculations**	Rolling sphere method

X. Surge Arresters (with or without Recorders)

Sr. No	Parameters	Min, Specifications- Required
1	**Applications**	With DC & AC sides
2	**Discharge Current (1 amp)**	With 200 A
3	**Impulse Current (1 amp)**	With 200 A
4	**Response Time**	5.5 m sec
5	**Leakage Current**	≤ 1mA
6	**Dielectric Strength**	2000V AC@1 minute
7	**Protection Class**	Class 2 (type 2 Minimum)
8	**Discharge Voltage**	600 V DC (line to earth or above)
9	**Ingress Protection**	Maximum IP20 (placed in IP66 Box along with other protection)
10	**Short Circuit with stand Capacity**	Min. 30 L A

Note: The External Surge Arresters /protection AC/DC may be added by the procuring department/agency, if required according to the specific size requirement.