Initial Environmental Examination Report

Project Number: 46526-007
Loan Number: 3562-PAK
Date: August 2020

Punjab Intermediate Cities Improvement Investment Project

IEE for Sialkot Water Wastewater Treatment Plant

Prepared by Project Management Unit of PICIIP, Government of Punjab, Pakistan

Punjab Intermediate Cities Improvement Investment Program (PICIIP)

Sialkot Component

TA 8683 (PAK)

Initial Environmental Examination

Part 2: Sialkot Wastewater Treatment Plant

August 2020

Prepared by PMU - PICIIP for the Asian Development Bank (ADB)

This Initial Environmental Examination Report is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature. Your attention is directed to the "terms of use" section of the ADB website.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgements as to the legal or other status of any territory or area

CURRENCY EQUIVALENTS

As of 3rd August 2020 Currency Unit – Pak Rupees (Pak Rs.)
Pak Rs 1.00 = $ 0.00595 US$1.00 = Pak Rs. 168

CONVERSIONS

1 meter = 3.28 feet

1 hectare = 2.47 acre

Acronyms

ADB	Asian Development Bank
CIU	City Implementation Unit
CDIA	Cities Development Initiative for Asia
PICIIP	Punjab Intermediate Cities Improvement Investment Program
PMU	Project Management Unit
SPS	Safeguard Policy Statement
EA	Executing Agency
EIA	Environment Impact Assessment
EPA	Environmental Protection Agency
ESCF	Environment Screening and Categorization Form
EMP	Environmental Management Plan
IA	Implementing Agency
GoP	Government of Pakistan
IEE	Initial Environmental Examination
LAA	Land Acquisition Act (of 1984)
LARP	Land Acquisition and Resettlement Plan
Leq	Equivalent sound pressure level
NEQS	National Environmental Quality Standards
O&M	Operation & Maintenance
PC	Public consultation
PEPA	Punjab Environmental Protection Agency
PEPAct	Pakistan Environment Protection Act 1997
RP	Resettlement Plan
REA	Rapid Environmental Assessment
WATSAN	Water supply and Sanitation
WWTP	Wastewater treatment plant

Table of Content

Annexures

Annexure A	**Photographs of public consultations**
Annexure B	**Environment Screening & Categorization Forms (ESCF)**
Annexure C	**Occupational Health and Safety Plan**
Annexure D	**Emergency Response Plan**
Annexure E	**Archaeological 'Chance Find' procedure**
Annexure F	**Dust Management Plan**
Annexure G	**Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor**
Annexure H	**Ambient Laboratory Monitoring**

List of Figures

List of Tables

EXECUTIVE SUMMARY

Project Overview

1. This is the Initial Environmental Examination report (IEE) for the Wastewater Treatment Plant (WWTP) to be developed in the North zone of Sialkot, Punjab province of Pakistan. A map of the project area is provided as **Figure ES-1**.

2. This document has been prepared as an update to the umbrella IEE assessment[1] prepared in July 2017, which covered all water supply and sanitation (WATSAN) works to be conducted in Sialkot city. This document focuses solely on the proposed scope of works to be conducted under 2 Lots for development of the WWTP and contains the EMP, which shall be implemented by the Contractor to mitigate any potential impacts and shall be used by the PMU and ADB for compliance monitoring.

Project Need

3. At present, Sialkot city is urgently in need of a WWTP as presently, no treatment plant is available for treatment of sewage in the project area of Sialkot City. The raw sewage is being directly disposed of into the canals, seepage drain and in agricultural fields in outskirts of the city. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;

   Furthermore, the disposal of untreated wastewater into water bodies/ agriculture fields is causing contamination of the water and food chain and several associated environmental and health issues;

Study Methodology

4. Primary and secondary data has been collected and used to assess the environmental impacts of the proposed WWTP development. Extensive due diligence visits were conducted to the project area for the proposed works from April'20 to June'20 to examine the project area and to assess the baseline in order to evaluate whether there are any key receptors that will need to be considered during the project works to prevent any long term and irreversible impacts.

5. Detailed baseline monitoring in the project area to assess potential impacts on air quality and noise levels has been conducted and presented in this study. This IEE report highlights all potential environmental impacts associated with the WWTP project and recommends mitigation measures. Any environmental impacts associated with the project need to be properly mitigated, through the existing institutional arrangements described in this report.

[1] https://www.adb.org/projects/documents/pak-46526-007-iee-2

6. The activities to be conducted under the two Lots in the North zone of Sialkot city were screened for potential impacts at the design/pre-construction, construction and operation phases of the WWTP. This 'activity wise' screening enabled to obtain a clear picture of the expected level of impacts resulting from the different activities and helped identify required mitigation measures to mitigate them to within acceptable limits as per local and international applicable regulations. A detailed environmental management and monitoring plan was developed to ensure compliance to the proposed measures during the project development.

7. The screening matrices for the key issues that have been identified during the different project development stages across the two Lots are provided in the **Tables ES-1** to **ES-3** below.

Public Consultation Process

8. Detailed and extensive consultations with different key stakeholders have been conducted to date, consisting of the local communities and local businesses located in the project area, different public sector line departments etc. and their comments/concerns/suggestions were obtained. The details of the persons consulted are provided as **Annexure A**.

9. The key comments and concerns raised as a result of the consultations are as follows:

- Public safety should be on top priority during construction.
- The traffic should be managed properly during the WWTP development.
- As the existing water and sanitation is not in a good condition, so this sub-project should be executed on urgent basis with due diligence.
- There should be awareness campaigns to guide public in a way that they may start discouraging the wastage of water and throwing the garbage in sewer lines.
- The Contractor should comply with the mitigation measures proposed in the Environmental and Management and Monitoring Plan (EMMP) and HSE compliance policy.
- Contractor's activities should be confined to minimize any inconvenience to the public.
- Dust produced due to construction activities may create different health problems, therefore water sprinkling should be carried out regularly to suppress the dust emissions;
- During construction, labour force movement should be controlled so that activities of the community are not disturbed;
- The participants/representatives also stressed the need for timely completion of the project.
- The movement of the heavy machinery should be controlled to avoid harm to other associated properties/structures;

- Grievance redressal mechanism (GRM) at the PMU level should be formalized to address any complaints from the stakeholders at site.
- Awareness campaigns by using Print, Electronic and Social media are highly required to create civic sense among masses.

Analysis of Alternatives

10. A number of different alternatives were also assessed as follows:

- **'No Project' Option:** It was concluded considering the urgent need for the development of a wastewater treatment plant for Sialkot city, the project must be developed and the 'No Project' option is not viable.
- **Selection of Wastewater Treatment Technology**
- **Site Selection Analysis**
- **Biogas Management Alternatives**
- **Options for Use of Sludge**
- **Options for Use of treated Effluent**

Land Acquisition & Resettlement

11. The proposed project site for the WWTP development is located on publicly owned land and thus no land acquisition and/or resettlement will be required.

Conclusion & Recommendations

12. The implementation of the existing EMP in its true letter and spirit shall ensure any potential impacts are managed and no long-term significant impacts take place during the construction works at the WWTP site.

13. During the operation phase of the WWTP, mostly positive impacts are expected in order to effectively manage and treat the wastewater being generated from Sialkot city while any potential impacts resulting from the operation of the WWTP will be managed by implementation of the proposed mitigation measures and conducting the required monitoring of the treated effluent quality being discharged into the Ravi Chenab as well as the ground water quality in the project area.

14. As a result of this IEE study, it has been determined that any adverse or harmful impacts shall be effectively mitigated through implementation of necessary measures

and through regular monitoring. The project falls under the Category 'B' of ADB's Guidelines and thus an IEE has been prepared for the proposed WWTP project.

Table ES-1: 'Activity Wise' Screening of possible Impacts during Design/Pre-Construction phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Lack of integration of IEE/EMP requirements into Construction bid documents	Likely	Moderate	Medium
2	Material Haul Routes	Likely	Moderate	Medium
3	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium
4	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

Table ES-2: Screening of Possible Impacts during Construction Phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Excavated Material (Earthworks) Disposal	Certain	Major	Significant
2	Degradation of air quality due to construction works	Certain	Major	Significant
3	Potential accidents and injuries to communities in project area during construction works	Likely	Major	Medium
4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Major	Medium
5	High noise levels from construction activities	Likely	Major	Medium
6	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium
7	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium
8	Soil Erosion and Sedimentation	Likely	Moderate	Medium
9	Soil Contamination	Likely	Moderate	Medium
10	Employment Conflicts	Likely	Moderate	Medium
11	Communicable diseases	Likely	Moderate	Medium
12	Vegetation and Wildlife	Unlikely	Moderate	Low

	Loss			
13	Historical/Archaeological Sites	Unlikely	Moderate	Low

Critical Risk Level

Significant Risk Level

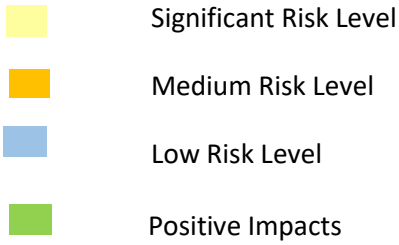
Medium Risk Level

Low Risk Level

Table ES-3: Screening of Possible Impacts during Operation Phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Possible Emergencies and Plant Failure	Unlikely	Major	Medium
2	Odor generation	Likely	Major	Medium
3	Improper Disposal of Sludge	Unlikely	Major	Medium
4	Disease Vector Generation & Transmission	Likely	Major	Medium
5	Improvements in Public Health	Positive impacts expected		
6	Lower Loads on Ecosystem	Positive impacts expected		
7	Generation and use of byproducts i.e. Sludge for agriculture	Positive impacts expected		

Critical Risk Level


Significant Risk Level
Medium Risk Level
Low Risk Level
Positive Impacts

1 Introduction

1.1 Overview

15. The Asian Development Bank (ADB) and the Cities Development Initiative for Asia (CDIA) are partnering with the Government of Punjab Province (GoPP), to undertake the Punjab Intermediate Cities Improvement Program (PICIIP).

16. The PICIIP aims to improve the quality of urban services available in selected cities in Punjab Province (city populations between 250,000 and 1,000,000). Urban infrastructure development is an important component of the PICIIP. The duration of the program will be six years. Funding will be accessed in phases. The PICIIP's overall budget is US$250 million, to be disbursed in phases.

17. The first phase will fund investments in the intermediate cities of Sahiwal and Sialkot. Major projects planned for Sialkot are water supply improvement; sewerage and drainage improvement, sewage treatment plant, green spaces development and transport routes improvement.

18. This IEE document focuses solely on the scope of works of the Construction of Wastewater Treatment Plant (WWTP) in North Zone, Sialkot and assesses any potentially significant impacts and proposes required mitigation measures, which shall be implemented by the Contractor and monitored by the PMU and ADB using the EMP.

19. This is the Part 2 i.e. WWTP development of the WATSAN landscape for Sialkot with Part 1 consisting of the proposed water and sewage piping networks and associated infrastructure already covered under a separate IEE study.

1.2 Purpose, Scope and Context of IEE Study

20. As per the master plan of the sewerage network of Sialkot city, the city is divided into three zones i.e. Zone 1,2 and 3. The proposed WWTP is to be constructed in Zone 3 of Sialkot city as shown in **Figure 1.2** below.

21. The proposed WWTP will be constructed in two stages, as follows:

    - Stage-1: for population up to Year 2029
    - Stage-2: for population from Year 2030 to 2044

22. A summary of WWTP components is provided as **Table 1.1** below.

Table 1.1: Key Components of proposed WWTP

S/No.	Components	Numbers
1	**Sewage Conveyance Work**	
a)	Collection Chamber	1
b)	Inlet Channel	1
2	**Sewage Treatment Works**	
a)	Anaerobic Ponds	12
b)	Facultative Ponds	12
c)	Maturation Ponds	12
3	**Treated Effluent Collection, Conveyance and Disposal Works**	
a)	Treated Effluent Channel	1
b)	Disposal/Bypass channel to dispose of wastewater/treated effluent into Palkhu Nullah as final disposal	
c)	Treated Effluent Pumping Station to transfer treated effluent in MR Link Canal for further use in irrigation network	
4	**Auxiliary Facilties**	
a)	Access/Internal Roads	1
b)	Substation Building	1
c)	Staff / Operator Quarter	1
d)	Laboratory and Administration Building	1
e)	Main Gate and Guard Room	1
f)	Buffer Zone (Thick Plantation) all around WWTP	1

23. The degree of treatment in the proposed WWTP would be such that the treated effluent can safely be discharged into inland waters i.e. MR Link Canal/Palkhu Nullah as per Punjab Environmental Quality Standards (PEQS), which would resolve the issue of ultimate disposal of wastewater of Sialkot city. In phase 1, the wastewater treatment upto secondary level is proposed to meet the PEQS limits to safely discharge the treated effluent to Palkhu Nullah, which ultimately joins the River Chenab.

24. According to ADB's Safeguard Policy Statement (SPS) 2009, a Rapid Environmental Assessment (REA) Checklist was prepared for the proposed WWTP works. The Pakistan Environmental Protection Agency's "Guidelines for the Preparation and Review of Environmental Reports (2000)" were also consulted. Based on the limited scope of the works, this sub-project has been classified as Category 'B'.

25. The conditions (as per ADB SPS 2009) provided in the table below MUST ALL BE fulfilled if the WATSAN works are to be considered an Associated Facility (AF) to the proposed WWTP. The assessment is provided in the **Table 1.2** below.

Table 1.2: Assessment to determine Associated Facility

	Condition	Comment
1	Separately financed by the borrower or third party?	No, it is also being financed by ADB along with the other WATSAN works.
2	Viability and existence of the AF depends exclusively on the WWTP sub-project?	Yes, as the WWTP will be handling and treating the sewerage from the infrastructure to be developed through the WATSAN works.
3	Goods and services of AF are essential to successful operation of the WWTP sub-project	Yes, since without the WWTP, the sewerage being input into the WATSAN infrastructure cannot be treated and disposed off in an environmentally sustainable manner in accordance with applicable national guidelines.

26. Since all three conditions above have NOT been satisfied, thus it is concluded that the WWTP is not an associated facility to the proposed WATSAN sub-projects.

Figure 1-1: Location of Sialkot City

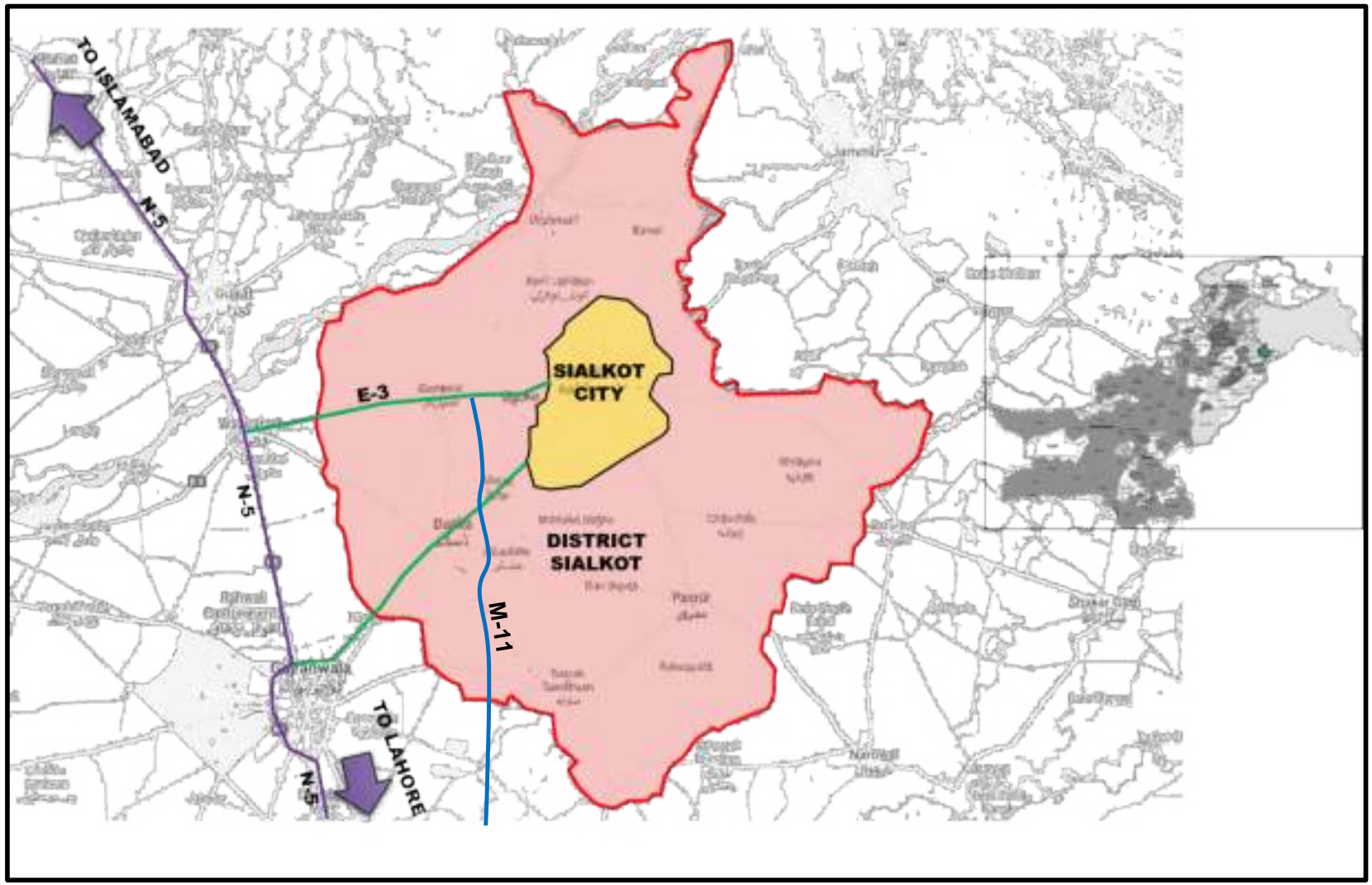
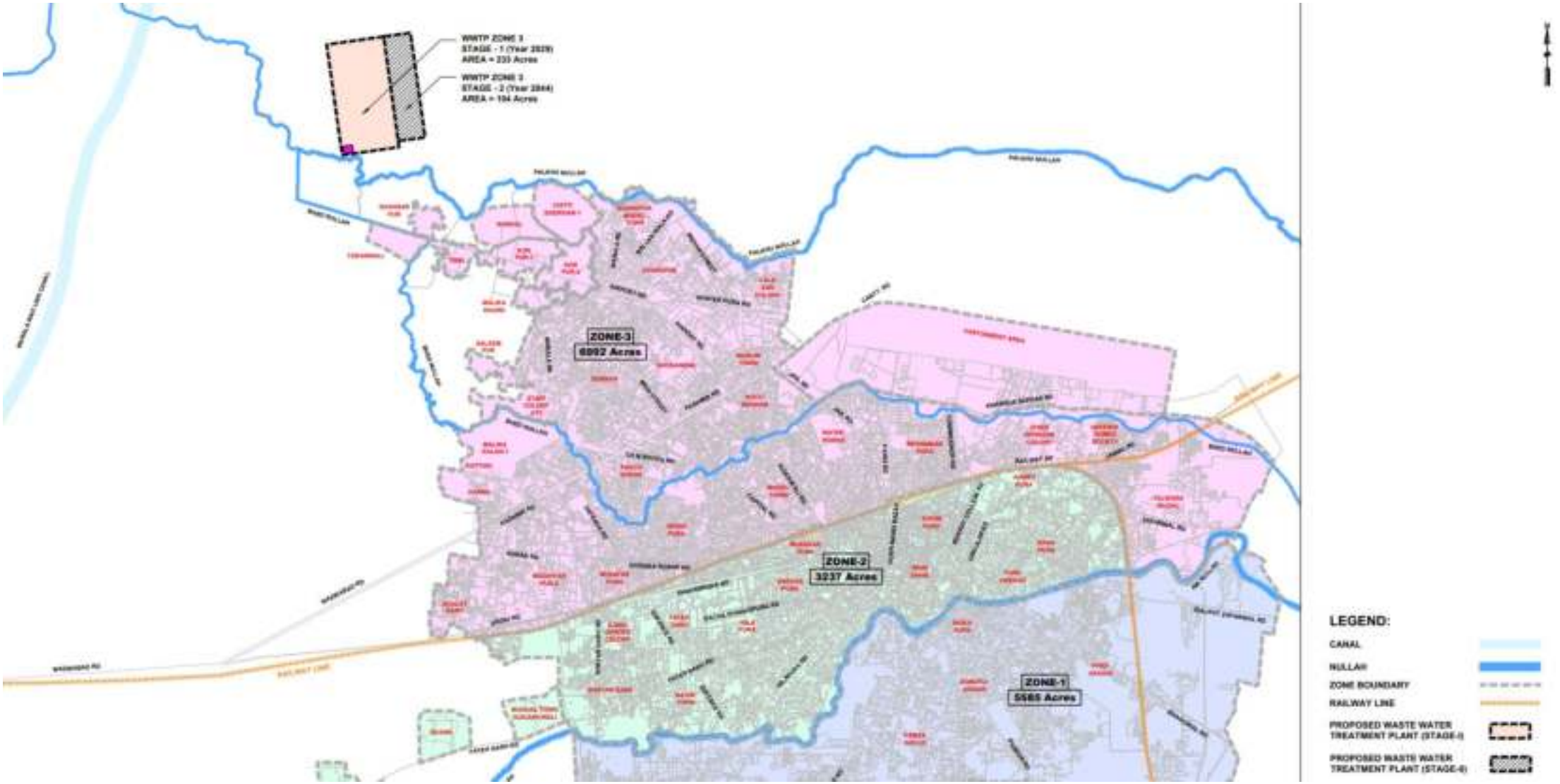


Figure 1-2: Proposed WWTP location in Sialkot Zone 3



2 Policy and Legal Framework

2.1 General

27. This section provides an overview of the policy framework and national legislation that applies to the proposed WWTP in Sialkot North zone. The project will comply with all national legislation relating to the environment in Pakistan and will obtain all the regulatory clearances required from the financing agency, ADB.

2.2 National Policy and Legal Framework

28. The Pakistan National Conservation Strategy (NCS) that was approved by the federal cabinet in March 1992 is the principal policy document on environmental issues in the country (EUAD/IUCN, 1992). The NCS outlines the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed WWTP development are pollution prevention and abatement and increasing energy efficiency while conserving biodiversity.

29. Prior to the adoption of the 18th Constitutional Amendment, the Pakistan Environmental Protection Act (PEPA) 1997 was the governing law for environmental conservation in the country. Under PEPA 1997, the Pakistan Environmental Protection Council (PEPC) and Pak EPA were primarily responsible for administering PEPA 1997. Post the adoption of the 18th Constitutional Amendment in 2011, the subject of environment was devolved, and the provinces have been empowered for environmental protection and conservation.

2.3 Regulations for Environmental Assessment, Pakistan EPA

30. Under Section 12 (and subsequent amendment) of the PEPA (1997), a project falling under any category specified in Schedule I of the IEE/EIA Regulations (SRO 339 (I0/2000), requires the proponent of the project to file an IEE with the concerned provincial EPA. Projects falling under any category specified in Schedule II require the proponent to file an EIA with the provincial agency, which is responsible for its review and accordance of approval or request any additional information deemed necessary.

2.4 Regulatory Clearances, Punjab EPA

31. In accordance with provincial regulatory requirements, an IEE/EIA satisfying the requirements of the Punjab Environmental Protection Act (2012) is to be submitted to Punjab environmental protection agency (PEPA) for review and approval, and subsequent issuance of NOC before the commencement of construction.

2.5 Guidelines for Environmental Assessment, Pakistan EPA

32. The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines that are relevant to the proposed sub-project are listed below:

- Guidelines for the Preparation and Review of Environmental Reports, Pakistan, EPA1997;
- Guidelines for Public Consultations; Pakistan EPA May 1997;

2.6 National Environmental Quality Standards (NEQS) 2000

33. The National Environmental Quality Standards (NEQS), 2000, specify the following standards:

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers);
- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources;
- Maximum allowable concentration of pollutants (two parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles;
- Maximum allowable noise levels from vehicles;

34. These standards apply to the gaseous emissions and liquid effluents discharged by construction machinery.

2.7 Other Environment Related Legislations

35. The national laws and regulations are provided in **Table 2.1** below.

Table 2.1: Environmental Guidelines and Regulations

Legislation/Guideline	Description
National Environmental Policy (2005) (NEP)	NEP is the primary policy of Government of Pakistan addressing environmental issues. The broad Goal of NEP is, “to protect, conserve and restore Pakistan’s environment in order to improve the quality of life of the citizens through sustainable development”. The

Legislation/Guideline	Description
	NEP identifies a set of sectoral and cross-sectoral guidelines to achieve its goal of sustainable development. It also suggests various policy instruments to overcome the environmental problems throughout the country.
The Forest Act (1927)	The Act empowers the provincial forest departments to declare any forest area as reserved or protected. It empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and topping of trees, branches in reserved and protected forests. No protected forest is situated in the project area for the WWTP works.
Punjab Wildlife Protection Ordinance, 1972	It empowers the government to declare certain areas reserved for the protection of wildlife and control activities within in these areas. It also provides protection to endangered species of wildlife. As no activities are planned in these areas, no provision of this law is applicable to the proposed WWTP works.
The Antiquities Act (1975)	It ensures the protection of Pakistan's cultural resources. The Act defines "antiquities" as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GOP to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the subproject proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, report to the Department of Archaeology, GOP, any archaeological discovery made during the course of the project.
Pakistan Penal Code (1860)	It authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.
NATIONAL ENVIRONMENTAL AND CONSERVATION STRATEGIES	
National Conservation Strategy	Before the approval of NEP, the National Conservation Strategy (NCS) was considered as the Government's primary policy document on national environmental issues. At the moment, this strategy just exists as a national conservation program. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas.
Biodiversity Action Plan	The plan recognizes IEE/EIA as an effective tool for identifying and assessing the effects of a proposed operation on biodiversity.
INTERNATIONAL CONVENTIONS	
The Convention on Conservation of Migratory Species of Wild Animals (1981.21)	The Convention requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties are also required to promote or cooperate with other countries in matters of research on migratory species. There are no endangered species of plant life or animal life in the vicinity of the proposed project areas for the WWTP works.
Convention on	The convention requires Pakistan to impose strict regulation (including penalization, confiscation of the specimen) regarding trade

Legislation/Guideline	Description
International Trade in Endangered Species of Wild Fauna and Flora (1973)	of all species threatened with extinction or that may become so, in order not to endanger their survival further.
International Union for Conservation of Nature and Natural Resources Red List (2000)	Lists wildlife species experiencing various levels of threats internationally. Some of the species indicated in the IUCN red list are also present in the wetlands of Pakistan.

2.8 ADB's Safeguard Policy Statement (SPS), 2009

36. The ADB's SPS 2009 requires that environmental considerations be incorporated into ADB funded projects to ensure that the project will have minimal environmental impacts and be environmentally sound. Occupational health & safety of the local population should also be addressed as well as the project workers as stated in SPS. A Grievance Redress Mechanism (GRM) to receive application and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance is also established.

37. All loans and investments are subject to categorization to determine environmental assessment requirements. Categorization is to be undertaken using Rapid Environmental Assessment (REA) checklists, consisting of questions relating to (i) the sensitivity and vulnerability of environmental resources in project area, and (ii) the potential for the project to cause significant adverse environmental impacts. Projects are classified into one of the following environmental categories:

38. **Category A**: A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

39. **Category B**: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.

40. **Category C**: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

41. **Category FI**: A proposed project is classified as category FI if it involves investment of ADB funds to or through a financial intermediary (FI).

2.9 ADB's Access to Information Policy (AIP) 2018

42. ADB's new Access to Information Policy (AIP), reflects the ADB's ongoing commitment to transparency, accountability, and participation by stakeholders. The policy contains principles and exceptions to information sharing with external stakeholders, led by a new overarching principle of "clear, timely, and appropriate disclosure."

2.10 ADB's Accountability Mechanism Policy 2012

43. The objectives of the Accountability Mechanism is providing an independent and effective forum for people adversely affected by ADB-assisted projects to voice their concerns and seek solutions to their problems, and to request compliance review of the alleged noncompliance by ADB with its operational policies and procedures that may have caused, or is likely to cause, them direct and material harm. The Accountability Mechanism is a "last resort" mechanism.

2.11 Implications of ADB's safeguard policies on proposed project

44. The objectives of ADB's safeguards are to:

- avoid adverse impacts of projects on the environment and affected people, where possible;
- minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- help borrowers/clients to strengthen their safeguard systems.

45. ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- environmental safeguards,
- involuntary resettlement safeguards, and
- Indigenous Peoples safeguards.

46. The objective of the environmental safeguards is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. ADB's policy principles are summarized in **Table 2.2** below.

Table 2.2: ADB Policy Principles

	Policy principle	Summary
1	Screening and categorization	Screening process initiated early to determine the appropriate extent and type of environmental assessment.
2	Environmental assessment	Conduct an environmental assessment to identify potential impacts and risks in the context of the project's area of influence.
3	Alternatives	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts, including no project alternative.
4	Impact mitigation	Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts. Prepare an environmental management plan (EMP).
5	Public consultations	Carry out meaningful consultation with affected people and facilitate their informed participation. Involve stakeholders early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation. Establish a grievance redress mechanism.
6	Disclosure of environmental assessment	Disclose a draft environmental assessment in a timely manner, in an accessible place and in a form and language(s) understandable to stakeholders. Disclose the final environmental assessment to stakeholders.
7	Environmental management plan	Implement the EMP and monitor its effectiveness. Document monitoring results and disclose monitoring reports.
8	Biodiversity	Do not implement project activities in areas of critical habitats.

9	Pollution prevention	Apply pollution prevention and control technologies and practices consistent with international good practices. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges. Avoid the use of hazardous materials subject to international bans or phaseouts.
10	Occupational health and safety Community safety.	Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities
11	Physical cultural resources	Conserve physical cultural resources and avoid destroying or damaging them. Provide for the use of "chance find" procedures.

2.12 IFC Sector Specific Guidelines on Water & Sanitation

47. The relevant clause applicable to discharge of treated wastewater from a centralized wastewater treatment facility is as follows:

48. ''Design, construct, operate, and maintain wastewater treatment facilities and achieve effluent water quality consistent with applicable national requirements or internationally accepted standards and consistent with effluent water quality goals, based on the assimilative capacity[2] and the most sensitive end use of the receiving water.[3]''

49. A comparison of the PEQS water quality discharge standards for inland waters with the FAO guidelines for threshold levels of trace elements in the wastewater being discharged for use in crop production is provided as **Table 2.6** below. It is important to mention here that based on an extensive literature review, it has been concluded that major international institutions such as the WHO/IFC, USEPA etc. do not have

[2] The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to, the total volume of water, flow rate, flushing rate of the water body and the loading of pollutants from other effluent sources in the area or region. A seasonally representative baseline assessment of ambient water quality may be required for use with established scientific methods and mathematical models to estimate potential impact to the receiving water from an effluent source.

[3] https://www.ifc.org/wps/wcm/connect/0d8cb86a-9120-4e37-98f7-cfb1a941f235/Final%2B-%2BWater%2Band%2BSanitation.pdf?MOD=AJPERES&CVID=jkD216C

any standard set of pre-defined wastewater quality standards in place. Only guidance notes are provided in order to support the process of determining the applicable wastewater quality discharge parameters based on the specific operational modalities of the WWTP.

50. In the case of the proposed WWTP, the selection of the PEQS national standards for treated wastewater discharge from the WWTP into the River Chenab is based on the following factors:

- In the case of national approval, the PEQS will always be applicable and will be used as the applicable standard for treated wastewater discharge from the WWTP. However, the ADB SPS requires the use of 'most stringent' standards/guidelines between the national and international standards, with the IFC general and sector specific guidelines considered globally acceptable. As mentioned in Para 48 above, the first part of the IFC relevant guideline requires the use of: '*…applicable national requirements* ***or*** *internationally accepted standards…*'. Since there are no specific wastewater discharge guidelines available from IFC that would be applicable to the proposed WWTP, thus there is no other option but to use the national, PEQS, treated wastewater discharge standards for inland waters.
- Furthermore, the second part of the IFC applicable guideline mentions the '…*assimilative capacity and the most sensitive end use of the receiving water*…', which in this will be the River Chenab. Based on the secondary data of water quality analysis of the River Chenab[4], it can be concluded that it is significantly polluted at present with a very high pollution load and key pollutant parameters considerably exceeding the applicable limits based on samples taken from the river water body at different locations. Thus, considering the present status of the assimilative capacity of the receiving water body in this case i.e. River Chenab, once the WWTP operation commences, the use of the national treated wastewater discharge standards i.e. PEQS is not expected to result in any adverse impact on the water quality and ecology of the River Chenab.

2.13 Comparison of International and Local Environmental Legislations

51. The ADB SPS requires application of pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards. The SPS states that when host country

[4] https://pdfs.semanticscholar.org/5886/37c659b445d6cdc46d30271dc5d27697ad27.pdf

regulations differ from these standards, the EA will achieve whichever is more stringent.

52. In order to select the most stringent standards applicable, a mix of local (NEQS) and international (IFC) regulations have been selected. The IFC Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental, Noise Management has noise level guidelines for daytime and nighttime, which are applicable. It shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the project area.

53. The **Table 2.3** presents IFC workplace noise standards that are applicable to the construction workers. It should also be noted that IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the project should not result in an increase of more than 3 dB over existing ambient noise at the nearest receptor location off-site.

54. A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 2.4** below. In the case of most pollutants, the NEQS standards for ambient air quality are more stringent in comparison to USEPA and WHO/IFC standards. The applicable and most stringent parameters for each respective pollutant are highlighted in green.

55. Similar to the standards for air quality, the comparison of noise standards provided in **Table 2.5** clearly shows that NEQS standards for noise are more stringent in comparison to the IFC standards. The only exception is the daytime noise level standard for Industrial areas where the IFC standard is more stringent (70 dB(A)) in comparison to NEQS (75 dB(A)) and so for this particular parameter, the IFC standard will be used. Apart from this one exception, the NEQS standards have been used for the proposed WWTP development project.

56. As far as regulations regarding other environmental parameters are concerned such as acceptable effluent disposal parameters, the local regulations i.e. NEQS take precedence over any other international regulations such as IFC.

Table 2.3: IFC Work Environment Noise limits

Type of Work, workplace	IFC General EHS Guidelines
Heavy Industry (no demand for oral communication)	85 Equivalent level L_{eq},8h
Light industry (decreasing demand for oral communication)	50-65 Equivalent level L_{eq},8h

Table 2.4: Comparison of International and local Air Quality Standards*

Pollutants	USEPA		WHO/IFC		Pak. NEQS	
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard
SO_2	3 hrs 1 hr	0.5 ppm 75 ppb	24 hr 10 min	20 ug/m^3 500 ug/m^3	Annual Mean 24 hrs	80 ug/m^3 120 ug/m^3
CO	8 hrs 1 hr	9 ppm (11 mg/m^3) 35 ppm (43 mg/m^3)	-	-	8 hrs 1 hr	5 mg/m^3 10 mg/m^3
NO_2	Annual Mean 1 hr	100 ug/m^3 (53 ppb) 100 ppb	1 yr 1 hr	40 ug/m^3 200 ug/m^3	Annual Mean 24 hrs	40 ug/m^3 80 ug/m^3
O_3	8 hrs	0.07ppm (148 ug/m^3)	8 hrs	100 ug/m^3	1 hr	130 ug/m^3
TSP	-	-	-	-	Annual Mean 24 hrs	360 ug/m^3 500 ug/m^3
PM_{10}	24 hrs	150 ug/m^3	1 yr	20 ug/m^3	Annual Mean	120 ug/m^3

			24 hr	50 ug/m^3	24 hrs	150 ug/m^3
$PM_{2.5}$	Annual Mean 24 hrs	15 ug/m^3 35 ug/m^3	1 yr 24 hr	10 ug/m^3 25 ug/m^3	Annual Average 24 hrs 1 hr	15 ug/m^3 35 ug/m^3 15 ug/m^3

*: The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.

* In instances where the airshed is significantly degraded and the pollutant levels are already exceeding the ambient pollutant concentrations provided in the table above, it shall be ensured that the project activities cause as small an increase in pollution levels as feasible, and amounts to a fraction of the applicable short term and annual average air quality guidelines or standards as established in the project specific environmental assessment.

Table 2.5: Comparison of International and Local Noise Standards

Category of Area/Zone	Limit in dB(A) Leq			
	NEQS		WHO/IFC	
	Day Time 06:00 – 22:00	Night Time 22:00-06:00	Day Time 07:00 – 22:00	Night Time 22:00-07:00
Residential area (A)	55	45	55	45
Commercial area (B)	65	55	70	70
Industrial area (C)	75	65	70	70
Silence zone (D)	50	45	55	45

*: The standards highlighted in green for each respective Area/Zone are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.

* In instances where baseline noise levels are already exceeding the standards above, it will need to be ensured that the project activities do not cause an increment of more than 3 dB(A) from the baseline noise levels.

Table 2.6: Environmental Quality Standards for Municipal & Liquid Industrial Effluents (mg/l - unless otherwise specified)[5]

S/No.	Parameter	PEQS Standards (Wastewater discharge Into Inland Waters)	FAO Guidelines for Threshold Levels of Trace Elements for Agriculture Use[6]	EU Council Directive, 91/271/EEC, Urban Wastewater Discharge directive[7]
1	Temperature or Temperature Increase	≤3°C	-	-
2	pH Value	6-9	-	-
3	BOD at 20°C	80	-	25
4	COD	150	-	125
5	TSS	200	-	35
6	TDS	3500	-	-
7	Grease and Oil	10	-	-
8	Phenolic compounds (as phenol)	0.1	-	-
9	Chloride	1000	-	-
10	Fluoride	10	1.0	-
11	Cyanide	1.0	-	-

[5] https://epd.punjab.gov.pk/system/files/Punjab%20Environmental%20Quality%20Standards%20for%20Muncipal%20And%20Liquid%20Industrial%20Effluents%20final_0.pdf

[6] http://www.fao.org/3/T0551E/t0551e04.htm

[7] https://www.adb.org/sites/default/files/project-document/60815/42408-033-aze-iee-05.pdf

12	An-ionic detergents	20	-	-
13	Sulfate	600	-	-
14	Sulfide	1.0	-	-
15	Ammonia	40	-	-
16	Pesticides	0.15	-	-
17	Cadmium	0.1	0.01	-
18	Chromium (trivalent and hexavalent)	1.0	0.1	-
19	Copper	1.0	0.2	-
20	Lead	0.5	5.0	-
21	Mercury	0.01	-	-
22	Selenium	0.5	0.02	-
23	Nickel	1.0	0.2	-
24	Silver	1.0	-	-
25	Total Toxic Metals	2.0	-	-
26	Zinc	5.0	2.0	-
27	Arsenic	1.0	0.1	-
28	Barium	1.5	-	-
29	Iron	8.0	5.0	-

30	Manganese	1.5	0.2	-
31	Boron	6.0	-	-
32	Chlorine	1.0	-	-

3 Project Description

3.1 Project Description

57. The specific information on the proposed construction of WWTP in Sialkot North zone (Stage-1) are provided below.

58. The layouts and schematics of the different project components are provided as **Figures 3.2** to **3.12** below.

3.2 Scope of WWTP Works

59. The general step wise sequence of activities to be conducted under each of the two Lots are described below. It shall be ensured that staging of activities takes place to manage any potential impacts, including traffic management issues.

- **Site Preparation Works**[8]

60. In this step, the site is made level through earth works and filling, to ensure that a stable levelled surface is available for conducting the next steps of the construction activity.

- **Access to Site through temporary road works**

61. If no suitable access roads are available to reach the proposed site, it shall be ensured that required access is created through necessary clearing and earth works, as necessary, to ensure that a clear access way to the site is available.

- **Piling Work**

62. Pilling work for all structures will be carried out at ground elevation of EL ±0.00 m. Concrete pile of 400 mm × 400 mm (n = 6150), and 300 mm × 300 mm (n = 10) are proposed for foundation of each facilities. Concrete pile shall be driven by diesel hammer.

- **Excavation Work**

63. Excavation work shall be conducted mainly by backhoe. Clamshell shall be applied for excavation depth is more than GL - 5.00m. Excavated soil is transported by dump truck and kept in the treatment site. Excavated soil is also used for backfilling material.

- **Civil Works**

[8] https://openjicareport.jica.go.jp/pdf/11650314_05.PDF

64. The civil works cover the substructure design and the architectural works cover the superstructure design. All structures are designed by reinforced concrete except the effluent pipe, which will be constructed by pre-cast concrete.

65. Structure work of the wastewater treatment plant is to construct reinforced concrete structures of treatment facilities.

66. Main facilities to be constructed are as follows:

- Lift Pumping Station
- Wastewater Treatment Plant
- Disinfection Tank
- Water Supply Facility
- Effluent Pipe
- Pipe Gallery
- Substructure of Main Building
- Substructure of Blower Building
- Substructure of Dewatering Building
- Gravity Thickener
- Compost Plant Facilities
- Connection Pipe
- Landscape Works
- Sanitary Sewer
- Conveyance Sewer
- Temporary Works

67. Concrete placing shall be conducted by concrete pump machine. Concrete structures shall be constructed in combination with mechanical and electrical equipment installation.

- Mechanical Works
- Electrical Installation
- Storm Water Drainage
- WWTP Landscaping

68. The cross-section drawings of the proposed WWTP is provided below as **Figures 3.3** to **3.5**.

69. Based on the geotechnical investigations conducted by the EPCM consultant, it has been recommended that composite liner shall be used for the construction of the WWTP to control leakage/migration of contaminants from the impoundment into underlying soil/groundwater. The components of the composite liner will be:

- Compacted soil liner
- Geo-membrane (HDPE)
- Protective soil cover

70. The guidelines recommend the use of HDPE liner / geomembrane along with clay liner to act as a barrier against mixing of polluted sewage water in available groundwater. The information regarding sub-surface ground conditions including type of soils and groundwater table (GWT) is already provided in the geotechnical investigations data. It is pertinent to mention that in modern/robust practice, flexible membrane liner (FML) are specified in addition to clay liners as a fool proof system against leaching of waste and mixing to groundwater.

71. **Compacted Soil Liner** shall be placed at the bottom and on side slopes of the ponds. The material suitable to be used for compacted soil liner shall meet the following specifications:

- Vertical in-situ hydraulic conductivity in compacted state ≤ 1 x 10-7 cm/sec
- Fines (particles passing 0.075 mm sieve) ≥ 30 %
- Plasticity index = 8 – 20 %
- Gravels (particles passing 75 mm sieve and retaining 4.75 mm sieve) ≤ 20 %
- Maximum particle size ≤ 10 mm

72. Soft soil/fill material, if encountered during construction of the WWTP, will be be excavated and removed completely. The exposed surface will be compacted to at least 90% of the maximum modified Proctor dry density at 2 to 3 % wet of optimum moisture content.

73. The compacted soil liner shall be placed at the bottom and on side slopes of the ponds and shall have a minimum thickness of 600 mm (24 inches) and shall meet the material specifications mentioned above. The soil liner shall be placed in layers with maximum compacted layer thickness of 150 mm and compacted to at least 90 percent of the maximum modified Proctor dry density at 2 to 3 % wet of optimum moisture content.

74. After the placement of each layer, it shall be inspected and tested to ascertain compliance with specifications, including dry density, moisture content, hydraulic conductivity, etc. by an independent laboratory and Engineer’s approval must be taken before laying the next layer.

75. **Geo-membrane (HDPE Liner):** High density polyethylene, HDPE Liner having minimum thickness of 60 mils (60/1000 inches) shall be placed over the compacted soil liner. HDPE liner must cover the entire area of earth material that would be in contact with the treated or stored effluent.

76. **Protective Soil Cover:** HDPE Liner is required to be covered immediately after placement. The HDPE Liner shall be covered by at least 300 mm thick cover of soil to prevent puncture by equipment and to protect it from degradation by ultraviolet light. The on-site / borrow area fine grained soils classified as Lean Clay as per unified soil classification system (USCS), free of any objectionable material, will be used in the construction of the protective soil cover.

77. The protective soil cover shall be placed in layers with maximum compacted layer thickness of 150 mm (6 inches) and compacted to at least 90 percent of the maximum modified Proctor dry density at 2-3% wet of optimum moisture content. The protective soil cover will be placed within 24 hours after placement of the HDPE Liner to minimize the potential for damage from various sources, including precipitation, wind, and ultraviolet light exposure. Also,

- Sides slope of pond embankments shall be constructed at 3H:1V slope for stability of sides.

- During field investigations, groundwater table (GWT) was found at a depth of 1.28 m to 1.80 m below NSL at Treatment Plant location. Groundwater may encounter during construction of treatment plant if depth of excavation is more than 1 m below NSL. Therefore, appropriate dewatering measures / arrangements would be required at construction stage to lower the groundwater to at least 0.5 m below final excavation base level.

3.3 Project Need

78. At present, Sialkot is urgently in need of a sewage treatment plant due to the following existing situation:

- Presently, no treatment plant is available for treatment of sewage in the project area of Sialkot.

- Raw sewage is being directly disposed of into the canals, seepage drain and in agricultural fields in outskirts of the city. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;

- Disposal of untreated wastewater into water bodies/ agriculture fields is causing contamination of the water and food chain and several associated environmental and health issues;

- Many areas have no final disposal points. The disposal problem becomes more severe when the farmers do not need raw sewage for their crops(s) during raining season and certain period(s) of year when water is not required for crops.
- Presently, no treatment plant is available for treatment of sewage in the project area of Sialkot City.
- Raw sewage is being directly disposed of into the Nullahs (Aik, Palkhu and Bhed) which are passing through the city. The main purpose of these nullahs were to take the storm water during monsoon season. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;
- Disposal of untreated wastewater into Nullahs is causing ground water contamination and several associated environmental and health issues.

79. Thus, the proposed scope of works needs to be implemented on an urgent basis with the population projections over different time periods provided in the **Table 3.1** below.

Table 3.1: North Zone Projected Population[9]

System	2019	2029	2035	2044
Population	434,916	612,078	685,323	902,851

80. As can be observed, the Stage 1 of the proposed WWTP, upto year 2029, will benefit upto 612,078 people in Sialkot city.

3.4 Project Design Parameters

81. The degree of treatment in proposed wastewater treatment plant would be such that the treated effluent can safely be discharged into inland waters i.e. MR Link canal/ Palkhu Nullah as per PEQS thus would resolve the issue of ultimate disposal of wastewater of Sialkot city. In phase 1, wastewater treatment upto secondary level is proposed to meet the PEQS limits to safely discharge treated effluent in to Palkhu Nullah which ultimately joins River Chenab. The expected projections of wastewater flows in year 2029 is provided as **Table 3.2** below.

Table 3.2: Projected Wastewater Flows (Year 2029)[10]

S/No.	Parameter	Value
i.	**Average Flow**	
a	MGD	36.76

[9] PC-1 for Sialkot WWTP
[10] PC-1 for Sialkot WWTP

b	Cusec	68.23
c	m^3/day	166,905
d	m^3/sec	1.93

82. Based on the comparison of the wastewater monitoring report of pollution parameters with previous data of similar projects and international literature, the design concentrations for WWTP are provided as **Table 3.3** below.

Table 3.3: Design Concentration for WWTP[11]

S/No.	Parameters	Unit	PEQS Value	Design Value
1	pH	-	6-9	7.0
2	Biological oxygen Demand (BOD_5)	mg/l	80	180
3	Total Suspended Solids (TSS)	mg/l	200	500

83. WWTPs are intended for the removal of common pollutant presents in the wastewater. The principal target pollutants shall be BOD, SS and fecal coliform. The objective of the treatment system shall be to bring the values of wastewater BOD, TSS and fecal coliform within the limits given in the PEQS for Municipal and Liquid Industrial Effluents, as promulgated under Punjab Environmental Protection Act and WHO Guidelines.

84. The **Table 3.4** below presents the design influent characteristics for BOD, SS and Coliform, applicable PEQS values, expected effluent concentrations and respective expected treatment efficiencies.

[11] PC-1 for Sialkot WWTP

Table 3.4: Design Influent Characteristics[12]

Parameter	PEQS Value	Design Concentrations		Treatment
		Influent	Effluent	Efficiency (%)
BOD (mg/l)	80	180	≤80 (filtered)	56
TSS (mg/l)	200	500	≤150	70

85. The design effluent concentrations for BOD and SS are in fact kept equal to those achievable, under normal operating conditions, in a typical well-designed aerobic treatment plant. These values are actually lower than the PEQS values. It is pertinent to mention that ideal operational conditions (i.e. growth of bacteria, algae, availability of nutrients and good process operation & control etc.) will be required to achieve the desired limits.

86. **Anaerobic ponds (APs)** have been designed on the basis of the volumetric loading rate. The design value of permissible volumetric BOD loadings and percentage BOD removal in the APs varies for different design temperatures as shown in **Table 3.5** below.

Table 3.5: Permissible Volumetric Loading Rates and & BOD Removal at Corresponding Temperatures[13]

Temperature (°C)	Volumetric Loading ($g/m^3.day$)	BOD Removal (%)	Adopted
<10	100	100	-
10-20	20T - 100	20T - 100	YES
20-25	10T + 100	10T + 100	-
>25	350	350	-

87. **Facultative ponds (FPs)** are designed for BOD removal on the basis of a relatively low surface loading (100 - 400 kg BOD/ha. d) to permit the development of a healthy algal population as the oxygen for BOD removal by the pond bacteria is mostly generated by algal photosynthesis. The design parameters along with the variation in

[12] PC-1 for Sialkot WWTP
[13] PC-1 for Sialkot WWTP

the hydraulic retention time due to the temperature change is provided in **Table 3.6** below.

Table 3.6: Design Parameters for Facultative Ponds[14]

Parameter	Unit	Range	Adopted
Water Depth	m	1-2	2.0
Free Board	m	0.5-1	0.5
Length to Width Ratio	-	>1.5	4.6
Hydraulic Retention Time	Day		
a)For Temp <20°C	Day	>5	6
b)For Temp>20°C	Day	>4	-
BOD Removal Efficiency (filtered)	%	70-90	79
Side Slope	m	2-3	3.0

88. A comparison of area requirement and treated effluent BOD (filtered & unfiltered) at coldest month temperature (12.6°C) and adopted temperature (20°C) is presented in the **Table 3.7** below. As proposed for the project, wastewater flow is divided in to 12 parallel trains/modules. Each module will consist of one Anaerobic Pond (AP), one Facultative Pond (FP) and one Maturation Pond (MP) in series.

Table 3.7: Area Requirement and Treated Effluent BOD

Description	Temperature		Area Reduction (%)
	12.6°C	20°C	
No. of Modules	12	12	-
Ponds Area (acre)			
Anaerobic	2.01	1.58	21
Facultative	30.476	11.03	64
Maturation	13.77	2.71	80

[14] PC-1 for Sialkot WWTP

Total Area (acre)	46.256	15.32	67
Effluent BOD – Unfiltered (mg/l)	50	25-72	-
Effluent BOD – Filtered (mg/l)	15	14.5	-

89. Adopted design temperature of 20°C shall result in significant reduction in area requirement (more than 50% less) as well as capital cost of proposed WWTP. At adopted design temperature of 20°C, treated effluent BOD (both filtered and unfiltered) will remain within PEQS limits throughout the year if WSP is properly operated and managed.

3.5 Project Components

90. The proposed WWTP will be designed and constructed in the northern part of Sialkot in the following two stages:
    - Stage-1: Design of WWTP up to year 2029 (covered in this IEE report)
    - Stage-2: Design of WWTP for year 2029 to 2044 (planned as a future investment, to be covered in a separate IEE report in the future)

91. Flow of WWTP shall be monitored during operation of Stage1 as it will be fruitful in estimating Stage-2 investment depending upon actual flows and future requirements.

92. Key treatment facilities of the proposed WWTP for planning horizon of 2029 shall consist of the following components.
    - 01 No. Collection Chamber (CC)
    - 01 No. Inlet Channel
    - 12 Nos Anaerobic Ponds (APs)
    - 12 Nos Facultative Ponds (FPs)
    - 12 No. Maturation Ponds (MPs)
    - 01 No. Outlet/Treated effluent Channel
    - 01 No. Disposal/Bypass Channel to dispose off wastewater/treated effluent into Palkhu Nullah as final disposal
    - Treated Effluent Pumping Station to transfer treated effluent in MR Link Canal for further use in irrigation network

93. The design Consultant conducted 24 hour equal volume composite wastewater sampling and testing of various pollution parameters, through an EPD Punjab approved laboratory of major disposal stations in the North Zone of Sialkot city. The

wastewater samples were collected from the Collecting Tank and pump discharge points. The test results of disposal stations falling in the North Zone are provided as **Table 3.8** below.

Table 3.8: Wastewater Test Results of Project Area[15]

Parameters	Analysis Method	Unit	LOR	RESULT				PEQS
				Dara Araiyan Wala	Model Town	Pakka Garha	Jail Road	
CHEMICAL ANALYSIS								
Temperature	-	°C	-	22.0	24.0	23.0	21.0	-
pH	APHA-4500H+ B	pH unit	0.01	7.31	7.65	7.44	7.78	6-9
Total Dissolved Solid	APHA-2540 C	mg/l	1.0	806.0	799.0	1301.0	829.0	3500
Oil and Grease	USEPA-1664	mg/l	0.1	3.8	1.8	7.0	4.2	10
BOD (Raw)	APHA, 5210	mg/l	1.0	171.0	139.0	69.0	82.0	80
BOD (Filtered)	APHA, 5210	mg/l	1.0	23.0	28.0	25.0	30.0	80
BOD (Settable)	APHA, 5210	mg/l	1.0	26.0	40.0	24.0	26.0	80
COD (Raw)	APHA-5220-D	mg/l	1.0	513.0	418.0	208.0	251.0	150
COD (Filtered)	APHA-5220-D	mg/l	1.0	71.0	82.0	76.0	86.0	150
COD (Settable)	APHA-5220-D	mg/l	1.0	87.0	139.0	73.0	83.0	150
TSS (Raw)	APHA-2540-D	mg/l	1.0	520.0	638.0	332.0	170.0	200
TSS (Settled Sample)	APHA-2540-D	mg/l	1.0	105.0	155.0	90.0	50.0	200
Settable Solids	APHA-2540 F	mg/l		415.0	483.0	242.0	120.0	-
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.24	79.40	143.92	258.07	144.14	1000
Cyanide (CN)	APHA-4500CN E	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	1.0
Anionic Detergents	APHA-5540 B	mg/l	-	1.2	0.8	1.8	1.5	20
Sulphate	APHA-4500-SO4C	mg/l	0.41	117.71	127.18	165.87	154.35	600
Sulphide	APHA-4500-S2-E	mg/l	0.2	28.8	46.4	17.6	20.8	1.0
Ammonia	APHA-4500-NH3-B	mg/l	0.002	1.8	1.7	2.0	2.1	40
Chromium	APHA-3500Cr B	mg/l	0.0054	0.49	0.43	0.48	0.51	1.0
Copper	APHA-3500Cu B	mg/l	0.0045	0.79	0.86	0.72	0.76	1.0
Lead	APHA-3500-Pb B	mg/l	0.013	0.11	0.08	0.08	0.09	0.5
Nitrite	APHA-4500NO2 B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	-
Nitrate	APHA-4500NO3 B	mg/l	0.1	2.4	2.0	1.3	3.2	-
Phosphate	APH4500-P C	mg/l	0.002	0.03	<0.02	0.46	<0.02	-
Arsenic	APHA-3500As B	mg/l	0.01	0.13	0.17	0.14	0.11	1.0
Sodium Absorption Ratio	-	-	-	22.92	38.94	49.08	28.17	-
MICROBIOLOGICAL ANALYSIS								
Total Coliforms	APHA-9222 B	CFU/100ml		$0.9x10^5$	$0.8x10^5$	$1.0x10^5$	$0.9x10^5$	-
Faecal Coliforms	APHA-9222 D	CFU/100ml		350	$1x10^3$	$2.8x10^3$	$2.4x10^3$	-

94. An overview of the WWTP components is provided in the **Table 3.9** below.

Table 3.9: Overview of WWTP Components

S/No.	Components	Numbers
1	**Sewage Conveyance Work**	
a	Collection Chamber	1
b	Inlet Channel	1

[15] PC-1 of Sialkot WWTP

2	**Sewage Treatment Works**	
a	Anaerobic Ponds	12
b	Facultative Ponds	12
c	Maturation Ponds	12
3	**Treated Effluent Collection and Conveyance Works**	
a	Treated Effluent Channel	1
b	Disposal/ Bypass channel to dispose of wastewater/treated effluent into Palkhu Nullah as final disposal	1
c	Treated Effluent Pumping Station to transfer treated effluent in MR Link Canal for further use in irrigation network	1
4	**Auxiliary Facilities**	
a	Access/Internal Roads	1
b	Substation Building	1
c	Staff/Operator Quarter	1
d	Laboratory and Admin Building	1
e	Main Gate and Guard Room	1
f	Buffer Zone (Thick Plantation) all around WWTP	1

Description of all components is given below.

- **Collection Chamber**

95. One (01) collection chamber (CC) will be provided to receive influent sewage/wastewater through six force mains (three force mains will be provided in Phase-1) from proposed influent pumping and convey it to inlet channel as per capacity. The design summary of the CC is provided below as **Table 3.10** below.

Table 3.10: Design Specifications of Collectlon Chamber

S/No.	Parameter	Unit	Value
1	**Flows**		
	Design Peak Flow (year 2044)	m^3/sec	201
		Cusec	5.70
2	**Collection Chamber (CC)**		
	Number	No.	1
	Length	ft	50.0
	Width	ft	30.0
	Total Depth of Chamber	ft	4.5
	Hydraulic Depth	ft	3.5

- **Inlet Channel**

96. One (01) inlet channel has been proposed which shall carry sewage/ wastewater from distribution chambers to series of anaerobic ponds. The inlet channel is designed as the water retaining/distribution structure on the basis of hydraulic retention time. The purpose of the inlet channel is to uniformly distribute influent wastewater into the WSP modules. A summary of the design specifications of the inlet channel is provided in **Table 3.11** below.

Table 3.11: Design Specifications of Inlet Chamber

S/No.	Parameter	Unit	Value
1	**Flows**		
	Design Peak Flow	**m^3/sec**	**201**
		Cusec	**5.70**
2	**Inlet Channel**		
	No. of Channel	No.	1
	Length of Channel	ft	3,971
	Width of Channel	ft	10
	Hydraulic Depth of Channel	ft	3.5

	Total Depth of Channel	ft	5

- **Anaerobic Ponds (APs)**

97. A total of twelve (12) APs shall be provided in parallel for primary treatment of sewage/wastewater. Each AP shall receive equal sewage flow of 3.06 MGD from the inlet channel. These ponds will receive wastewater and will reduce BOD of the sewage/wastewater through anaerobic processes. A summary of the design specifications of the APs is provided in **Table 3.12** below.

Table 3.12: Summary of Anaerobic Ponds (APs) of WWTP

S/No.	Parameter	Unit	Value
			AP-1
1	Total No. of Anaerobic Ponds	No.	12
2	Retention Time	Days	1.0
3	Volumetric Loading Rate	$g/m^3.d$	300
4	Design Temperature	°C	20
5	Influent BOD	mg/l	180
6	Effluent BOD	mg/l	72
7	BOD Removal Efficiency	%	60
8	Hydraulic depth of one pond	ft	16.5
9	Free Board	ft	1.5
10	Top length of one pond	ft	335
11	Top width of one pond	ft	205
12	Top area for one pond	Acres	1.58
13	Total area of ‘n’ No. of ponds	Acres	18.91

98. Desludging of APs is normally carried out after 2-3 years. Drying of sludge is proposed to be carried out inside AP on periodic basis separately for each terrain/module. During desludging period, flow to respective AP will be closed. It is recommended that desludging shall be carried out in summer season, when temperature would be more that 20°C so that remaining AP may take increased flow without compromising treatment efficiency.

99. At one time, one AP will be dewatered and settled sludge at bottom of pond, allowed to dry directly under sun shine. Once sludge drying process will be completed, dried sludge will be removed from the pond and transported to the proposed landfill site for disposal or may be used as manure depending on characteristics of sludge. The same process will be repeated for all APs, one by one. The proposed landfill is expected to be commissioned by 2024-25.

- **Facultative Ponds (FPs)**

100. For the secondary treatment, a total of twelve (12) FPs have been proposed in parallel. Each FP will receive a cumulative flow of 3.06 MGD wastewater flow from one (01) AP. A summary of the design specifications of the FPs is provided in **Table 3.13** below.

101. Removal rate of BOD in WSPs will depend upon ambient temperature. In summer months, removal rate will be higher due to increase in temperature, however, in winter months removal efficiency of pond will be less. As per estimation based on available empirical relationship, available in literature, unfiltered effluent BOD will remain in the range of 25 – 50 mg/l in summer months (March to November), provided that WSP will be properly operated and managed. However, in winter months, it may range from 62 – 72, very close to PEQS limits. However, it is estimated that filtered effluent BOD will remain in the range of 15 – 22 mg/l throughout the year.

Table 3.13: Summary of Facultative Ponds (FPs) of WWTP

S/No.	Parameter	Unit	Value
1	Total No. of Facultative Ponds	No.	12
2	Retention Time	Days	6
3	Surface Loading Rate	kg/ha.d	253
4	Design Temperature	°C	20
5	Effluent BOD@ 20°C (filtered)	mg/l	≤50
6	Hydraulic depth of	ft	6.5

	one pond		
7	Free Board	ft	1.5
8	Top length of one pond	ft	1435
9	Top width of one pond	ft	335
10	Top area for one pond	Acres	11.03
11	Total area of 'n' No. of ponds	Acres	132.36

- **Maturation Ponds (MPs)**

102. For tertiary treatment, total twelve (12) MPs have been proposed in parallel. Each MP will receive a cumulative flow of 3.06 MGD wastewater flow from one (01) FP. A summary of the design specifications of the MPs is provided in **Table 3.14** below.

103. The removal rate of coliform in MPs will depend upon the ambient temperature. In the summer months, removal rate will be higher due to an increase in temperature, however, in the winter months, the removal efficiency of the pond will be less and the removal efficiency may be reduced.

Table 3.14: Summary of Maturation Ponds (MPs) of WWTP

S/No.	Parameter	Unit	Value
1	Total No. of Maturation Ponds	No.	12
2	Retention Time	Days	1
3	Design Temperature	°C	20
4	Hydraulic depth of one pond	ft	5
5	Free Board	ft	1.5

6	Top length of one pond	ft	375
7	Top width of one pond	ft	315
8	Top area for one pond	Acres	2.72
9	Total area of 12 ponds	Acres	33.0

- **Treated Effluent Channel**

104. One (01) Treated Effluent Channel shall be provided which shall receive treated effluent from series of Maturation Ponds (MPs). From the channel, treated effluent will be carried to Disposal/Bypass Chanel for final disposal to Palkhu Nullah under gravity. As another option, the treated effluent channel will be carry the treated effluent to proposed treated effluent pumping station to transfer it to MR Link Canal through pumping. A summary of the design specifications of the Outlet channel is provided as **Table 3.15** below.

Table 3.15: Summary of Outlet Channel of WWTP

S/No.	Parameter	Unit	Value
1	**Flows**		
	Design Peak Flow (year 2044)	m^3/sec	5.70
		Cusec	201
2	**Collection Chamber (CC)**		
	Number	No.	1
	Length of Channel	ft	3,873
	Width of Channel	ft	10
	Hydraulic Depth of Channel	ft	3.0
	Total Depth of Channel	Ft	5.7

- **Treated Effluent Pumping Station**

105. One treated effluent pumping station shall be provided. The main function of treated effluent pumping station shall be to receive treated effluent from maturation ponds through treated effluent channel and transport it to irrigation network courses for irrigation of field crops. Proposed treated effluent pumping station is designed on

average daily flows of design year 2044. A summary of the technical specifications of the Treated Effluent Pumping Station is provided as **Table 3.16** below.

106. One screen chamber, two wet wells and two dry wells have been proposed with four pumps, non-clogging, horizontal, centrifugal type, in each dry well. All civil structures of the treated effluent pumping station have been designed on an average wastewater flow of 2.02 m^3/sec (71 cusec), estimated for year 2044. In the first stage, for design year 2029, pumping capacity of 60 cusecs will be provided with 33 percent standby pumping capacity. To cater treated effluent flow of year 2029, four pumps (3 operating, 1 standby) will be provided. Bypass engagement has also been proposed to direct disposal of treated effluent into Sukhrawa Seepage drain without introducing it to the pumping station.

Table 3.16: Summary of Treated Effluent Pumping Station of WWTP

S/No.	Parameter	Unit	Value
1	**Design Average Flow (Year 2044)**	m^3/sec	2.85
		Cusec	100.639
2	**Wet Well**		
	No. of Wet Well	No.	2
	Detention Time	min	2
	Working Depth	ft	6.5
	Length of Wet Well across Pumps Direction	ft	30
	Length of Wet Well along Pumps Direction	ft	32
3	**Dry Well**		
i	No. of Dry Wells	No.	2
ii	No. of Pumps in each Dry Well (03 Working, 01 Standby)	No.	4
iii	No. of Pumps in Dry Well	No.	8
iv	Center/Center Distance between Pumps	ft	6.0

v	Width of Dry Well	ft	30
vi	Length of Dry Well	ft	35
4	**Pumps (Design Year 2035)**		
i	Total No. of Pumps	No.	7
ii	Working Pumps	No.	5
	a) No. of 20 cusec pumps	No.	3
	b) No. of 10 cusec pumps	No.	2
iii	Standby Pumps	No.	2
	a) Number of 20 cusec pumps	No.	1
	b) Number of 10 cusec pumps	No.	1
4	**Pumps (Design Year 2044)**		
i	Total No. of Pumps	No.	8
ii	Working Pumps	No.	6
	c) No. of 20 cusec pumps	No.	4
	d) No. of 10 cusec pumps	No.	2
iii	Standby Pumps	No.	2
	c) Number of 20 cusec pumps	No.	1
	d) Number of 10 cusec pumps	No.	1
5	**Force Mains**		
i	No. of Force Mains	No.	2
ii	Diameter of Force Mains	mm	1200

- **Treated Effluent Conveyance System for Irrigation Purposes**

107. As per requirement of MC Sialkot, degree of treatment in proposed treatment plant would be such that the treated effluent can safely be reused in fields for agriculture purposes as per WHO and discharged into inland water i.e. Rivers as per PEQS. When water would not be required for agriculture use in case of rainy season or when water would not be needed by the crops, it can be safely discharged in to seepage drains available in the vicinity of WWTP site. These seepage drains are

ultimately linked to Ravi Chenab and thus would also resolve the issue of ultimate disposal of wastewater of Sialkot.

3.6 Project Construction Schedule

108. The project construction phase is expected to last for a total of 2 years with the activity expected to commence in the second quarter of 2020 and completed by mid of 2023.

3.7 Construction Camps and Work Force

109. The construction activity has to span over approximately twenty-four months. There shall be a number of contracts for a variety of works. The selected Contractor shall have the option to select suitable site(s) located near the project sites to establish his labor camps. If private land is selected, the contractor shall enter into contract with the private owner.

110. Essential for the work bases is easy approach, availability of a suitable place for temporary storage of material and availability of water for construction in the vicinity. Presence of shade from trees close to the work bases can add to the comfort of the labor while taking rest during the hot season.

111. The location of storage materials and camps will be critical. Since the project contractor(s) will be responsible for identifying the suitable locations for storage and labor camps from the private sector, thus there will need to be clear guidelines for this process, which will need to be closely monitored by the implementing agency. As far as possible, the project design team shall be assigned the task to identify the suitable location(s) for storage of materials since inappropriate storage of materials may result disruption of the traffic movement.

3.8 Machinery Requirement

112. For storing materials, stocking equipment and parking machinery and vehicles, the Contractor shall require open and accessible sites close to the labor camps. The Contractor, at his own expense, but keeping in view his contractual obligations to honor the applicable national and international guidelines regarding level of pollution, shall make the arrangements.

3.9 Sensitive Receptor Mapping

113. The map of the project location with the distance of the proposed WWTP boundaries from the nearest residential settlements, as the only sensitive receptors in the project

area, are provided in **Figure 3.1** below. As can be observed, the WWTP will be developed in a sparsely populated location with the nearest receptor located 530 meters away. Thus, no sensitive receptors are located in close proximity to the proposed WWTP site.

3.10 Climate Risks from Project

114. The biogas production in conventional APs is not collected and directly released into atmosphere due to the large pond area and this same practice has been adopted for the proposed WWTP project. In order to ensure collection and reuse of biogas, high rate anaerobic ponds are designed which have higher capital and operating expenses as compared to conventional APs. These systems are not considered for this proposed WWTP project.

115. It has been estimated that based on the WWTP's operational parameters, during the first stage, upto the Year 2029, approximately 15,800 tonnes/year CO_2e will be emitted from the WWTP plant operation as a result of the wastewater treatment processes.

Figure 3-1: Sensitive Receptor Map of WWTP

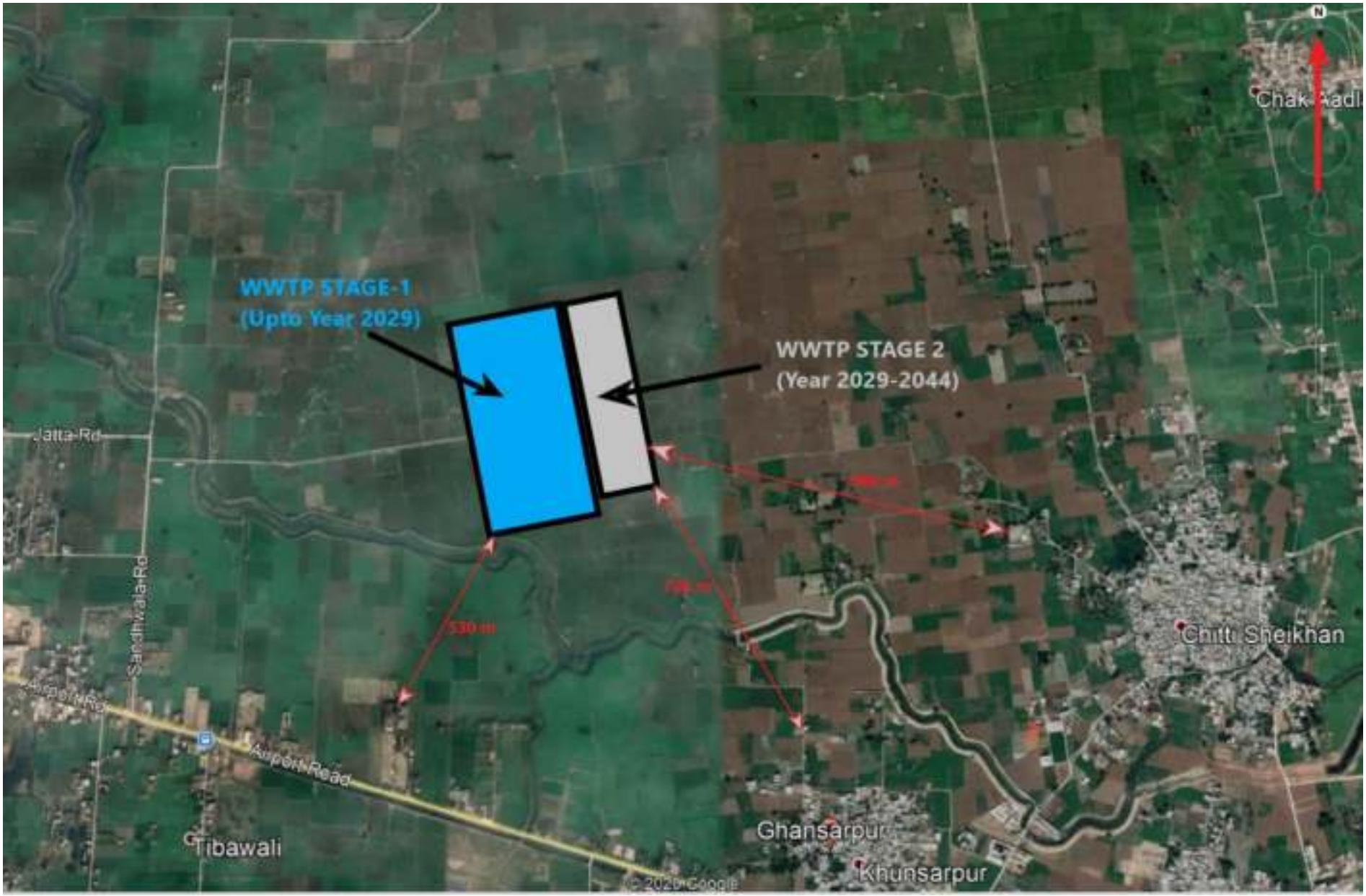


Figure 3-2: WWTP layout Plan

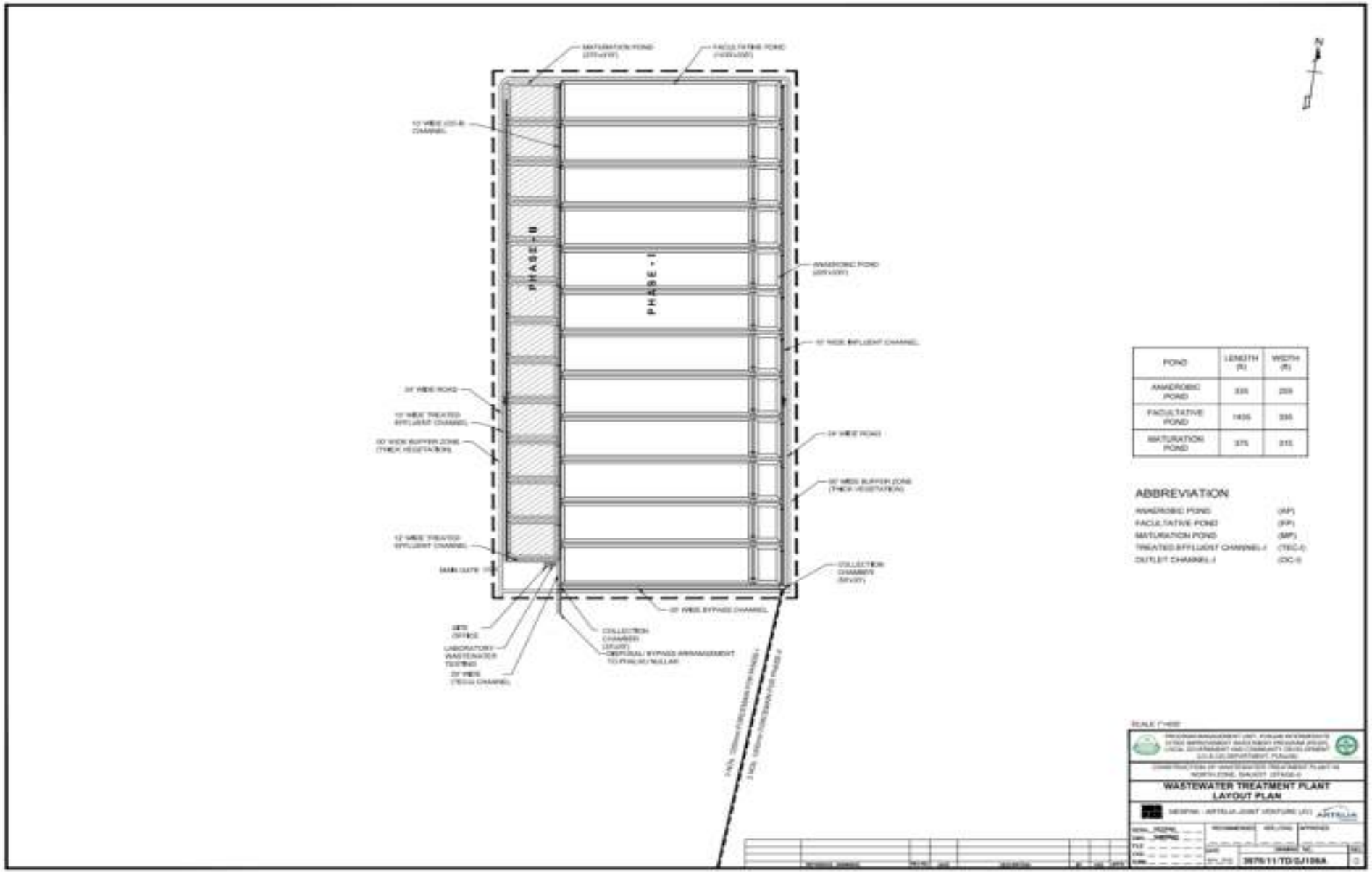


Figure 3-3: WWTP Process Flow Diagram

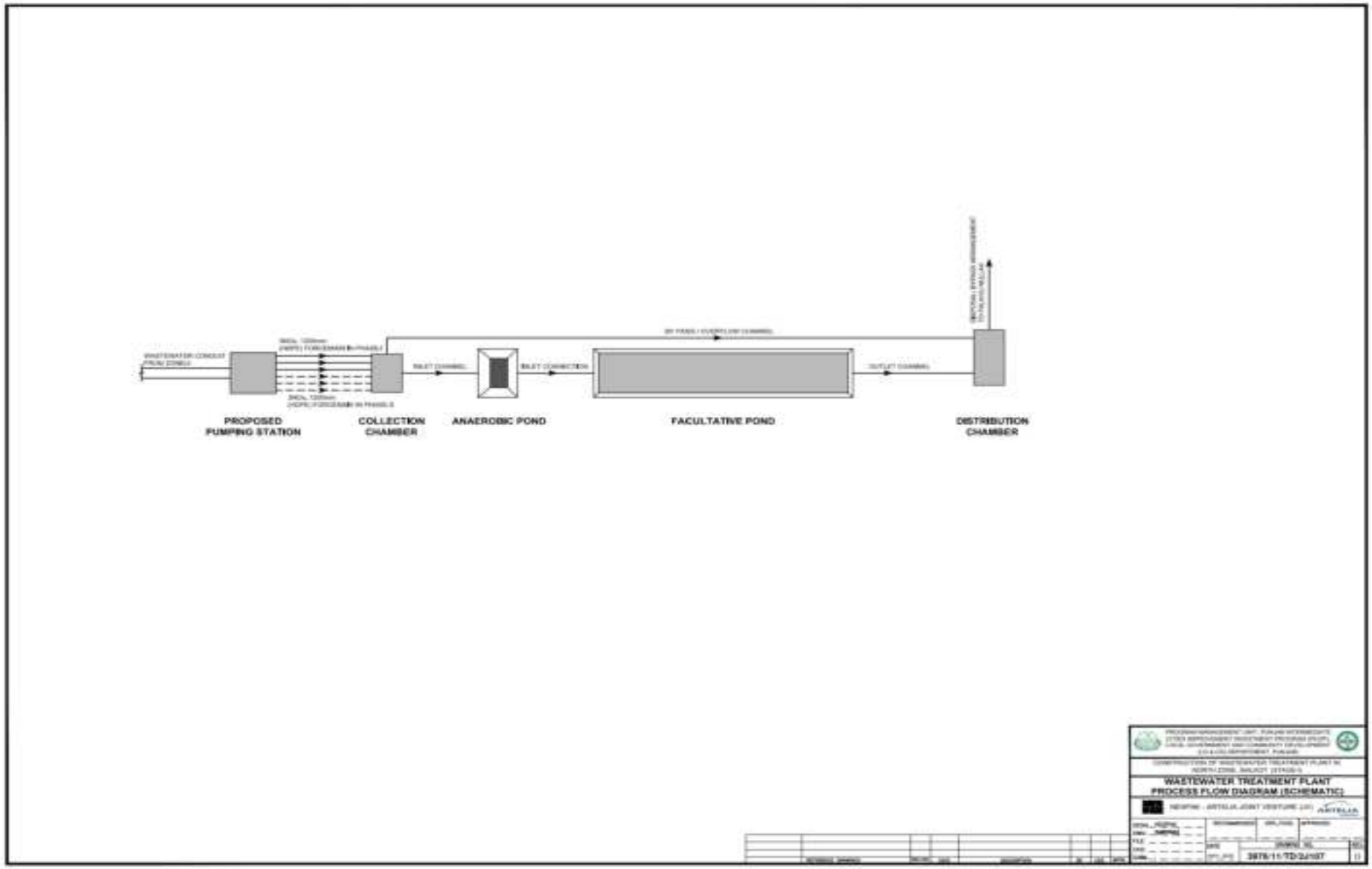


Figure 3-4: WWTP Hydraulic Profile

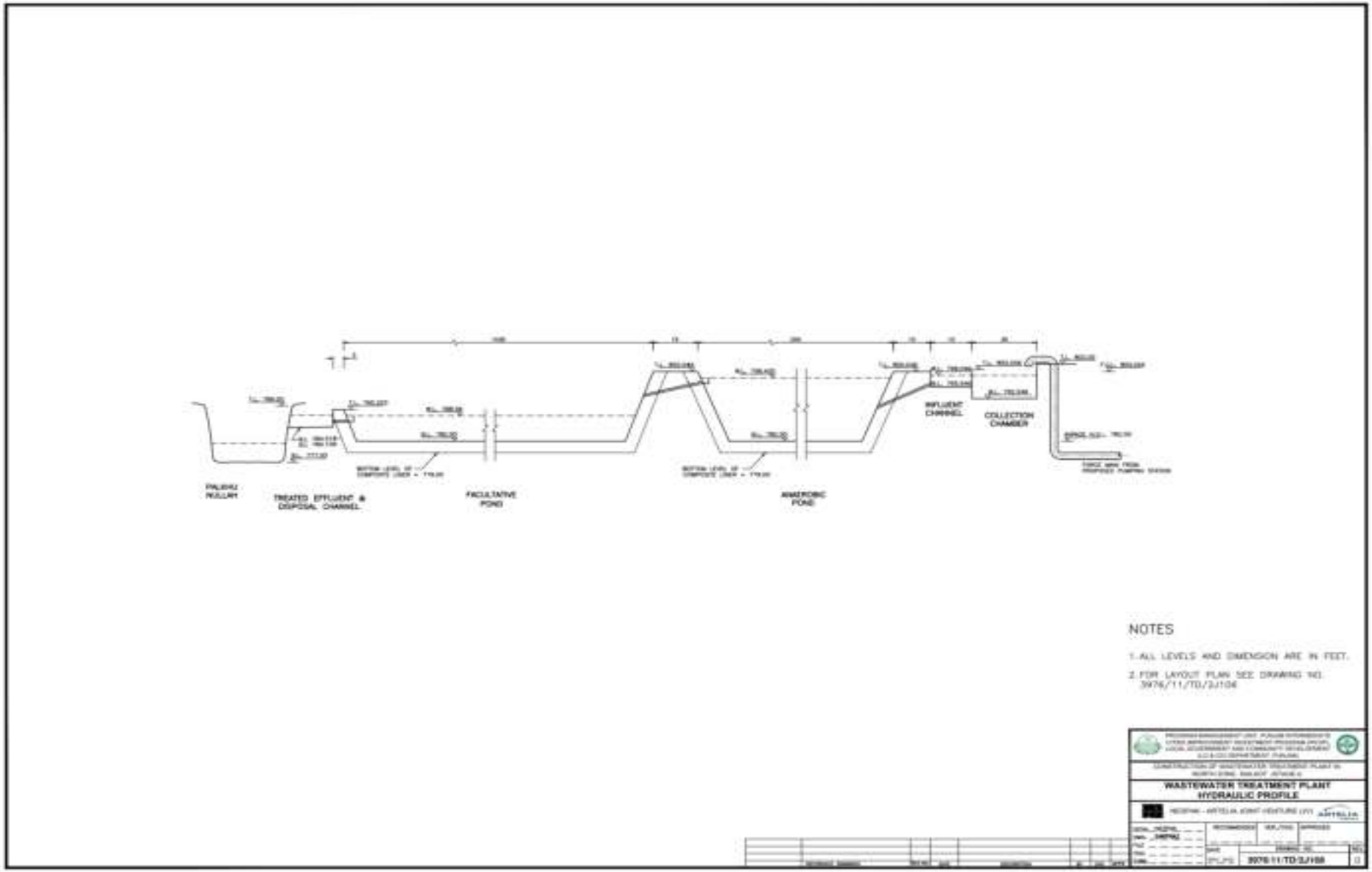


Figure 3-5: FP & MP – Plan and Section

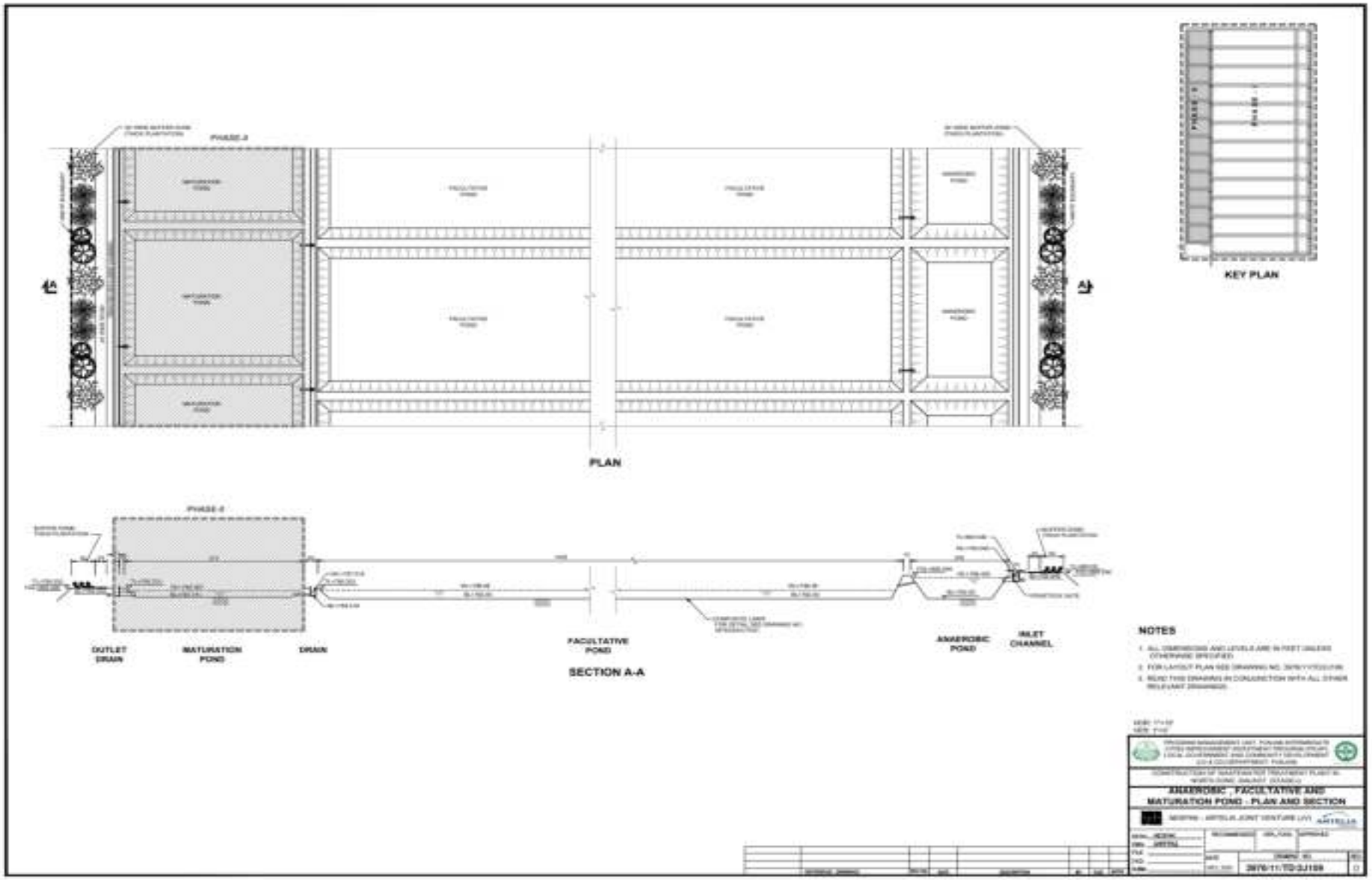


Figure 3-6: AP – Plan & Section

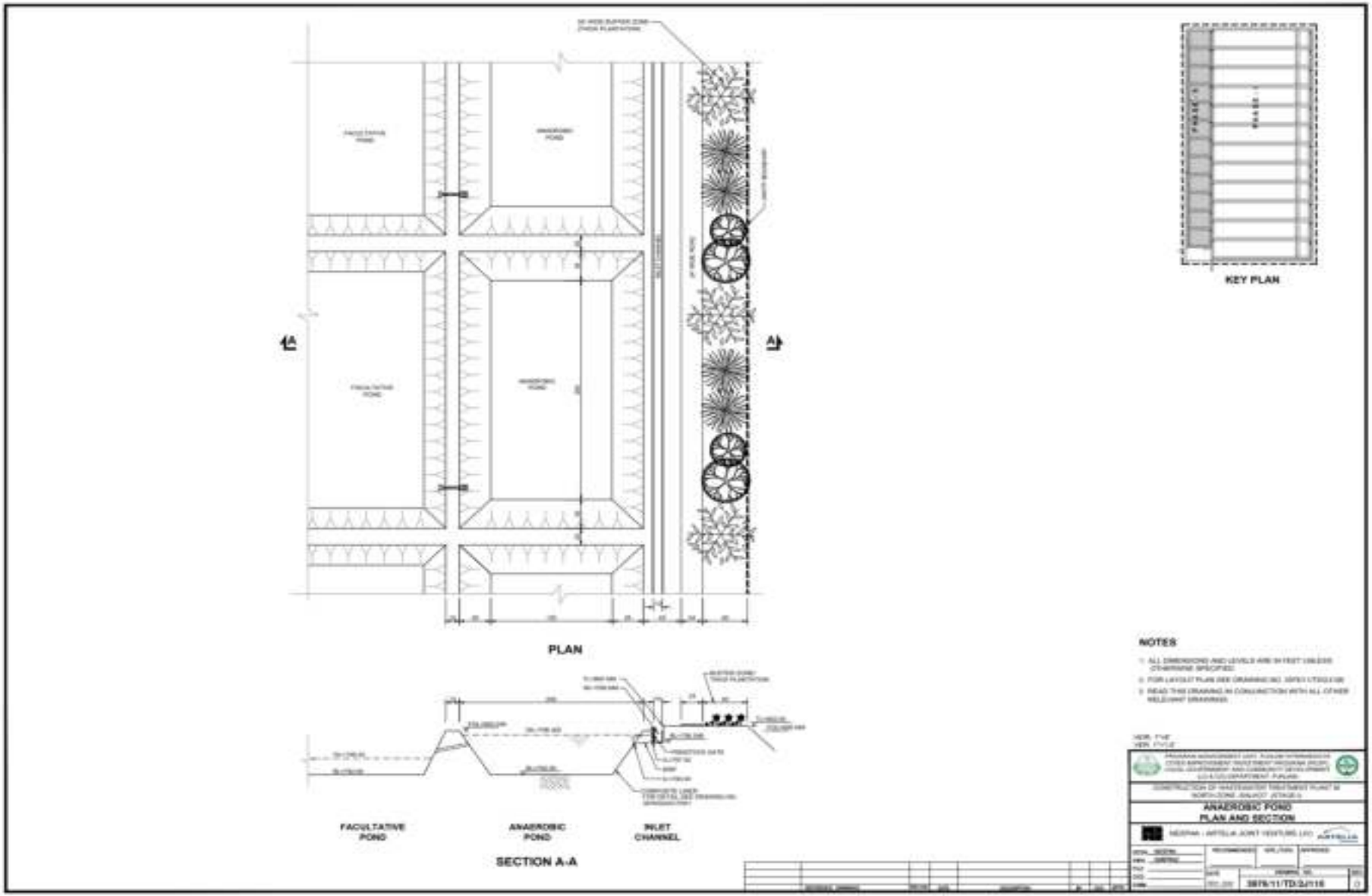


Figure 3-7: FP – Plan & Section

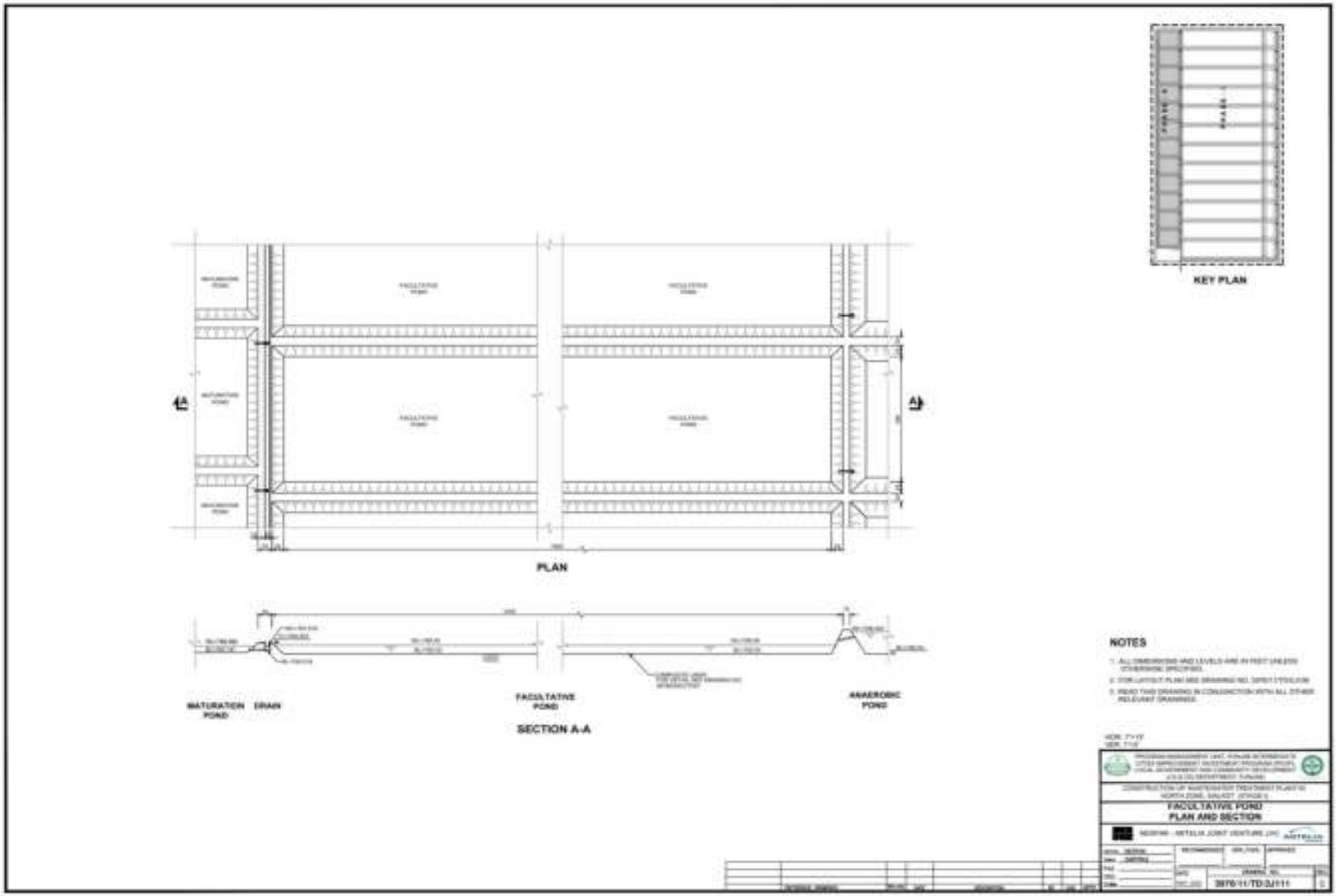


Figure 3-8: Collection Chamber – Plan & Section

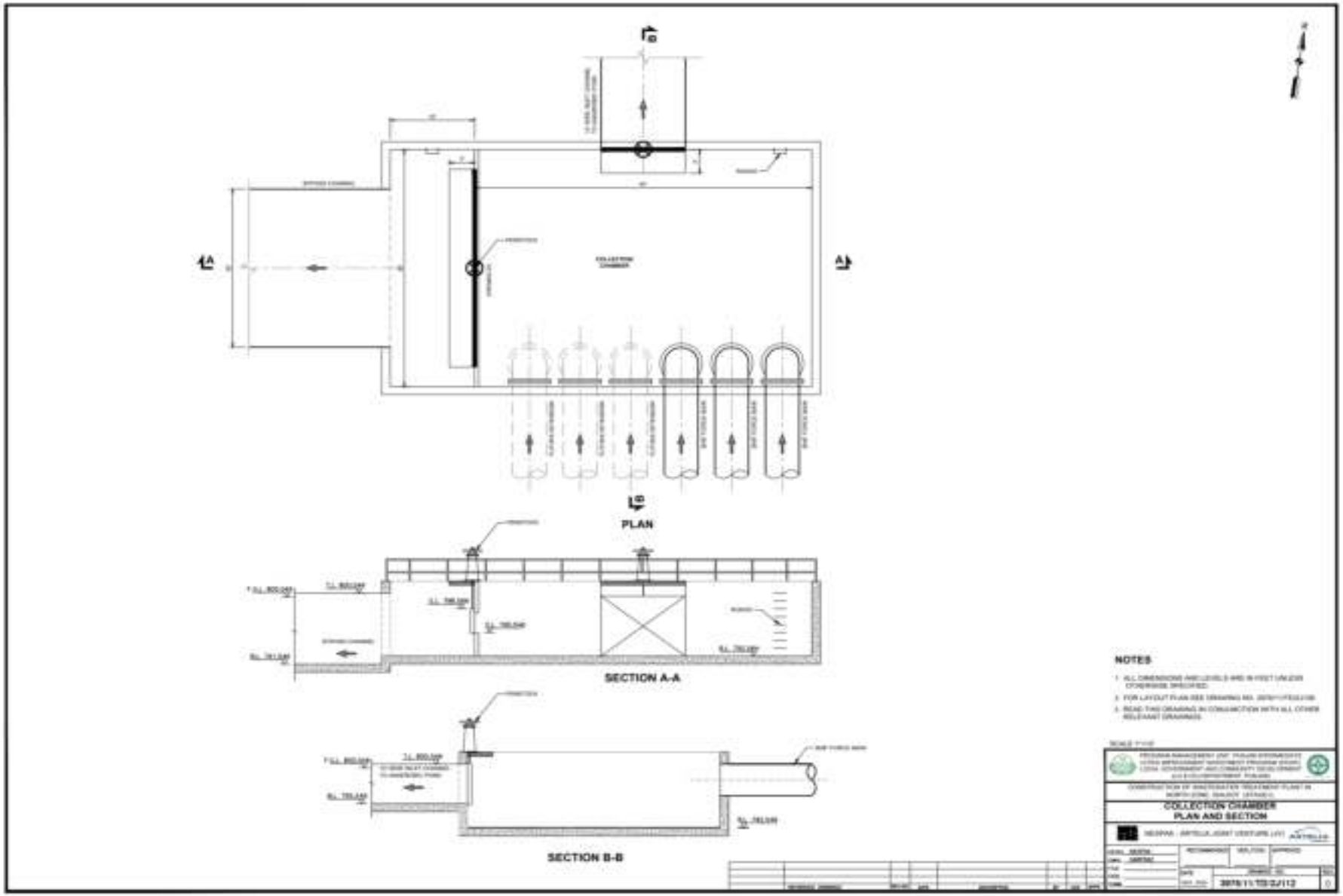


Figure 3-9: Inlet Channel and Outlet Channel – Section

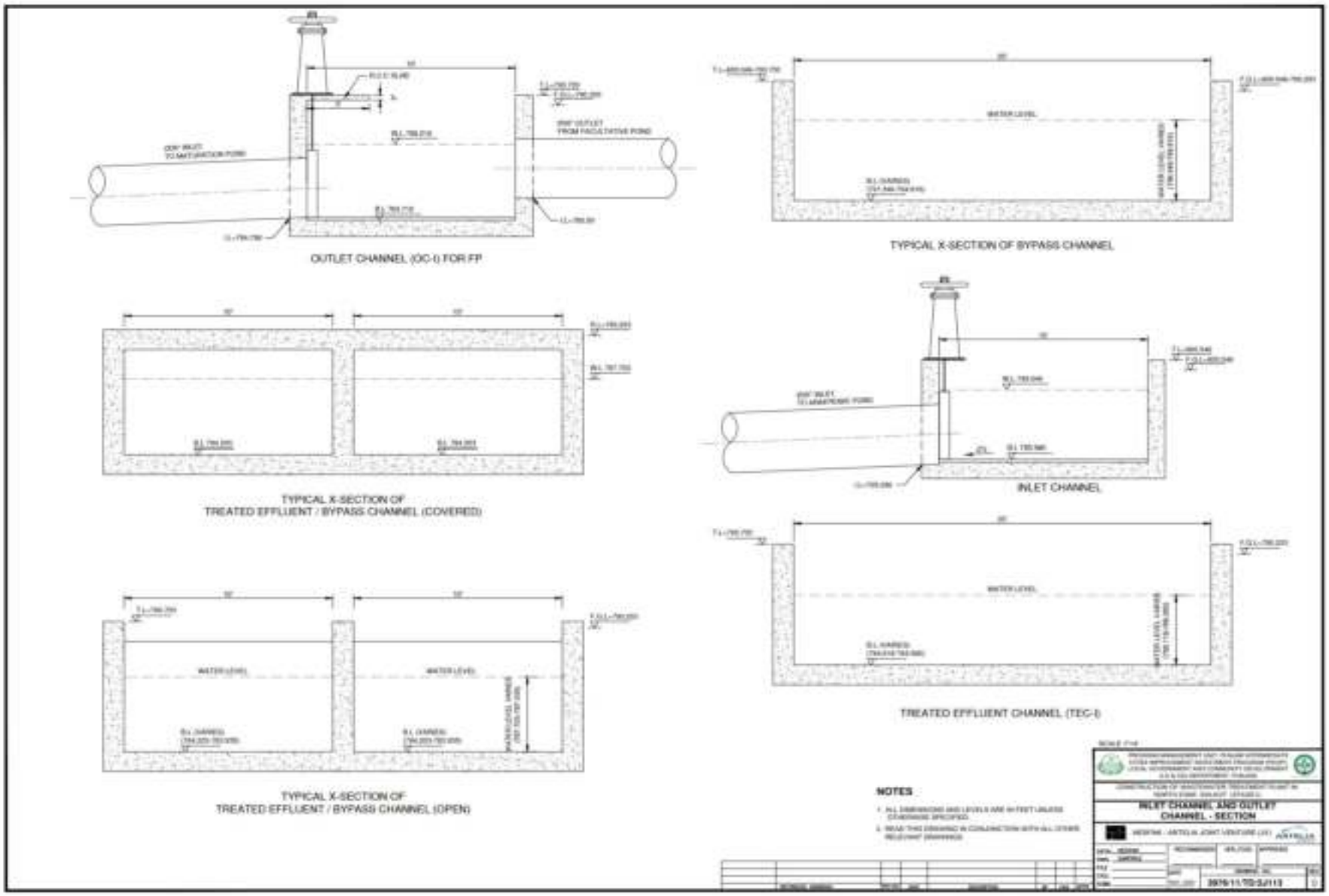


Figure 3-10: Interconnection Detail in between AP & FP

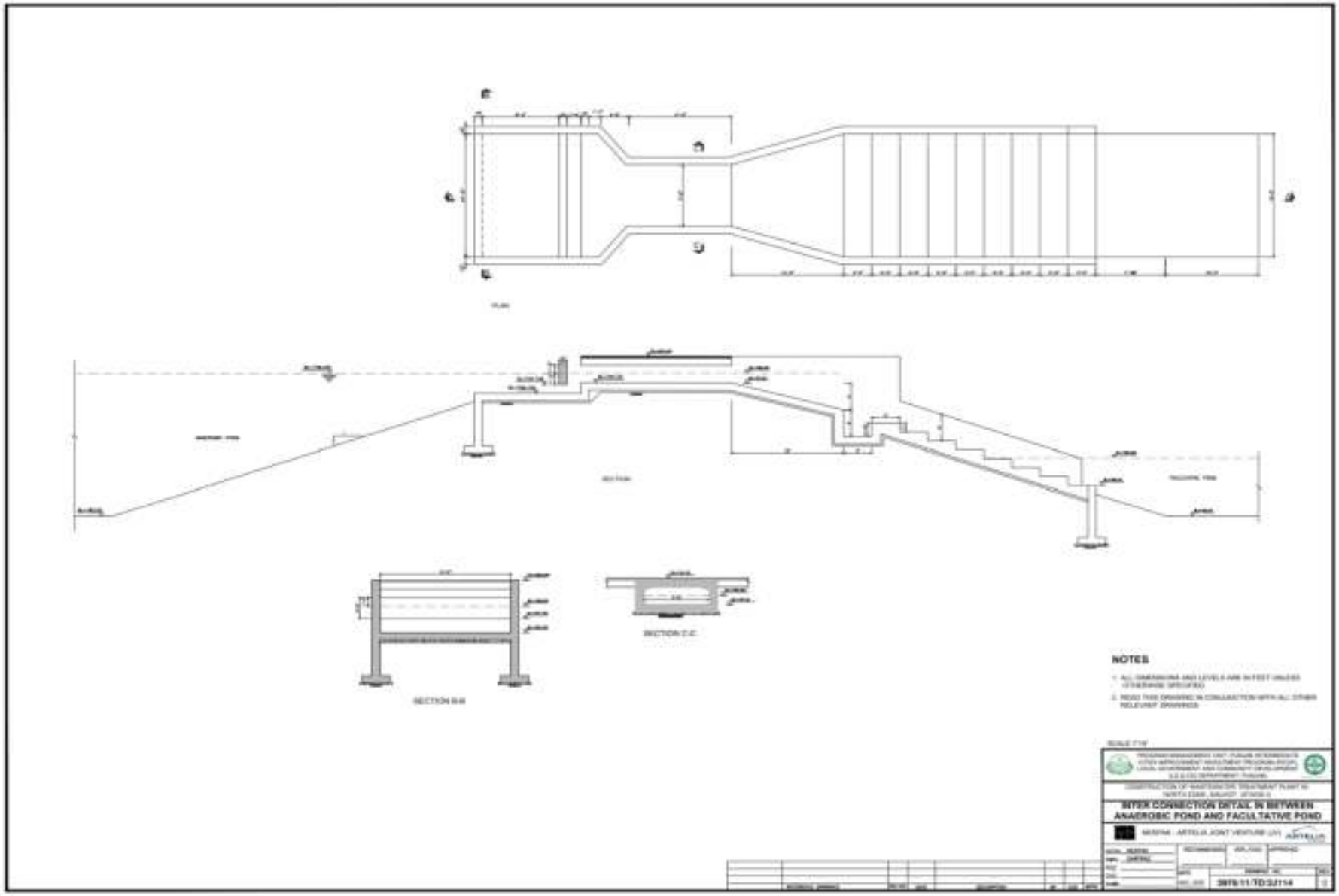


Figure 3-11: Outlet Structure detail from FP

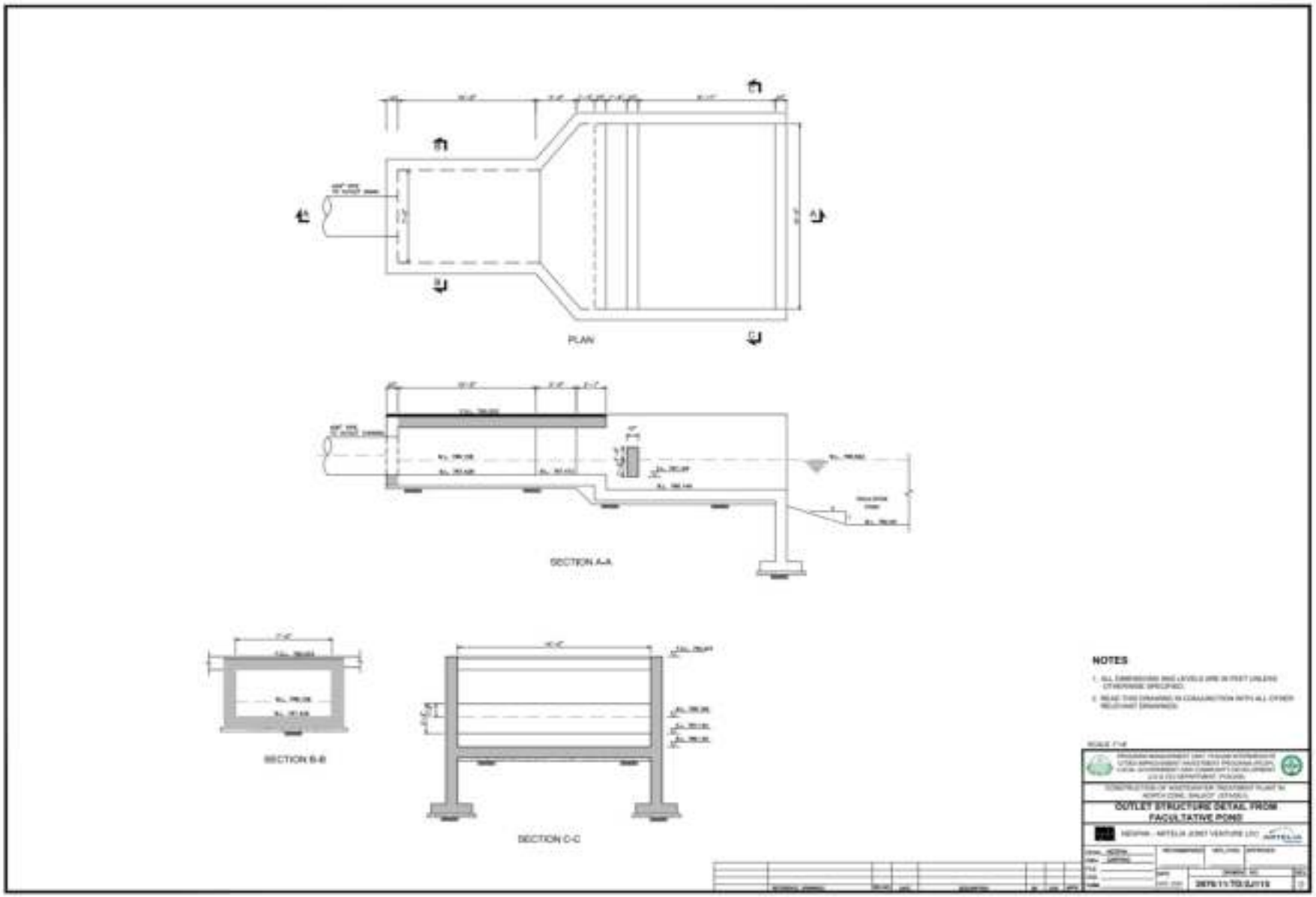
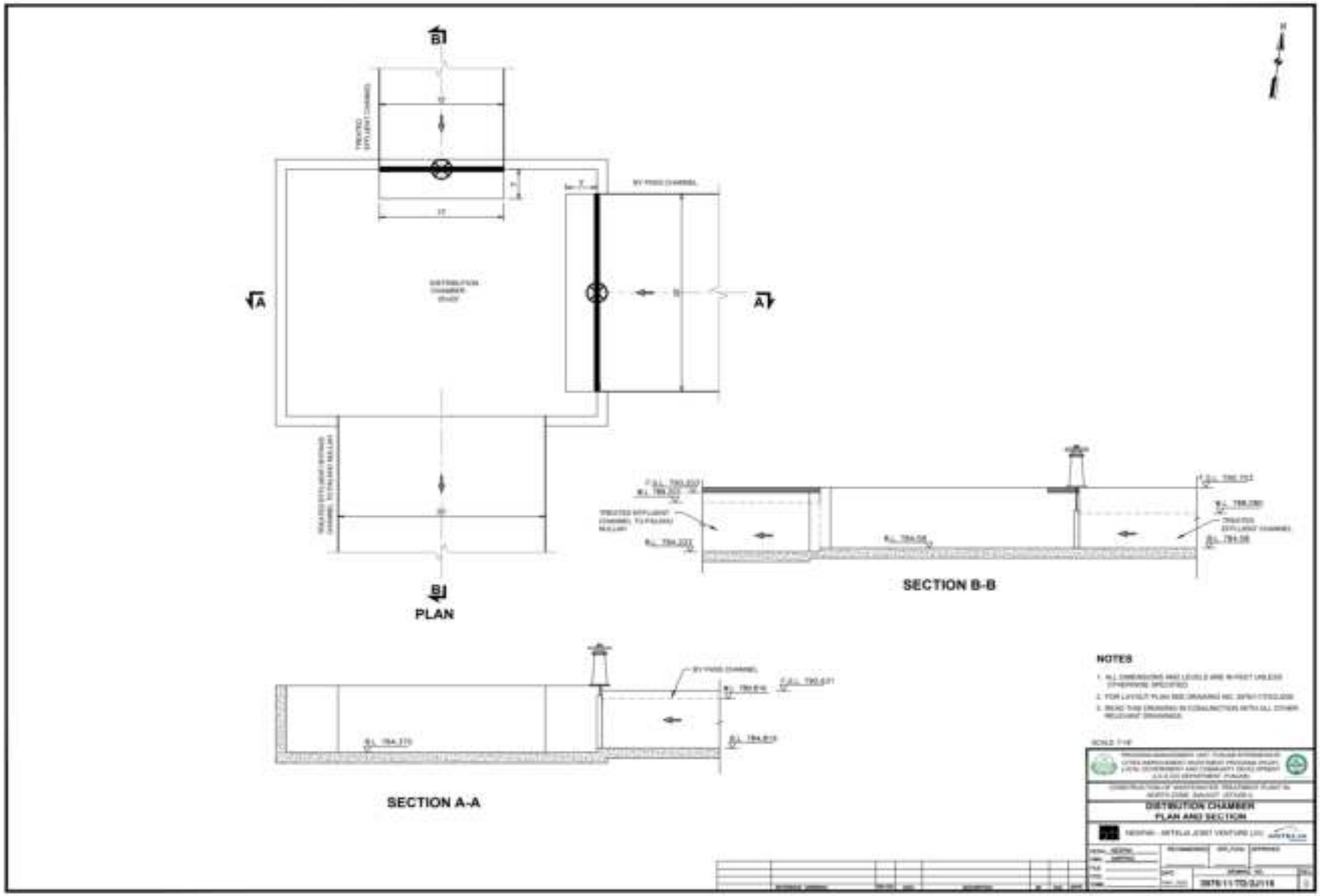


Figure 3-12: Distribution Chamber – Plan & Section



4 Description of Environment

116. This chapter describes the baseline environmental and social conditions of the project area for the proposed WWTP. The project area's environmental conditions will describe the various resources which could be affected by the economic development that takes place, i.e. physical resources (atmospheric conditions e.g. ambient air quality and climate, topography and soils, surface water and groundwater quality), ecological resources (fisheries, wildlife, forests, rare and endangered species, protected areas etc.) and social resources.

4.1 Physical Resources

i. Sialkot City Geography

117. Sialkot city is the thirteenth largest city in the Punjab Province of Pakistan and it is the ninth largest district of Pakistan and encompasses over an area of 745,269 acres (3,016 km^2) with population of about 3.9 million based on Population and Housing Censes, 2017. Whereas, a total 0.7 million are currently residing in Municipal Corporation (MC) Sialkot. Sialkot city is located at 32°29′33″N 74°31′52″E and is 256 m (840 ft) above mean sea level. The district is shown in **Figure 4.1** below.

Figure 4-1: Location Map of Sialkot

118. Sialkot district is bounded on the north-east by the Jammu & Kashmir state, on the north-west by rivers of Ravi and Chenab, which separate it from the Gujrat district, on the west and southeast by Gujranwala and Narowal district respectively. It is an irregular tract occupying the sub-mountainous portion of Rachna. It is divided in four sub-divisions i.e. Sialkot, Daska, Pasrur and Sambrial. The district is a plain, sloping down from the uplands at the base of the Himalayas to the level country in the south.

119. Sialkot is one of the few cities of Pakistan where dry port was established in 1984 and export processing zone (EPZ) was developed in 1995. Sialkot has 8,100 industrial units which make it the fourth largest manufacturing hub. Sialkot is the second largest surgical instrument manufacturing city in the world. It is the third largest sports manufacturer in the world and ranks first in Asia. Sialkot is the sole city in Pakistan in which private airport was developed, having the longest runway. The water and sanitation systems are being managed by Municipal Corporation (MC).

ii. Natural and Climate Conditions of Sialkot

120. Sialkot has the same basic natural and climatic conditions that prevail in Punjab. The climate in most of the area is arid to semi-arid, characterized by four district seasons in a year: winter from mid-November to February; spring from mid-March and April; summer from May to mid-September; and autumn from mid-September to mid-November.

121. The maximum temperatures in summer are 41°C whereas minimum temperature in winter is 5.7°C. The average annual temperature in Sialkot is 23.6°C as can be seen in the **Table 4.1** below.

Table 4.1: Sialkot Climate Data

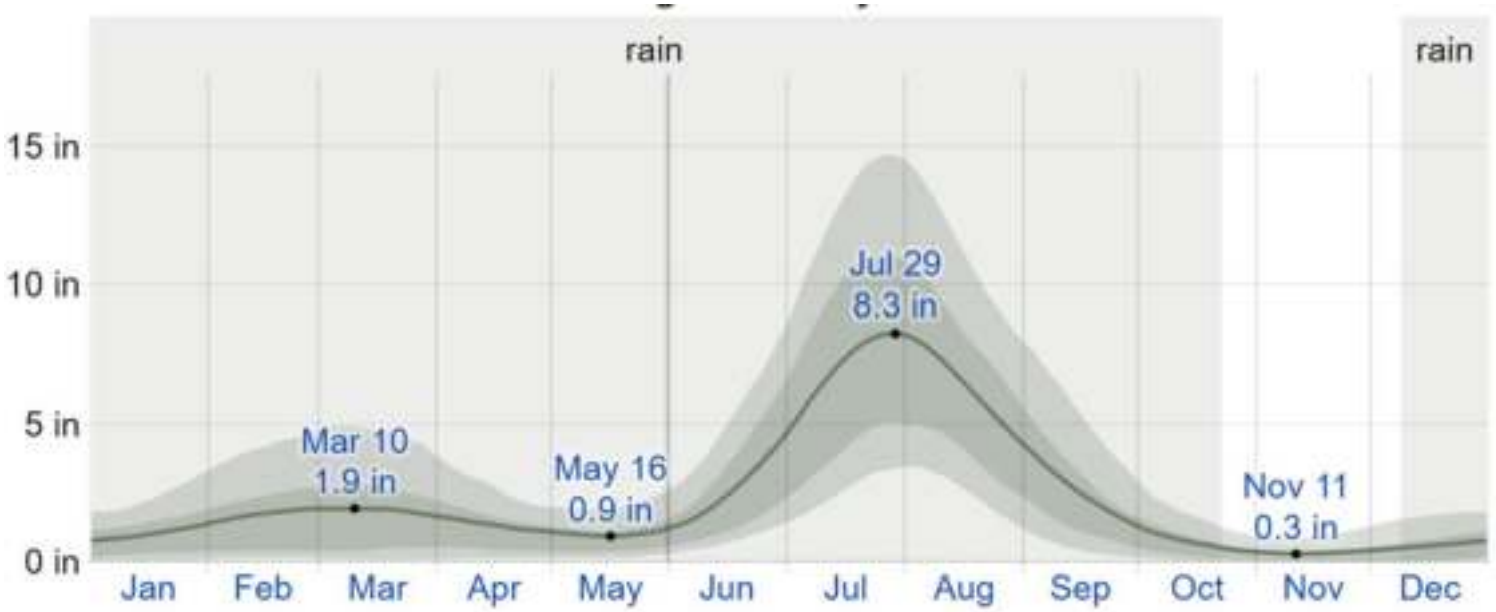
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Avg Temperature (°C)	12.1	14.8	20.1	25.8	31	33.6	30.9	29.5	29	25.1	18.5	13.3
Min Temperature (°C)	5.7	8.1	13.3	18.4	23.1	26.6	26.2	25.3	23.6	17.8	10.5	6.1
Max Temperature (°C)	18.5	21.6	26.9	33.2	38.9	40.7	35.6	33.8	34.4	32.4	26.5	20.5
Precipitation / Rainfall (mm)	46	40	41	20	16	61	134	252	114	18	8	22

a. Rainfall[16]

[16] https://weatherspark.com/y/108040/Average-Weather-in-Sialkot-Pakistan-Year-Round

122. The average monthly rainfall in Sialkot is shown in **Figure 4.2** below. It can be observed that the highest volume of rainfall is received during the month of July.

Figure 4-2: Average Monthly Rainfall in Sialkot District



b. Humidity

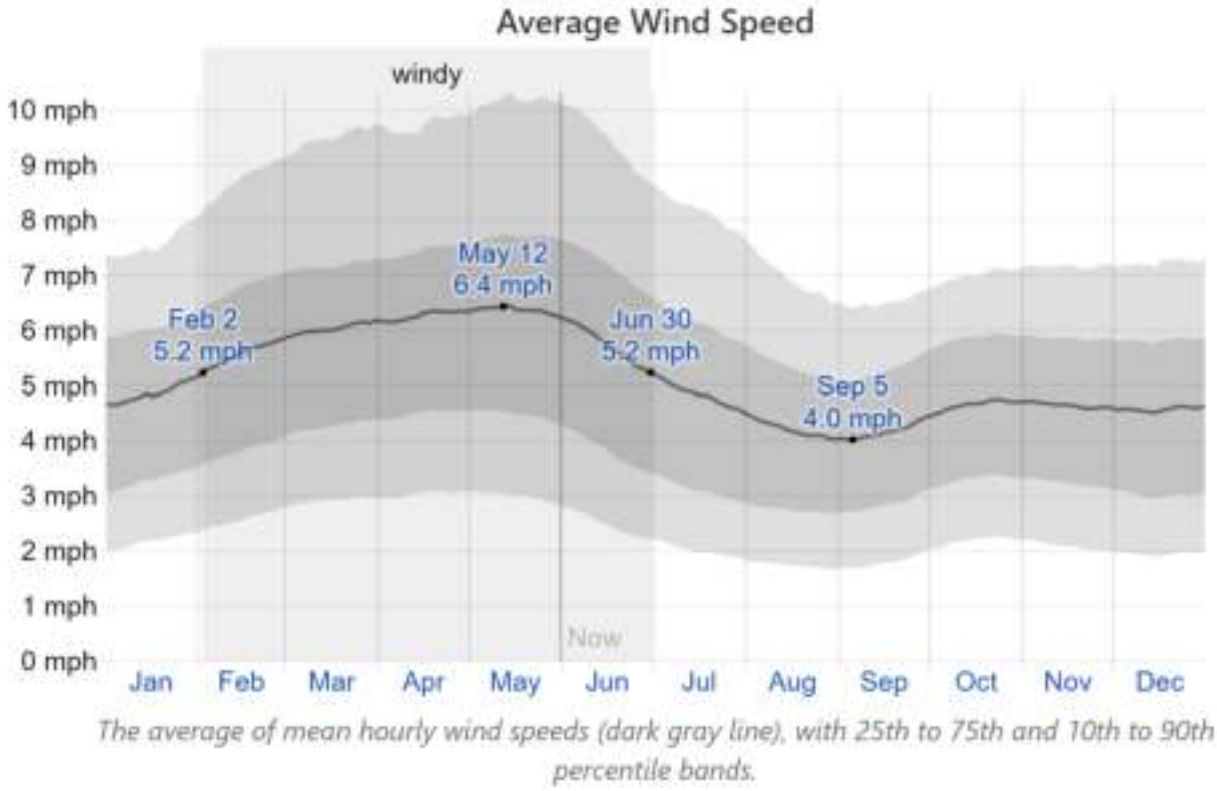
123. As can be observed in **Figure 4.3** below, it gets very humid during the months of July to September while the winter months are quite comfortable in terms of levels of humidity.

Figure 4-3: Average Humidity Levels in Sialkot District

c. Wind Speed and direction

124. The year-round wind speed and direction patterns are provided in **Figures 4.4** and **4.5** below

Figure 4-4: Average Wind Speed in Sialkot



The average of mean hourly wind speeds (dark gray line), with 25th to 75th and 10th to 90th percentile bands.

Figure 4-5: Wind Rose for Sialkot

iii. Ambient Air Quality

125. Ambient air quality was continuously monitored for a 24 hour period at the Airport road, since it is located in close proximity to the proposed location for the WWTP, which is shown in **Figure 4.6** below.

126. The ambient air quality in the project area is presented in the **Table 4.2** below. As can be observed, the airshed is generally of good quality except for PM_{10}, which is exceeding the applicable standards. The detailed ambient air quality results are provided as **Annexure H.**

III. Noise Levels

127. The ambient noise levels were also monitored at the same location as ambient air quality i.e. Airport Road in Sialkot. The results of the noise monitoring are provided in **Table 4.3** below. As can be observed, the noise level was monitored to be 44.7 dB during the daytime, which is within the applicable day time standard of 65 dB. In comparison, the night time noise limit is not being exceeded with average nighttime noise levels assessed to be 41.2 dB.[17] The detailed ambient noise quality results are provided as **Annexure H**.

[17] Results might be misleadingly low and thus inaccurate, considering the minimized traffic and movement of goods and people due to the COVID-19 pandemic from the 'business as usual' scenario.

Figure 4-6: Map of Monitoring Location

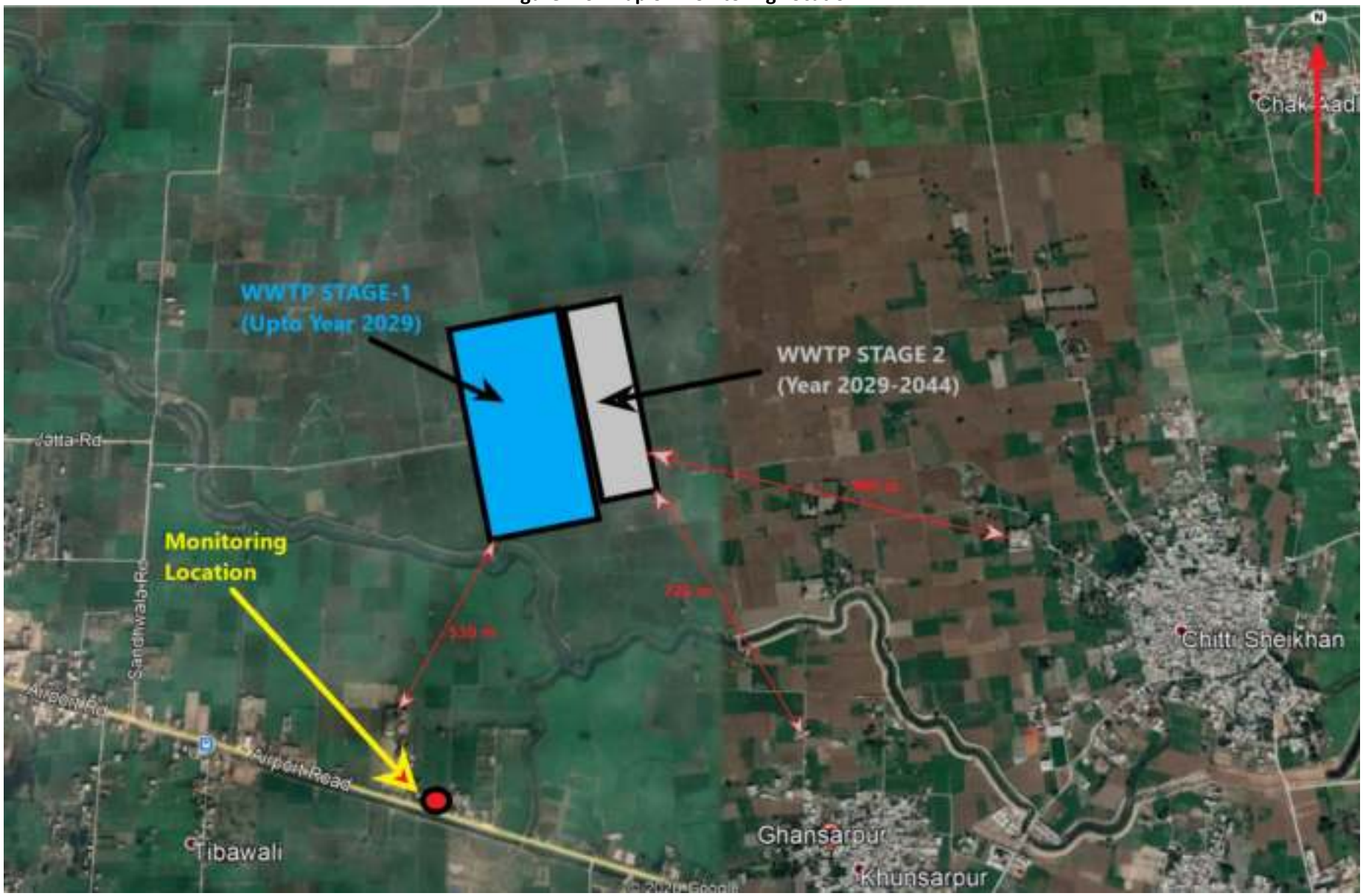


Table 4.2: Comparison of ambient air quality results versus applicable Air Quality standards[18]

Monitoring Location	Parameter	NO (ug/m^3)	NO_2 (ug/m^3)	CO (ug/m^3)	SO_2 (ug/m^3)	NOx (ug/m^3)	$PM_{2.5}$ (ug/m^3)	PM_{10} (ug/m^3)	TSP (ug/m^3)
Applicable Guideline (ug/m^3) for 24 hrs		-	**80**	-	**20**	-	**25**	**50**	**500**
Monitoring Values at Airport Road	-	11.12	16.01	0.84	19.3	27.13	25	126	237

'Exceeding' applicable guidelines for acceptable pollutant levels **'Within' applicable guidelines for acceptable pollutant levels**

[18] Results might be misleadingly low and thus inaccurate, considering the minimized traffic and movement of goods and people due to the COVID-19 pandemic from the 'business as usual' scenario. Based on comparison with secondary data obtained during the pre-COVID-19 lockdown period, the results appear consistent, even though ambient concentrations of certain parameters are slightly lower. The PM2.5 and PM10 levels are lower at present than the pre-lockdown period, however, PM10 are still exceeding the applicable guidelines.

Table 4.3: Ambient Noise Monitoring Results (24 hrs) in Project Area

Monitoring Location	Parameter	Noise Reading Results	Noise Guideline (Commercial Area)	Compliance Status for Commercial Areas
Day Time Readings (0600 to 2200)			**Day time**	
Airport Road	dB(A) Leq	**44.7**	65	
Night Time Readings (2200 to 0600)			**Night time**	
Airport Road	dB(A) Leq	**41.2**	55	
Average Noise Levels (24 hour average)	dB(A) Leq			

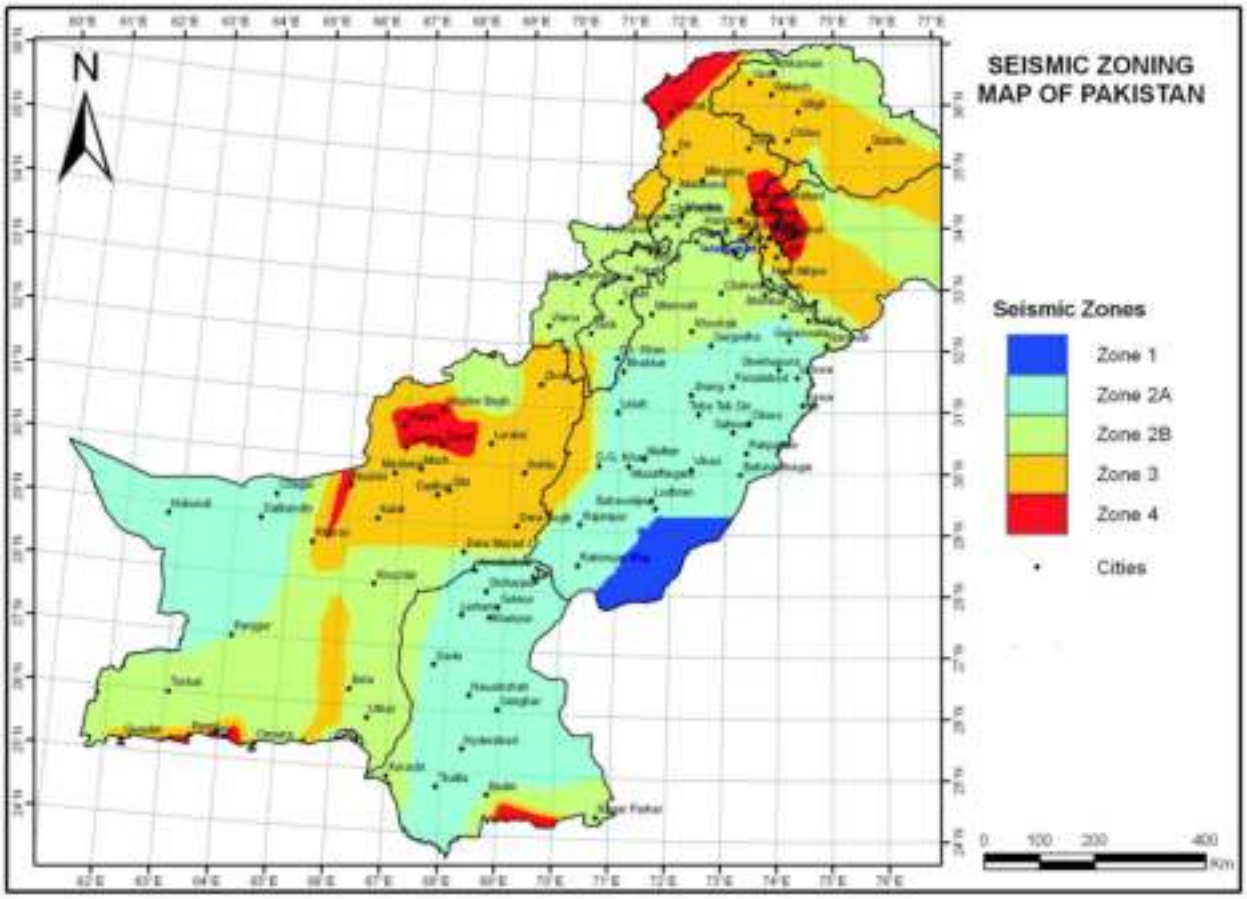
Exceedance from applicable guidelines

'Within' applicable guidelines

iv. Seismicity

128. Pakistan lies in a seismically active zone. Seismic observations indicate that hundreds of shocks occur in the region every year. According to the seismic zoning map of Pakistan, included in Pakistan Building Code Seismic Provisions (2007), the project area falls under seismic zone 2A, with a peak horizontal ground acceleration of from 0.08 to 0.16. The seismic zoning map of Pakistan is given as **Figure 4.7** below.

Figure 4-7: Seismic Zoning Map of Pakistan



v. Surface Water

129. Sialkot is situated in the Upper Rechna Doab bounded by the Ravi and Chenab rivers. The city is traversed by three seasonal streams: Aik Nullah to the south, Bhaid Nullah between the Cantonment and the city, and Pahlu Nullah to the north of the Cantonment.

130. The total catchment area upstream of Marala (the point of entry in Pakistan) is about 28000 km^2. From Marala barrage to the confluence with river Indus, the river Chenab traverses through Punjab province for another 576 km. A number of smaller

tributaries i.e. Halsi, Bhimber, Palkhu and Aik join the river between Marala and Khanki barrages, draining a total area of 3437 km^2.[19]

131. At Sialkot, 0.6 m^3/sec of industrial effluent enters the river Chenab with a BOD of 24.9 tons per day and a TDS of 3607.5 tons per day. Secondary data results of sampling of the Chenab river at different points are provided below. Water quality samples of the River Chenab water body at the discharge point of the drain from the WWTP into the River Chenab will need to be taken prior to commencement of operation of the WWTP in order to develop a robust baseline of the pre-project river water quality.

Location of sampling points and analytical data of River Chenab[20]

Sampling Points	Analysis Parameters				Trace metals			
	pH	EC (dS/m)	SAR	RSC (me/l)	Cu (mg/l)	Ni (µg/l)	Pb (µg/l)	Zn (mg/l)
Marala Headworks	7.91	0.34	1.1	0	0.3	0	0.17	0.43
Khanki Headworks	8.1	0.38	1.17	0	0.26	0	0.19	0.4
Qadirabad Headworks	8.13	0.41	1.32	0.1	0.29	0	0.19	0.41
Trimmu Headworks	8.12	0.98	4.81	0.4	0.46	0.12	0.29	0.56
Avgerage	**8.01**	**0.53**	**2.1**	**0.13**	**0.33**	**0.03**	**0.21**	**0.45**

vi. Groundwater

132. River Chenab is the main nearest source of surface water for Sialkot City. Marala Barrage is the nearest structure to Sialkot on River Chenab. The Barrage is located 23 km towards North East from Sialkot city. It is 16 km from the foothills of Pir Punjab Range where it enters the plain lands near Ahknoor. Upper Chanab Canal (UCC) and Marala Ravi (MR) Link Canal take-off from Marala Barrage and cross the Sialkot City from the north-west. Similarly, some natural nullahs are also passing through the Sialkot.

133. Groundwater underlying the project area occurs under water table conditions. The aquifer mainly comprises sand with clay lenses of varying thickness

[19] https://pdfs.semanticscholar.org/5886/37c659b445d6cdc46d30271dc5d27697ad27.pdf

[20] https://pdfs.semanticscholar.org/5886/37c659b445d6cdc46d30271dc5d27697ad27.pdf

and extension at places. The previous studies and behavior of existing shallow and deep tube wells in the area reveals aquifer as a single homogeneous water body. Groundwater is available at shallow depth and is being extracted through hand pumps, shallow and deep tubewells for drinking, agriculture and industrial use. In order to have an idea of groundwater potential of the project area, electrical resistivity survey was carried out in Sialkot city at 32 locations. The medium and high resistivity zones have been identified as potential zones. These zones with above predominant lithological characteristics are the source of groundwater in the project area. These zones are available in appreciable thickness up to investigated depth 300 meter below NSL and can produce safe yield (Q)

134. The groundwater quality results were examined that is being used for drinking purpose and for insight into the elevated concentrations of specific elements in the water samples. Any groundwater contamination in the area, being the aquifer as a single homogeneous water body, may create serious environmental and health problems. Therefore, in addition to the physical parameters, of particular interest was to determine if the bacteriological parameter (Total Coliform) exceeds the standard limit.

135. Analytical results for the unlimited Total coliform values indicate that coliform was substantially high and groundwater quality has been significantly impacted. The presence of coliform in groundwater has revealed contamination of aquifer that has been evidenced from all the tube wells. The reason for presence of coliform was not understandable which requires further monitoring. The predominant level of coliform in most of the tube wells is of major concern

136. The coliform presence can be associated with a leaking mechanism of some sewage water from pipelines into the aquifer that should further be verified, if these values decrease appreciably over time. Details of the groundwater monitoring is presented as **Annexure H**

137. Once all investigations with regards to the source and extent of the coliform in the groundwater aquifers across Sialkot city have been completed, a detailed remedial plan shall be prepared containing the required interventions and treatment options that need to be put in place to ensure the coliform in the groundwater is removed and the water is suitable for use.

4.2 Ecological Resources

i. Flora of the Area

138. In Sialkot district, the most important species of trees are Kikar (*Acacia Arabica*); Shisham or Tahli (*Delbergia sissoo*); Beri (*Zizyphus jujube*); Toot (*Morus alba*); Sharin (*Albizzia lebbek*); Dherek (*Melia azeharach*); Phulai (*Acacia modesta*); Pipal (*Ficus religiosa*); and Bohr (*Ficus bengalansis*), which are planted for shade. The trees in Rakhs mainly consist of three species: Jand (*Prosopis spicigera*); Karir (*Capparis aphylla*); and Wan (*Salvadora oleoides*). Occasionally, Rero (*Acacia ieucophhloea*) and Farash (*Tamarix articulata*) are also found. The Pilchhi (*Tamarix dioica*) is found on moist sandy soils along riverbanks and is used for wicker work, and basket making, etc. Mesquite bushes and some Eucalyptus trees grow wild in the areas along the canals, roads and barren land, but natural forest cover has been significantly reduced.

139. Sialkot is a green and fertile town with 11,522 forested acres. The area's main crops are wheat, cotton, sugarcane, maize, sorghum forage and rice. Main fruits grown are citrus, mangoes and guava.

140. Flora: The climate tends to have hot, sometimes extremely hot, summers and mild warm winters. The soil and climatic characteristics support short or scrubby vegetation which can be termed as open and pronouncedly of xerophytic nature in which thorny leguminous species predominate. However, commonly found vegetation (Trees, Shrubs, Grasses) of project as well as study area include species given in the **Tables 4.4** to **4.6** below.

Table 4.4: Name of Trees

S. No.	Common Name	Scientific Name	IUCN Status
1	Kikar	*Acacia nilotica*	NA
2	Shisham	*Dalbergia sisso*	NA
3	Simal	*Bombax ceiba,*	NA
4	Sufeda	*Eucalyptus species*	NA
5	Frash	*Tamarix articulate*	NA
6	Neem	*Azedarachta indica*	NA
7	Jaman	*Syzygium cumini*	NA
8	Bakain	*Melia azedarach*	NA
9	Ber	*Zyziphus mauritiana*	NA
10	Toot	*Morus alba*	NA
11	Lasura	*Cordia myxa*	NA
12.	Sukh Chaen	*Pongamia glabra*	LC
13.	Mesquite	*Prosopis juliflora*	NA
14.	Date Palm	*Phoenix dactylifera*	NA

NA= Not Assessed LC= Least Concern

Table 4.5: Name of Shrubs and Herbs

S. No.	Common Name	Scientific Name	IUCN Status

1	Akk	*Calotropis procera*	NA
2.	Phog	*Calligonum polygonoides*	NA
3	Jantar	*Sesbania aculeate*	NA
4	Bathu	*Chenopodium botrys*	NA
5	Lana	*Suaeda fruticosa*	NA
6	Arind	*Ricinus communis*	NA
7	Piazi	*Asphodelus tenuifolius*	NA

NA= Not Assessed

Table 4.6: Name of Grasses

S. No.	Common Name	Scientific Name	IUCN Status
1	Khabbal	*Cynodon dactylon*	NA
2	Dab	*Desmotachya bipinnata*	NA
3	Khawi	*Cymbopogan jwarancusa*	NA
4	Kana	*Saccharum munja*	NA
5	Gorkha	*Elionorus hirsutus*	NA
6	Kai	*Saccharum spontaneum*	LC

NA= Not Assessed, LC= Least Concern

141. Existing Trees: The project area is flat agricultural land which supports trees of various species on the boundary of agricultural fields as well as individually scattered growth. Trees (girth 61 cm and above) and pole crop (girth 20 to 58 cm) standing within the project area were enumerated along with their kind of species. The detail of trees present in the project area is given in **Table-4.7** below.

Table 4.7: Species Wise Tree Distribution

Sr. No.	Species	No. of Trees		
		Poles (girth 20 to 58 cm)	Trees (girth 61 cm and above)	Total
1	Kikar	5	12	17
2	Shisham	8	10	18
3	Toot	7	13	20
4	Miscellaneous	5	7	12
	Total	**25**	**42**	**67**

Miscellaneous includes Sukh Chaen, Lasura, Jaman, Neem, Date Palm

ii. Fauna of the Area

142. The faunal habitat is quite modified with several species of wildlife having adapted to the changed habitat. These include, Bengal fox; small Indian mongoose; shrew; hog deer; wild hare; and rodent pests, including porcupine; fruit bats; and wild boar. The

avifauna that has survived the modified habitat include doves; black partridge; cuckoos; koel; woodpeckers; parakeets; bulbuls; babblers; black drongo; bee eaters; finches; owls; hawks; and house sparrow. The reptilian species of this modified habitat include krait; cobra; saw scaled viper; rat snake; and monitor lizard.

143. Scavengers, such as, jackals are attracted to garbage dumps and human faeces for food. House sparrows breed in houses. Bank mynas and cattle egrets feed on grasshoppers that are present in the rangelands that also support cattle and buffalos. Banyan and peepal trees still grow in the villages. Green pigeons and barbets feed in these trees.

144. Some of the oldest trees still stand in the old British-era colonies. Some rare species of birds, such as hornbills, green pigeons, and barbets still live on these trees. Large populations of pigeons breed in urban houses. Kites, crows, mynas, house sparrows and alexandrine parakeets breed in urban areas. Shisham and acacia trees are usually planted along the roads and canals. Doves mainly breed on these types of trees.

145. The extent of fauna presence is related to the availability of vegetative cover in an area. Since the project area is basically agricultural supporting chunk of land without any dense forested area nearby, it lacks richness in natural fauna. No conspicuous wildlife was observed in the area during field visit However, mammals reported in the project area, are given in **Tables 4.8** to **4.10** below.

Table 4.8: Names of Mammals

S. No.	Common Name	Scientific Name	IUCN Status
1	Jackal	*Canis aureus*	LC
2	Fox	*Vulpus bengalensis*	NA
3	Porcupine	*Hystrix indica*	LC
4	Squirrel with strips	*Funambulus pennanti*	NA
5	Mouse	*Mus musculus*	LC
6	Mongoose	*Herpestes auropunctatus*	NA
7	Indian Hare	*Lepus nigricollis*	LC

NA= Not Assessed, LC= Least Concern

Table 4.9: Names of Reptiles

S. No.	Common Name	Scientific Name	IUCN Status
1	Cobra	*Naja naja*	NA
2	Spiny tailed Lizard	*Uromastyx hardwickii*	NA
3	Fringed Toed Lizard	*Acanthodactylus cantoris*	LC

4	Indian Krait	*Bungarus caeruleus*	NA

Table 4.10: Names of Amphibians

S. No.	Common Name	Scientific Name	IUCN Status
1	Common Frog	*Rana tigrina*	LC
2	Common Toad	*Bufo bufo*	LC

146. The area is comparatively dry and does not support wide variety of birds. The common species found in the project area are enlisted in **Table-4.11** below.

Table 4.11: Names of Birds

S. No.	Common Name	Scientific Name	IUCN Status
1	House Sparrow	*Passer domesticus*	LC
2	Mynah	*Acridotheres tristis*	LC
3	House Crow	*Corvus splendens*	LC
4	Pigeon	*Columba livia*	LC
5	Koel	*Eudynamys scolopacea*	LC
6	Red-Wattled Lapwing	*Vanellus indicus*	LC
7	Gray Partridge	*Francolinus Pondicerianus*	LC
8	Quail	*Coturnix coturnix*	LC
9	Red Vented Bulbul	*Pycnonotus cafer humayuni*	NA
10	Little Bittern	*Ixobrychus minutus*	LC
11	Hoopoe	*Upupa epops*	LC
12	Ring Necked Dove	*Streptopelia decaocto*	LC
13	Little Egret	*Egretta garzetta*	LC

147. On account of anthropogenic interventions mainly agriculture, no habitat is left to support much of wildlife in the project area. None of the existing species of plants or animals, therefore, are of endangered category

148. **Fisheries:** Fishery sector is not rich in district Sialkot on account of precious fertile land for agriculture production.

149. **Agriculture:** Agriculture is the main source of income of the inhabitants of the project area. District Sialkot being the land of three rivers is considered as one of the most fertile land zones of the Punjab. Therefore, due to the most sophisticated canal irrigation system and supporting ecological and climate characteristics, this area has a good potential for producing almost all kinds of food commodities. The area has a diverse

cropping pattern because of its heterogeneity in agro-climatic conditions. The main agricultural crops, fruit trees and vegetables grown by the farmers of the area are given below.

150. **Main Crops:** Sugarcane, wheat, rice, maize and cotton are the main crops grown in the area. Besides guar seed, bajra, moong, mash, masoor, jawar, oil seeds are also grown in minor quantities in Sialkot area. Average yield of important crops in the area of study is given below in **Table 4.12**.

Table 4.12: Average Yield of Agricultural Crops

Sr. No.	Crop Name	Average Yield/Acre (kg)
1	Cotton	1,000
2	Sugarcane	20,600
3	Maize (Spring)	3,400
4	Maize (Autumn)	2,800
5	Rice	800
6	Wheat	1,400
7	Potato	9,600

151. **Fruits:** Citrus, guavas and mangoes are the main fruits grown in the district. Besides, pomegranate, litchi, falsa and banana are also raised on minor scale.

152. **Vegetables:** Potatoes, onion, cauliflower, tomato and turnip are main vegetables grown in the area. Besides, peas, garlic, chilies and lady finger are grown on a smaller scale.

iii. Protected areas / National Sanctuaries

153. In Pakistan, there are several areas where land is devoted to the preservation of biodiversity, through the dedication of national parks and wildlife sanctuaries. There is no protected area or national sanctuary near the area of where work will take place on the sub-project.

4.3 Economic Development

154. Sialkot is located close to the Indian border some 125 km north of Lahore. It is a major industrial center, specializing in leather products, surgical instruments, diesel engines, pharmaceuticals, steel rolling mills, textiles and sports goods. There are at least 264 tanneries, 244 leather garment producing units, 900 leather sports goods producing units, 57 rice husking mills and 14 flour mills in the city.

155. The history of industrialization of Sialkot is very old. The Damascene craftsmen of Sialkot (koftgars or koftars) were famous during the Mughal era for their fine swords and daggers. Papermaking in Sialkot dates back to the time of the Mughal Emperor Akbar

which was famous all over the world. Brick making was another historic skill of the people of the Sialkot and those bricks were known as the "Sialkoti Bricks" throughout South Asia. Most of the states in the South Asian region relied on the slender but strong Sialkoti bricks lanateer for the erection of forts, castles, monuments, public buildings, infrastructure construction, etc

156. Nowadays, Sialkot is famous all over the world because of its sports equipment and Surgical Instruments manufacturing industry. The most successful sports manufacturing firms now have international collaborations with the well-known sports brands like Adidas (Germany), Puma (Germany), Nexo Sports (Canada), Nike (USA), Dita (UK), Mikasa Sports (Japan) and Slazenger (UK). In the recent past, however, lack of modernization and allegations of child labor usage have resulted in a loss of market share to the new entrants in the business-like Thailand, Korea and China. The Sialkot Chamber of Commerce and Industry has now almost controlled the incidents of child labor usage within the industry with the collaboration of the United Nations (ILO). Most of the companies have adopted the ISO standards.

157. The facilities of a dry port and recently built airport have contributed significantly towards its economic growth and Sialkot is now the third largest economic hub in Punjab after Lahore and Faisalabad. It is commercially linked with the Lahore Stock Exchange through its Sialkot branch, known as the Sialkot Trading Floor (STF). The State Bank of Pakistan and the Export Promotion Bureau of Pakistan has branch offices in Sialkot. After Karachi, Sialkot is Pakistan's second largest source of foreign exchange earnings through its exports and remittances from the overseas manpower. For the past several decades, the manufacturers and exporters of the city have been awarded the annual National Exports Award by the Federation of Pakistan Chambers of Commerce and Industry. Sialkot has an Industrial Estate and an Export Processing Zone. Another Export Processing Zone is planned along the Sialkot Lahore Motorway. The per capita income of Sialkot is ranked among the highest in Pakistan.

4.3.1 Land Use

158. Land uses in Sialkot City are mixed, and in many cases incompatible. Sialkot would benefit from stronger land use controls, to prevent potentially harmful activities from being located near residential areas and vice versa. Sialkot has very few green areas or parks, with the most prominent being Gulshan-e-Iqbal park, off Narowal Road, a park in the Cantonment and the stadium. There is a need for more open spaces, more space for industrial activities and a betterdefined road network, in both core city and contiguous areas.

159. Eleven arterial roads radiate out from the Sialkot City center and link it with surrounding agricultural areas, other cities and Sialkot International Airport which lies about 20 km to the west of the City Centre. The airport road also connects to the Dry Port and proposed new Tanneries' Industrial Estate. This may become Sialkot's major growth direction.

160. Industries and housing estates have developed in a ribbon pattern along all of the north, west and south radial roads. Agricultural communities close to the roads and to industries are fast becoming urbanized:

4.3.2 Industrial Land Use

161. Industries have developed in a ribbon pattern along all of the north, west and south radial roads, as have housing estates. Agricultural communities close to the roads and to industries are fast becoming urbanized. Whereas industrial land uses within the central city are scattered throughout the area in Wazirabad Road and in the small Industries estates along Haji Pura, Daska, Emanabad, Narowal, Defense, Kullowal roads and north of the Railway Station. Commercial land uses, once concentrated in the area around the fort, are now found in outlying areas such as Defense Rd., Paris Rd., Saddar in the Cantonment and along major roads.

162. There are about 3,000 large, medium and selected small industries in Sialkot District, some located in the central city areas and many along the arterial roads leading out of the city. Together, they employ about 22,300 persons. Industries located along Gujranwala Road include Redo factory, Micro Corporation, Europlus, Saga Sports, Taj Mahal Factory, Phonix Cutlery, Remix Factory, Tata Sports, Motor Bike Apparel, numerous leather goods factories, Awan Sports, Taylon Industries, Pakol Industry and many more. Sambrial Road has significant tanneries along it, particularly between the two canals, east of the Dry Port. On Pasrur Road, there are mixed land uses along the segment closer to Sialkot urban area, but there are many rice mills along the outer segments of this road. There are however no significant developments along Eminabad Road and Zafarwal Road outside urban limits.

163. There is an industrial complex in Sambrial, in vicinity of the airport. This includes an export processing zone, a dry port and a number of industries around it and all along Wazirabad Road, which passes through Sambrial. These industrial developments, as stated earlier, are near the airport. An industrial estate for tanneries is also proposed near the airport. For this purpose, an area of 155 hectares (384 acres) has been acquired

4.3.3 Commercial

164. The city has a number of commercial areas including the area immediately north of the Fort. In addition to the older, more traditional areas high-end commercial, financial and related activities have been developed, making the city, once single-centered on the commercial areas around the fort, now multi-cantered.

4.3.4 Settlement Patterns

165. Settlement in Sialkot started with the 5,000-year-old fort on the central hill and has proceeded to expand in a more or less organic, low-rise manner since. The only formally planned part of Sialkot is the Cantonment Area. The traditional rural settlement pattern of tightly developed compact villages, chaks, have had a significant influence on Sialkot's urban form and settlement patterns as they have become absorbed into the main urban area.

166. The dominant and most problematic current settlement pattern is an unplanned and uncontrolled sprawl. This takes three main forms:

- Individual industrial developments, primarily along major traffic arteries;
- Small-scale commercial or individual houses developed in an ad hoc manner, and
- Larger scale "housing societies" where significant sized pieces of land are converted from agriculture to multi-unit private residential development. These again occur without planning approval.

The **Table 4.13** below presents the areas and proportions of various land uses in Sialkot.

Table 4.13: Land Use Distribution in Sialkot

Sr. No.	Land Use	Area		% of Total Area
		Acre	Sq.km	
1	Residential	1836.81	7.44	46.0
2	Commercial	363.44	1.47	9.1
3	Agricultural	169.32	0.69	4.2
4	Public Buildings	151.96	0.62	3.8
5	Religious	38.1	0.15	1.0
6	Education	87.48	0.35	2.2
7	Health	52.05	0.21	1.3
8	Industry	322.36	1.31	8.1
9	Graveyard	91.02	0.37	2.3
10	Parks/Open Spaces	256.13	1.04	6.4
11	Vacant Area	284.52	1.15	7.1
12	Unidentified Parcels	338.0	1.37	8.5

4.3.5 Institutional

167. Institutional land uses are also prominent, in areas such as Katchary Road, Beetshania Hospital, Allama Iqbal Memorial Hospital, the WAPDA offices and similar areas.

4.3.6 Agriculture, Horticulture and Industries

168. Cropping Pattern: The main crops in the sub-project area during winter are wheat, gram, barley, pulses, sesamum, linseed, barseem and green fodder. In summer, rice is the chief canal irrigated crop and is grown on 93% of the cultivated area, and the other crops during summer are cotton, maize, sawanki, sugarcane, Bajra and tobacco.

169. Horticulture: The main fruits grown in the area are jamun (Syzygium cumini), falsa (Grewia asiatica), banana, orange (type of Citrus fruit), kinno (type of Citrus fruit), fruiter (type of Citrus fruit), sweet lemon, plum, mulberry, mango, guava and pomegranate. The principal vegetables grown are onions, potatoes, ginger, egg-plant, arum, ladyfinger, spinach, mint, tomato, turnip, cloguxtida, carrot, cauliflower, bittergourd, garlic, pea, reddish, cucumber, etc.

170. Major Industry: This district has made tremendous progress in light as well as heavy industries. There are large industrial units of chemicals, food products, textiles and engineering. The engineering industry includes manufacturing of air conditioners, electric transformers, electric motors, electric washing machines, fans, etc. other industries are sugar manufacturing, paper and paperboard, tannery, steel re-rolling, pipes electric wires/ropes, edible oils and ghee, synthetic fibers, turbines and steel containers, small industrial units include lighting and scientific equipment, utensils, hosiery and non-metallic work.

171. Transportation: Sialkot district is quite developed in roads. All tehsil headquarters, major towns and villages are connected through asphalt roads. The main asphalt road runs from Sialkot to Lahore via Daska-Gujranwala. Sialkot is also connected with Islamabad via Sambrial and Wazirabad. 612 mauzas have asphalt roads, and 606 mauzas have un-metalledd roads.

172. With the exception of tehsil headquarters Daska, all other tehsil headquarters are also connected through rail with district headquarters Sialkot. Sialkot district is also served by Wazirabad-Narowal railway line.

173. Sialkot is linked by air with other countries and parts of the country through the Sialkot International airport.

4.3.7 Livestock

174. The population of cattle, buffaloes, sheep and goats was 195, 471, 42 and 137 thousand heads respectively. For poultry, there were 954 broiler, 134 layer and 9 breeding poultry farms, having a rearing capacity of 11,150, 747 and 63 thousand birds respectively. The annual availability of hides and skins is estimated at 536 thousand pieces. There exists a scope for dairy farms, animal/poultry feed and cattle/sheep/goat fattening farms.

4.3.8 Community Dynamics

175. The inhabitants in the sub-project areas fall into socioeconomic strata varying from poor to rich. The inhabitants generally were observed to have access to clean drinking water from hand pumps and motor operated pumps with the health and sanitation facilities mostly found to be inadequate. Much of the areas are dotted with agricultural fields which support both crop and livestock production, including cattle, goats and sheep. The majority of farmers within the sub-project areas appear to prefer horticulture to traditional agronomic crops. Sugarcane is raised for sugar mills.

4.3.9 Religion

176. The project area consists primarily of Muslim communities with a few minorities residing in peace and harmony. The area has no past record of communal riots or presence of any terrorist activity within the immediate area.

4.3.10 Languages

177. The mother tongue in the area is Punjabi with Urdu spoken as the national language. Majority of the communities possess basic English skills.

4.3.11 Occupations

178. The information regarding major source of income for the inhabitants was collected. According to the survey, 75 percent of population of sub-project area is associated with farming followed by labor work, shop keeping, mobile vendors, employees in private and government sectors, businessman and some of the workforce is working abroad. Moreover, a few families were associated with more than one occupation in the surveyed villages. The survey data indicated that average monthly income from farm and off-farm sources of the households was about Rs.25,645s.

179. It was assessed as a result of the survey that 70 percent of the houses of the villages in the project area were Pucca and 26 percent were semi pucca and 4 percent were reported as Kacha.

180. Sialkot has more than 3,000 factories. These provide the majority of employment. This will have a significant impact on present and future Sialkot. The following summary points are of particular interest with respect to the Sialkot District (specific data for Sialkot urban center is not available, but may be somewhat different given the industrial focus): [21]

- Overall labor force participation is below national average: 45% compared to 53.5 nationally
- Official unemployment rate is 6.6% compared to a national average of 5.3% o Share of employment in the informal sector is close to the national average at 69% for Sialkot compared to 72.9% nationally
- Informal Sector employment comprises:
- 33% in manufacturing
- 16% in construction
- 33% in trade and hospitality, and
- 10% in personal services o Lowest unemployment for all levels of education compared to national averages and other surveyed Districts
- Distribution of employment by major occupation groups is similar to national averages except with respect to “Craft and Related Trades Workers” where Sialkot exceeds all other Districts and at 33.9% is more than double the national average of 14.8%. This clearly reflects Sialkot’s unique and historical industrial activity.
- With respect to the sub-sector of “Precision, handicraft, printing and related trades workers” Sialkot excels with 20.2%, almost 4 times the national average of 5.5%, again reflecting Sialkot’s unique industries.

[21] https://www.urbanunit.gov.pk/Upload/ProjectDocument/IEE-Sialkot.pdf

4.3.12 Education

181. The literacy rates for males and females are below 40%, which is surprising considering the presence of educational institutions. There has been an increase in literacy in these communities compared to the earlier generations whose literacy rate was considerably lower.

182. Sialkot has a fairly well-developed educational infrastructure that comprises a sub-campus of the Fatima Jinnah Women University, a sub-campus of the Virtual University of Pakistan, 8 Degree Colleges for Women, 5 Degree Colleges for Men, 2 Cadet Colleges, 6 Commerce Colleges, one Law College, one Medical College, one Homeopathic Medical College, one Nursing School, one Para- Medical School, one Poly-Technic Institute, with numerous Inter Colleges, Higher Secondary Schools and over 250 High Schools. The University of Engineering Sciences and Technology (UEST) was recently established in collaboration with the Royal Institute of Technology, Sweden on the Sialkot Lahore Motorway and will also incorporate the development of a Technology Park.

4.3.13 Health Care

183. At district headquarters Sialkot, there is a civil hospital known as Allama Iqbal Memorial Hospital, a civil Hospital for women, a Mission Hospital, a police hospital, district Jail Hospital and a combined Military Hospital in Sialkot cantonment. There is a civil hospital at each Tehsil headquarters of the district. At Daska, there is an eye hospital. There are tuberculosis clinics at Sialkot and Daska, Allama Iqbal Sialkot hospital and WAPDA dispensaries in Sialkot. Doctors from Gujranwala visit this hospital thrice a week.

4.3.14 Energy Supplies

184. Almost all villages in the sub-project areas are connected to the WAPDA grid. Unfortunately, Sui gas connections are very rare while the remaining communities are forced to use LPG cylinders or firewood. Some poor communities also use cow dung for cooking purposes.

4.3.15 Communication

185. Majority of the community members possess cellular phones. PTCL line is present in the project areas but is not used commonly except in Public Call offices (PCOs). Some youth is IT literate and use desktop computers and have access to

the internet. Postal service is available in all villages in the sub-project areas. On special occasions, messages are also conveyed through word of mouth or on mosque loud speakers. Less than 10% of the community members have televisions at home while over 60 percent of the communities use radios to stay updated.

4.4 Archaeological and Cultural Heritage

186. No archaeological or cultural heritage has been observed during the surveys and neither was it reported. However, if at any stage any archaeological or physical heritage is discovered, it shall be managed as per established protocol from the department of Museum and Archaeology, GoP as per the 'Chance find' procedures.

187. The old city of Sialkot is a great center of Punjabi culture with many important historical and religious sites and buildings amongst the fascinating labyrinth of narrow streets and crowded bazaars.

188. The centuries-old historical Sialkot fort still remains the victim of un-ending negligence of Sialkot Tehsil Municipal Administration (TMA) and archeology department, as this crumbling ancient fort has illegally been surrounded by the encroachers by raising their encroachments, badly damaging the natural beauty of this fort.

189. Although the offices of Sialkot district government and Sialkot Tehsil Municipal Administration (TMA) are located in this Fort since long, but the Sialkot district government and TMA have never bothered to feel the need of maintenance of this fort, besides, remaining failure in making some direly needed effective measures to preserve and protect this rich heritage for future generation.

4.5 Climate Vulnerability of Sub-Project

190. The city sits over abundant shallow and deep groundwater aquifers that benefit from the Chenab River flows to the northwest, and the Marala-Ravi Link Canals flow to the west. The groundwater is used and extracted via wells by both the city water supply system and inhabitants for their water supplies. The water is pumped directly from tube wells to supply pipes. The aquifer is recharged from the Chenab River, which is located some 20 km north-west of the centre of Sialkot and from the water channels and bodies within the city. The water channels were

originally seasonal water courses but now carry wastewater from the city throughout the year. Local water bodies are heavily polluted.

191. The current water demand is 19 million Gallons per Day (MGD) for Sialkot. Population growth will dominate the future water demand. However, temperature has additional effects on water demand. Significant correlation exists between temperature and water consumption. A research conducted for Sunshine Coast, British Columbia, Canada, indicates that water consumption will increase by an average of 34 L/day per capita, which is about 9 gallons per capita per day (gpcd) for every 1°C increase in average daily temperatures during summer (July and August) (Staats, 2014). Based on the conservative water consumption of 32 gpcd at present, the water demand of Sialkot is projected to increase by 2030.

192. By the year 2035, the population growth will lead to water demand increase by 57% for Sialkot, without considering the climate change. Climate change will potentially have significant impact on the water demand. Further 17 to 39% more water may be needed by 2035 due to the temperature increase (mid-range projection is about further 26% increase, or a total of 83% increase from the baseline for Sialkot).

Impact assessment — Supply

193. The water supply of Sialkot relies completely on groundwater. Sialkot is situated in the Upper Rechna Doab bounded by the Ravi and Chenab rivers. The city is traversed by three seasonal streams: Aik Nullah to the south, Bhaid Nullah between the Cantonment and the city, and Pahlu Nullah to the north of the Cantonment. Water is pumped from tube-wells directly to a supply system comprising distribution pipes. Overhead water storages exist but do not functional and have not been used.

194. The groundwater aquifer is recharged from three sources: the Chenab River, which is located some 20 km northwest of the city; from the water channels and bodies within the city, which are heavily polluted; and to a lesser degree from rainfall.

195. Clearly, the Chenab River and the irrigated farmland are the two biggest contributors to the aquifer. Because some of irrigation water is from groundwater itself, the Chenab River becomes the most important recharge source for the groundwater, which should at least contribute more than half of the groundwater recharges. Therefore, an understanding of climate change impact on Chenab River

discharge is needed in order to assess climate change impact on the water supply at Sialkot.

196. Chenab River is one of the largest tributaries of the Indus River. The source of Chenab lays in Lahul and Split district in Himachai Pradesh India. Above the rim station Marala, the Chenab flows in a rugged and hilly terrain and has no major dam or headworks, therefore it maintains a free flow at Marala headworks. The total catchment area upstream of Marala is nearly 28000 km^2. Due to the high altitude in its upper catchment, water from snow and glacier melt makes significant contribution to the Chenab River discharge. Using a water balance approach, Singh et al. (1997) estimated that the average snow and glacier runoff contributes 49% to the annual flow of the Chenab River at Akhnoor.

197. Hence, the future status of glacier is of critical importance to the groundwater resource to Sialkot and nearby region. Studies have shown that, near the river's source, in mountains in the Indian-administered state of Jammu and Kashmir, the glaciers are thinning at an alarming rate of 0.7 m/year (Kääb et al., 2012). Western Himalayan glaciers are projected to retreat for the next 50 years initially causing increase of Indus River flows. Then, the glacier reservoirs will be empty, resulting in decrease of flows by up to 30% to 40% over the subsequent fifty years.

198. The impacts of climate change on the declining glacier mass on the Indus River discharge will be more substantial compared to the other river systems in the region, because of the high proportion of the Indus River discharge derived from melt water. The hydrological modelling revealed that late-spring and summer flows of the Indus River are expected to decrease significantly by around 2050 and in subsequent decades (Hewitt, 2005; Immerzeel et al., 2010). It is suggested that the current trends of glacial melt and potential climate change may cause the Indus River to become seasonal rivers in the near future (Immerzeel et al., 2010). No study has been conducted specifically for climate change impact on the glacier melt and the Chenab River discharge. Nevertheless, given almost half of the Chenab River discharge is from glacier and snow melt, it is expected that the climate change is likely has a similar impact effects on its discharge as the Indus River.[22]

199. The climate change will likely impact on the groundwater recharge in Sialkot region through its impact on the glacial melt and then the Chenab River discharge. Although quantitative impact consequences are not available and may require further

[22] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0165630

detailed research, it is almost certain that the discharge will reduce in the long term because of the shrinkage of the glacier, particularly in the second half of this century.

200. It should be noted that the rainfall in the region is projected to increase. By 2035, the annual rainfall around Sialkot area will increase by 4.8%, based on the mid scenario projection, with an uncertainty range of 3.7 to 10.5%. It is unknown whether the rainfall increase will lead to an increased rainfall recharge to groundwater.

201. The reasons are twofold: at first, part off the rainfall increase becomes surface runoff and contributes to the Chenab River and other water bodies. Secondly, the rainfall increase is accompanied by a temperature increase, which will result in evapotranspiration increase and hence reduce the volume of recharge water.

202. Nevertheless, the rainfall contribution to the groundwater is much less than the Chenab River, so the combined effects from the climate change impact is most likely pointing to a continuing groundwater resource depletion. Furthermore, it has been reported that the groundwater has been exploited above its safe yield (up to 400 mm more) already and a slight water table drop has already been observed.[23]

203. In summary, climate change will likely have negative impact on the groundwater recharge for Sialkot. The analysis of water consumption revealed that there is supply surplus in Sialkot based on present water production of 29 MGD for Sialkot. However, the supply may just barely meet the demand by 2035 for Sialkot. The gap will further increase in the long term when population keeps growing and climate change impact effects become even more pronounced.

[23] https://www.mdpi.com/1660-4601/13/11/1051/htm

5 Analysis of Alternatives

5.1 Overview

204. The scope of works for the proposed WWTP focused activities in North zone of Sialkot city. consist of developing of a new WWTP. The installation of this infrastructure is based on detailed feasibility assessments focusing on assessing the city requirements with regards to wastewater and then determining the most suitable and effective alignment for laying the required infrastructure.

5.2 'No Project' Option

205. At present, Sialkot city is urgently in need of a WWTP due to the following existing situation:

- Presently, no treatment plant is available for treatment of wastewater in the project area of Sialkot City.
- Raw sewage is being directly disposed of into the canals, seepage drain and in agricultural fields in outskirts of the city. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;
- Disposal of untreated wastewater into water bodies/ agriculture fields is causing contamination of the water and food chain and several associated environmental and health issues;
- Many areas have no final disposal points. The disposal problem becomes more severe when the farmers do not need raw sewage for their crops(s) during raining season and certain period(s) of year when water is not required for crops.

Thus, the proposed scope of works for development of the WWTP need to be implemented on an urgent basis and the 'No Project' option is not viable and cannot be considered further.

5.3 Selection of Wastewater Treatment System

206. The wastewater treatment facilities have been selected after taking due consideration of the pertinent technical, operational and economic factors, limitations and constraints. The key factors, which govern the choice of the treatment system, are listed and described below:

- **Nature and Strength of Wastewater**

207. The applicable physical, chemical and biological treatment processes are primarily governed by the nature of pollutants to be removed and their strengths in the wastewater. The treatment system selected shall ensure the required pollutant removal efficiencies.

- **Physical Constraints**

208. Physical constraints, principally being the area available and the topography of the plant site with reference to the system hydraulic requirement, govern the selection of the treatment technology.

- **Cost**

209. The system selected should be the least costeffective alternative, keeping in view both capital as well as operational costs, within the range of technically feasible options.

- **Operational Skills**

210. Skills required for the routine operation and maintenance of the treatment system should be available locally, with only a minimum of training. The proposed system shall have a relatively easy of operation and maintenance procedure.

- **Mechanical Equipment**

211. The selected system shall be such that minimum mechanical equipment needs to be provided. Unnecessary mechanical equipment should be avoided. The system should be designed such that maximum amount of mechanical equipment should be of local manufactured locally, where possible.

- **Nuisance**

212. The degree of colour, odor and noise shall be below the nuisance thresh-hold, especially, with reference to the proximity of the treatment system to the build-up areas.

213. A detailed technical and financial analysis was carried out for the proposed WWTP by considering the different wastewater treatment technologies. The technologies that were considered were as follows:

214. The qualitative analysis and cost comparison of alternative treatment technologies is presented as **Table 5.1** below.

215. **Activated Sludge Process (ASP):** Activated sludge process is the biological treatment, in which aerobic microorganisms present in wastewater, use the colloidal and dissolved organic matter of the wastewater, for their multiplication and growth, with the help of oxygen thus converting them into readily settleable biomass. Generally, the required oxygen supplies are maintained by forced supply of air to the wastewater in the aeration tank. The aerated effluent is then allowed to pass through a secondary settling tank to separate the biomass or the “activated sludge”. A part of the "activated sludge" is recycled to the aeration

tank to maintain optimum microorganism concentrations. The remaining secondary sludge is removed from the system periodically; dewatered and dried; and disposed of.

216. **Trickling Filter Process (TF):** In this process, the settled wastewater is allowed to trickle down over a circular deep bed of coarse aggregates filter. The microbial film, developed on the surface of aggregates over time, treats the wastewater. A part of this film, washed away by the hydraulic action of trickling wastewater, is separated in secondary clarifier, in form of humus sludge, disposed of after sludge treatment.

217. **Aerated Lagoons (AL):** Aerated lagoons are completely mixed basins, with detention periods, ranging from 2 to 6 days, in which wastewater is generally treated on flow through basis (without solids recycling), with forced aeration. The aerobic suspended biological flocs, responsible for the waste conversion, closely resemble to that of activated sludge process. Area requirements are in between those of the oxidation ponds and activated sludge process.

218. **Waste Stabilization Pond System (WSP):** Waste Stabilization ponds are large shallow basins, in which raw wastewater is treated entirely by natural processes, involving both algae and bacteria. They are the most important method of wastewater treatment in hot climates. However, since the rate of oxidation is slow so large areas are required for their construction. Their specific advantages are simple operation and no sludge management problem.

Table 5.1: Comparison of Alternative Treatment Technologies

S/No.	Parameter	ASP	TF	AL	WSP
1	**Qualitative Comparison incl. Environment related Parameters**				
a	Area requirement	Low	Moderate	Moderate	Large
b	Process Mechanical Equipment	Yes	Yes	Yes	No
c	Capital Construction Cost	High	High	High	Moderate
d	O&M Cost	High	Moderate	High	Low
e	Process Energy Requirement	High	Moderate	High	Nil
f	Operational Supervision & Control	High	High	High	Low
g	Quantities of Sludge produced	High	Moderate	High	Low
h	Daily Waste Sludge Disposal	Yes	Yes	Yes	No
2	**Cost Comparison**				
a	Capital Cost (incl. Land Cost) – Million PKR	5735	8315	4588	3322
b	Annual O&M Cost –	750	650	775	40

	Million PKR				
c	Area Requirement - Acres	45	54	113	230

Recommendation for Proposed Treatment Technology

219. In view of above technical and financial comparison of treatment technologies and availability of land in outskirts of Sialkot City, Waste Stabilization Ponds (WSP) are recommended in Master Plan Report for the proposed WWTP.

220. WSPs are large earthen basins in which raw wastewater is treated entirely by natural process, involving both algae and bacteria. They are amongst the most important methods of wastewater treatment in hot climates. However, since the rate of oxidation is slow, large areas are required for their construction. Their specific advantages are simple operation and low operation & maintenance costs. Quantities of sludge produced are less, due to long stabilization periods and no daily waste sludge disposal is needed. The ponds need to be de-sludged after very long operational durations of the order of 2-3 years.

221. The proposed WSP system is recommended keeping in view the following key factors:

- It is established that local municipal bodies of Punjab, at present or in near future, would not be in a position to afford the high recurring operation & maintenance costs (mainly owing to high electric energy requirement), associated with the treatment systems other than waste stabilization ponds. Consequently, provision of any of the mechanized systems, would, ultimately lead to non-operation of these treatment plants and mere wastage of the capital investments made on this account.
- Mechanized treatment systems invariably need a higher level of operational skill, responsibility, supervision and control, for their proper functioning, which under the prevailing conditions is envisaged to be difficult to be maintained by the local municipal bodies. Under these circumstances, the treatment systems, which are relatively easy to monitor, operate and maintain need to be adopted. Oxidation ponds are almost self-operating and do not need much operational intervention, for their proper functioning. Ease of operation, maintenance, monitoring and control are their principal characteristic.
- Climatic conditions in the Punjab, in terms of high ambient temperatures and longer durations of intense solar radiation, which enhance microbial activity and photosynthetic production of algal oxygen, favour the selection of oxidation ponds.
- In contrast with mechanized treatment systems, waste stabilization pond systems do not have any permanent structure, except for wastewater screening and pumping station and plant building, if any. Consequently, they offer a much higher degree of flexibility in terms of system change in future. If in the future, the conditions governing the selection

are changed, the land used for ponds can easily be reclaimed and put to other urban uses and a mechanized treatment system with much less area requirements can be installed in its place.

5.4 Options of Reuse of Treated Effluent for Agriculture

222. For reuse of treated effluent for agricultural purposes, following options were considered:

223. **Reuse in nearby Agriculture fields under gravity:** Option of direct reuse of treated effluent for irrigational purposes in nearby agriculture area under gravity by using hydraulic head available in WWTP is also evaluated. For this purpose, in nearby available agriculture area, network of channels, which will transfer the treated effluent to the agriculture fields, was marked by considering existing roads and pathways. Therefore, treated effluent cannot reach to agricultural fields for irrigation under gravity. In view of above, to carry the treated effluent to agriculture fields, lifting of treated effluent through pumping will be required. Therefore, option of treated effluent reuse under gravity was not considered for the project.

224. During the analysis, it is found that ground level of nearby agriculture fields are 1 – 5 ft higher than the WWTP Site which make it impossible to carry the treated effluent to agriculture fields under gravity and lifting of treated effluent through pumping will be required which will impart reasonable capital and operational costs. Apart from hydraulic aspect, agricultural aspects i.e. crop patterns, ground water table, climatic data and availability/continuation irrigation network (water inlet structures (Mogha) and water courses) were also considered for evaluation of this option. Based on the agricultural aspects, irrigation of nearby areas by treated effluent has following limitations:

- The future beneficiary area that might be irrigated with treated wastewater lies at higher elevation where gravity flows are not possible. Application of water to field areas is only possible through pumping. It is anticipated that huge expenses will occur on water pumping.
- The GIS studies indicate that the beneficiary areas are fragmented rather than consolidated. The gross area constitutes a blend of urban areas, infrastructure and crop areas. Further there is no existing irrigation system as tube well irrigation prevails. So the irrigation with treated water will require the development of a new irrigation system to convey water from wastewater treatment plant to agricultural fields.
- There is shallow water table depth in the beneficiary areas. Local farmers have adopted rice - wheat cropping pattern which is best suited under prevailing shallow water

table conditions. It is hard to grow cash crops like vegetables and orchards on such soils. It means that the land use potential is confined only to limited crops.

- The existing ground water of beneficiary areas is sweat. There may be preferences of locals to abstract their own shallow and sweat water rather than purchasing treated water. Shallow water pumping costs less than pumping from WWTP and conveying to distant agricultural areas.
- The available area that might be irrigated is only 3,200 acres, there is no option to have vast agricultural fields which may be served with treated water. For irrigation of 3200 acres area, only 20 to 25 cusec treated effluent will be required on seasonal basis which would be about 30-35% of total available treated effluent (68 cusec) and remaining will have to be disposed of into Palkhu Nullah/ MR Link Canal.

225. In view of above given hydraulics and agricultural limitations, reuse of treated effluent for irrigation of nearby areas under gravity would not be possible and require pumping of treated effluent and construction of irrigation network which would have huge cost impact and financially not feasible option. Therefore, this option is not considered for the project.

226. **Disposal/Bypass of Treated Effluent into Palkhu Nullah:** In this option, disposal channel will receive treated effluent from treated effluent channel. It will be used to finally dispose of treated effluent in to Palkhu Nullah which ultimately joins river Chenab after covering about distance of about 43 km from WWTP North Zone site at down side of Gujrat City. The treated effluent, to be discharged into Palkhu Nullah, can be reused for irrigation at downstream of River Chenab. The disposal channel is designed to cater design peak flows. Bypass channel will originate from collection chamber and will connect with disposal channel. In case of nonoperation of WWTP especially during rainy season, wastewater flows will be diverted to bypass channel for ultimate disposal into nearby water body i.e. Palkhu Nullah.

227. Both Disposal and bypass channel are designed to cater sewerage system design flow for design horizon 2044. It is pertinent to mention that Palkhu Nullah is originally a storm water channel, however, wastewater of some of Sialkot City is being discharged into it. As per Master Plan of Sialkot City, some portion of the wastewater, which is being discharged into Palkhu Nullah, will be carried to WWTP North Zone for treatment.

228. **Disposal into MR Link Canal:** As another option, one treated effluent pumping station is proposed for WWTP North Zone. The main function of treated effluent pumping station shall be to receive treated effluent from maturation ponds through treated effluent channel and transport it to MR Link Canal for irrigation purposes in

the downstream areas for which NOC from Irrigation Department will be required. Proposed treated effluent pumping station is designed on average daily flows of design year 2044. One screen chamber, two wet well and two dry well have been proposed with four (04) pumps, Non-Clogging, Horizontal, Centrifugal type, in each dry well. All civil structures of the treated effluent pumping station are designed on average wastewater flow of 100.64 cusec estimated for year 2044. Pumping capacity of 40 cusec will be provided with 33% standby pumping capacity. Bypass arrangement has also been proposed to direct disposal of treated effluent into disposal channel which ultimately Palkhu Nullah without introducing it to the pumping station.

229. Estimated CAPEX and Annual OPEX of the proposed treated effluent pumping station is about 1,361 and 30 million rupees respectively. Construction of this effluent pumping station will be carried out in Phase-2 after approval from MC, Sialkot considering its CAPEX and OPEX and also after obtaining NOC from Irrigation Department, Punjab.

230. By considering all above given options for reuse of treated effluent for irrigation purposes, option of directly disposal of treated effluent in to Palkhu Nullah under gravity will be the most economical and feasible option considering its low CAPEX and OPEX and ease of maintenance.

5.5 Options for Biogas Management

231. The possible options considered with regards to management of the biogas to be produced during the wastewater treatment process, particularly from the APs, are as follows:

- **'Do Nothing Scenario':** In this scenario, the biogas to be produced from the WWTP, primarily from the APs, would not be utilized and would be permitted to escape, resulting in the operation of the WWTP contributing to global warming through the emission of CH4 emissions into the atmosphere as long as the plant will remain operational. In addition, the biogas produced would not be used for economic benefit by capturing it and utilizing it for some productive and economically viable use.
- **Biofuel production:** The biogas to be produced from the WWTP could be used for production of biofuel through purification of the biogas coming from the anaerobic digestion of the sludge from the WWTP with the biofuel capable of being used later on in vehicles as fuel.
- **Combined Heat and Power (CHP) Utilization:** The biogas produced can be used to generate heat and power through installation of required infrastructure such as gas turbine

to generate power which could be used for the auxiliary consumption at the WWTP with any excess power being sold to consumers.

- **Biogas Use for auxiliary and domestic consumption:** The biogas could be used for auxiliary consumption at the WWTP along with supplied to domestic consumers in the area for meeting their needs for natural gas with the added economic benefits resulting from sale of the produced biogas.

232. While the rationale to capture and use the biogas produced are indeed quite strong and worth considering, however, at present, due to the capital cost implications along with operating expenses associated with capturing the biogas produced and utilizing it for any of the options mentioned above, thus it has been agreed to proceed with the 'Do Nothing' Scenario and to permit the biogas to escape into the atmosphere.

5.6 Options for Sludge Use

233. The options that have been considered for utilization of the sludge to be produced as a by-product of the wastewater treatment process are provided below.

- **Agriculture**

234. Not only is sludge use on land the preferred option under the waste management hierarchy, but it is also usually the best practicable environmental option (i.e. objective balance of practicability, affordability, sustainability and acceptability).

- **Landfilling**

235. It is now widely accepted that landfill disposal of organic wastes, such as sludge, is not a sustainable option due to concern over gas and leachate emissions and the need to conserve landfill void for those wastes that cannot be reused or recovered. National measures vary but include limits on organic matter and the separation of municipal solid wastes. Ultimately, the only means of sludge disposal to landfill will be as ash resulting from its thermal destruction.

- **Incineration**

236. The main problem confronting the incineration process is how to reduce the high water content of the sewage sludge. Water reduction means energy demand. Raw as well as oxidises and digested sludges have a natural water content of between 92% and 99%, the sludge water being well combined with the solid particles. The separation process of the liquid and solid content can be facilitated by biological, chemical, physical and thermal means. Biological

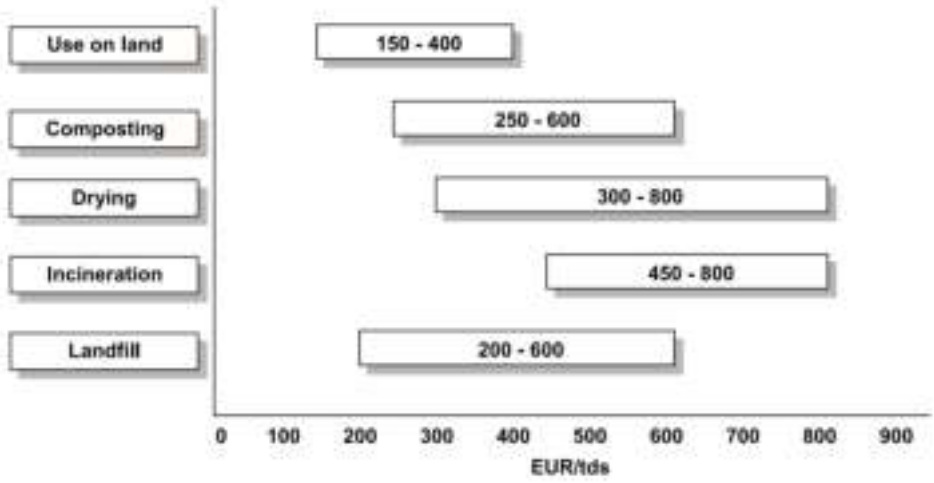
methods achieve the lowest and thermal methods the highest dewatering rates, though it should be borne in mind that the degree of dewatering depends on such factors as the type of energy (steam, electricity) used, processing pressure and reaction time.[24]

- **Composting**

237. The conversion of sludge to compost is a time and resource intensive activity which requires the dehydration of the sludge and the formation of the wind rows in order to enable the composting process to take place. The composting process itself requires a large acreage of available land for the wind rows. The logistical aspects are also cost intensive with the sludge required to be transported to the composting facility and once the compost is ready and has been packaged, it needs to be delivered to any interested customers. The composting process also leads to disease vector generation and thus required good housekeeping in order to minimize generation of any vectors.

238. The indicative costs associated with implementing any of these options are shown in **Figure 5.3** below. It can be observed that directly using the Sludge for agriculture i.e. 'Use on land' is the least cost option.

Figure 5.1: Sludge treatment and disposal costs



239. Based on the rationale provided above, till now it has been decided to use the sludge to be produced from the WWTP for landfilling since it is the least technically complicated and least resource intensive option, particularly from an economic standpoint.

[24] https://ec.europa.eu/environment/archives/waste/sludge/pdf/workshoppart4.pdf

6 Potential Environmental Impacts and Mitigation Measures

240. The analysis of potential environmental impacts in the umbrella IEE study[25] is generic and does not present any impacts specific to the proposed WWTP in north zone of Sialkot. Thus, this chapter presents a description of the environmental impacts and the proposed mitigation measures to minimize the negative impacts, if any.

241. Impact-screening matrices during each of the project phases i.e. project design, construction and operation are presented below.

6.1 Methodology for impact screening

242. The methodology for assessing the risk level associated with each potential impact is presented below.

243. Risk is assessed as the likelihood that the activity will have an effect on the environment as well as the consequence of the effect occurring. It is often described like this:

Risk = Likelihood × Consequence

Likelihood Scale

Likelihood	Definition	Scale
Certain	Will certainly occur during the activity at a frequency greater than every week if preventative measures are not applied	5
Likely	Will occur more than once or twice during the activity but less than weekly if preventative measures are not applied	3
Unlikely	May occur once or twice during the activity if preventative measures are not applied	2
Rare	Unlikely to occur during the project	1

Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities	5

[25] https://www.adb.org/sites/default/files/project-documents/46526/46526-007-iee-en_0.pdf

Major	The action will cause major adverse damage on the environment or surrounding communities	3
Moderate	No or minimal adverse environmental or social impacts	2
Minor	No or minimal adverse environmental or social impacts	1

Risk Score Table

Likelihood	Consequence				
		Catastrophic	Major	Moderate	Minor
	Certain	**25**	**15**	**10**	5
	Likely	**15**	**9**	6	3
	Unlikely	**10**	**6**	4	2
	Rare	5	3	2	1

Risk: Significant: 15-25
Medium: 6-10
Low 1-5

244. Any 'Medium' to 'Significant' risk requires an environmental management measure to manage the potential environmental risk. Judgement will be required concerning the application of an environmental management measure to mitigate low risk situations.

6.2 Design/Pre-Construction Phase

Impact Screening Matrix

245. The 'activity wise' screening of potential impacts across the two Lots during the design/pre-construction phase is provided in **Table 6.1** below.

Table 6.1: 'Activity Wise' Screening of possible Impacts during Design/Pre-Construction phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Lack of integration of IEE/EMP requirements into	Likely	Moderate	Medium

	Construction bid documents			
2	Material Haul Routes	Likely	Moderate	Medium
3	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium
4	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

6.2.1 Lack of integration of IEE/EMP requirements into Construction bid documents

Impacts

246. The bidding documents must reflect the requirement to select a qualified and experienced Contractor from the perspective of ensuring implementation of required safeguards during project development.

Mitigation Measures

247. The proposed 'Safeguards unit' that should be developed at the PMU should be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ.

6.2.2 Material Haul Routes

Impacts

248. Hauling of material can have significant impacts on the community, public safety, traffic congestion, air quality and lifespan of the Sialkot road ways.

Mitigation Measures

249. The construction vehicles hauling materials along the Sialkot roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the CIU will establish a route plan to minimize this disruption which shall be appended to the EMP.

6.2.3 Contractor's Environmental Safeguards Capacity

Impacts

250. The responsibility of the PMU in collaboration with the CIU is to review and finalize the documents relating to environmental issues. Contractors that do not possess the required capacity for safeguards management do not comply with workplace environmental, social and safety regulations.

Mitigation Measures

251. So far, local contractor firms in Pakistan working on large and medium scale environmentally sensitive projects have an unsatisfactory record for complying with workplace and environmental safety regulations. To address this, the contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures should be developed and approved by the PMU in collaboration with the CIU before the contractor commences any physical works on ground.

6.2.4 Identification of Locations for Labor Camps and ancillary facilities

Impacts

252. The duration of the construction activity for the WWTP development is expected to be 24 months and a considerable amount of work force will be engaged for development of the WWTP. As a result, worker camps will need to be developed and ancillary facilities will need to be provided such as electricity, washrooms for labor with suitable effluent and sewage disposal facilities as well as water for their everyday use for drinking and bathing etc.

Mitigation measures

253. In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc.

254. The use of proper planning while identifying locations for the labor camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.

6.2.5 Cultural Heritage & Religious Sites, Social Infrastructure

Impacts

255. No temples or religious sites are in proximity to the works to cause a nuisance.

256. The sensitive receptors already identified in the project areas are all separated from the sub-project and there will be sufficient buffer distance between the works and these facilities such that no major significant impact would be expected from the works. However, consideration should be made not to construct at night, from 7 pm onwards till 6 am in the morning, to avoid nuisances.

Mitigation Measures

No mitigation measures are required.

6.2.6 Land Acquisition and Resettlement Impacts

Impacts

257. The proposed works for the WWTP will be conducted on publicly owned land and no land acquisition or resettlement is expected.

Mitigation Measures

No mitigation measures required.

6.3 Construction Phase

Impact Screening Matrix

258. The screening of potential impacts during the construction phase is provided in **Table 6.2** below.

Table 6.2: Screening of Possible Impacts during Construction Phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Degradation of air quality due to construction works	Certain	Major	Significant
2	Potential accidents and injuries to communities in project area during construction works	Likely	Major	Medium
3	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Major	Medium
4	High noise levels from construction activities	Likely	Major	Medium
5	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium
6	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium
7	Soil Erosion and Sedimentation	Likely	Moderate	Medium
8	Soil Contamination	Likely	Moderate	Medium
9	Employment Conflicts	Likely	Moderate	Medium
10	Communicable diseases	Likely	Moderate	Medium
11	Vegetation and Wildlife Loss	Unlikely	Moderate	Low

12	Historical/Archaeological Sites	Unlikely	Moderate	Low

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

6.3.1 Air Quality

Impacts

259. The proposed WWTP development will involve large scale earth works and transporting and dumping large quantities of dry material. This will likely lead to an increase in SPM (Suspended Particulate Matter) in and around the construction zones.

260. Potential sources of particulate matter emission during construction activities include earthworks (dirt or debris pushing and grading), exposed surfaces, exposed storage piles, truck dumping, hauling, vehicle movement on unpaved roads, combustion of liquid fuel in equipment and vehicles, land excavation, and concrete mixing and batching.

261. Vehicles carrying construction material are expected to result in increased SPM levels near the haul roads. This can be of potential importance if the vehicles pass through the areas with a high concentration of sensitive receptors, such as schools and hospitals in this particular case.

262. At the construction yard, the dust levels are also expected to increase due to unloading of construction materials. It shall be ensured that most of the excavated material will be used within the project, with minimal cut and fill material to come from outside the site.

263. The quantity of dust that will be generated on a particular day will depend on the magnitude and nature of activity and the atmospheric conditions prevailing on the day. Due to the uncertainty in values of these parameters, it is not possible to calculate the quantity from a 'bottom-up' approach, that is, from adding PM10 emissions from every activity on the construction site separately. Typical and worst-case PM_{10} emissions from construction sites have been estimated[26] as

[26] Gaffney, G. and Shimp, D. 1997. *Improving PM_{10} Fugitive Dust Emission Inventories*. Sacramento, CA. California Air Resource Board. <www.arb.ca.gov/emisinv/pubs/pm10tmp.pdf>

0.27 megagram per hectare per month of activity (Mg/ha-month) and 1.04 Mg/ha-month, respectively.

Fugitive Dust Control

264. The source wise fugitive control measures are provided in **Table 6.3** below.

Table 6.3: Control measures for Fugitive Dust emissions

Source	Control Measures
Earth Moving	For any earth moving that is to take place in the immediate vicinity from the site boundary, watering must be conducted as required to prevent visible dust emissions
Disturbed Surface Areas	Apply dust suppression measures (clear vegetation only from areas where work is to commence, plant or mulch areas that will not receive traffic, construct artificial wind breaks or wind screens) frequently to maintain a stabilized surface. Areas that cannot be stabilized, such as wind driven dust, must have an application of water at least twice a day
Inactive Disturbed Surface Areas	Apply dust suppressants (clear vegetation only from areas where work is to commence, plant or mulch areas that will not receive traffic, construct artificial wind breaks or wind screens) in sufficient quantity and frequency to maintain a stabilized surface
Unpaved Roads	Water all roads used for any vehicular traffic at least twice per day during active operations and restrict vehicle speed to 20 kmph.
Open Storage Piles	Apply water to at least 80 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust or install an enclosure all along the storage piles
Track-out Control	Wash down of construction vehicles (particularly tyres) prior to departure from site.

Mitigation Measures

265. The following mitigation measures will be adopted for preservation of the environment:

- At the WWTP site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions.
- All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.

- Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions.
- Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions.
- Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin.
- Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area should be avoided.
- Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors.
- Stack height of generators will be at least 3 meters above the ground.
- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area.
- A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community.
- The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m^3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use.

Vehicular & Equipment Emissions

266. It shall be ensured that the following measures are taken to control emissions from vehicles being used in the construction activity:

- Periodically check and conduct maintenance of the construction machinery and haul vehicles.
- Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics.
- Use of catalytic converters and low Sulphur fuels.
- The stack height of generators will be at least 3 meters above the ground.
- Training of the technicians and operators of the construction machinery and drivers of the vehicles.
- Air quality monitoring at the project site during the construction phase.

6.3.2 Community Health and Safety

Impacts

267. The WWTP development will involve the use of considerable heavy machinery at the project site along with posing the risk of community members falling into trenches. In addition, the risk to commuters on the road during the construction works will be significant and thus a number of precautionary measures will be necessary to minimize the risk of possible accidents.

Mitigation Measures

268. The following mitigation measures will be implemented:

- Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for laying of pipelines and WWTP related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition.
- Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.
- Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible.
- Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.

6.3.3 Occupational Health and Safety

Impacts

269. There is invariably a safety risk when construction works for the WWTP are conducted, and precautions will be needed to ensure the safety of the workers.

270. The major safety hazards expected during the proposed activities are as follows:[27]

Accident Hazards

- Falls from height, especially when standing/working on ladders;
- Slips, trips and falls, especially while carrying heavy or bulky loads;
- Cuts and injuries caused by sharp instruments and tools;
- Hazard of suffocation from asphyxiant gases released in sewerage systems, or from oxygen deficiency, during maintenance and cleaning operations;

[27] https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_192256.pdf

- Burns caused by hot parts of equipment, steam lines etc, by release of hot water or steam;
- Electric traumas, caused by defective installations and equipment, especially portable;
- Musculoskeletal injury (especially of back), resulting from lifting and moving of heavy loads;

Physical Hazards

- Exposure to cold and/or heat stress, as a result of rapid movement between cold and hot areas;
- Exposure to UV radiation during welding operations;

Chemical Hazards

- Exposure to various chemicals, such as: adhesives, caulking compounds, fluxes (solder), hydrochloric acid, zinc chloride, tar and solvents, various greases and inorganic lead;

Biological Hazards

- Exposure to parasites, such as hookworm, ascaris, and various mites, chiggers and ticks;

Ergonomic, psychosocial and organizational factors

- Psychological stress due to dissatisfaction at work due to issues with peers, superiors etc.;
- General ill feeling as a result of work in confined spaces and development of 'sick building syndrome';

Mitigation Measures

271. The Contractor will be required to take measures such as:

- Ensuring that all workers are provided with and use appropriate Personal Protective Equipment (helmet, hand gloves, boots, masks etc);
- Follow standard practices of safety checks as prescribed before use of equipment;
- Provide on-site Health and Safety Training for all site personnel;

272. The Contractor will be required to prepare and implement an effective Worker Health and Safety Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard Worker Health and Safety measures and contractors will be bound to implement these fully.

This will include mandatory wearing of dust masks for any cement handling operations or at any area were cement dust is in the air.

273. Monitoring will be required to ensure that the health and safety plan based on contract specifications is followed. Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.

274. Based on the type of hazard applicable during the proposed works at site, the following mitigation measures as per IFC guidelines for Occupational Health and Safety (OH&S) must be implemented:[28]

Physical Hazards

Rotating and Moving Equipment

275. Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Recommended protective measures include:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. Examples of proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations. Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.

- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance.

- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.

Noise

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C). ·

- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the

[28] https://www.ifc.org/wps/wcm/connect/1d19c1ab-3ef8-42d4-bd6b-cb79648af3fe/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES&CVID=ls62x8l

average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A). ·

- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.

- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.

- Periodic medical hearing checks should be performed on workers exposed to high noise levels.

Vibration

276. Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers.

Electrical

277. Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

- Marking all energized electrical devices and lines with warning signs; ·

- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance;

- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools; ·

- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits; ·

- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas; ·

- Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited; ·
- Rubber tired construction or other vehicles that come into direct contact with, or arcing between, high voltage wires may need to be taken out of service for periods of 48 hours and have the tires replaced to prevent catastrophic tire and wheel assembly failure, potentially causing serious injury or death;
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work.

Eye Hazards

278. Solid particles from a wide variety of industrial operations, and / or a liquid chemical spray may strike a worker in the eye causing an eye injury or permanent blindness. Recommended measures include:

- Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should conform to standards published by organizations such as CSA, ANSI and ISO. ·
- Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors.
- Provisions should be made for persons who have to wear prescription glasses either through the use overglasses or prescription hardened glasses.

Welding/Hot Work

279. Welding creates an extremely bright and intense light that may seriously injure a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Recommended measures include: ·

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. ·

- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

280. Poorly trained or inexperienced industrial vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Industrial vehicle driving and site traffic safety practices include:

- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits. ·
- Ensuring drivers undergo medical surveillance. ·
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms. ·
- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction. ·
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate.

Ergonomics, Repetitive Motion, Manual Handling

281. Injuries due to ergonomic factors, such as repetitive motion, overexertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems should be minimized or eliminated to maintain a productive workplace. Controls may include: ·

- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind. ·
- Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds. ·
- Selecting and designing tools that reduce force requirements and holding times and improve postures. ·
- Providing user adjustable workstations. ·

- Incorporating rest and stretch breaks into work processes and conducting job rotation. ·
- Implementing quality control and maintenance programs that reduce unnecessary forces and exertions. ·
- Taking into consideration additional special conditions such as left-handed persons.

Working at Heights

282. Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

- Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area. ·
- Proper use of ladders and scaffolds by trained employees. ·
- Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines. ·
- Appropriate training in use, serviceability, and integrity of the necessary PPE. ·
- Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.

Physical Hazards

Air Quality

283. Poor air quality due to the release of contaminants into the workplace can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include: ·

- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects. ·
- Developing and implementing work practices to minimize release of contaminants into the work environment including:

- Direct piping of liquid and gaseous materials
- Minimized handling of dry powdered materials; o Enclosed operations
- Local exhaust ventilation at emission/release points
- Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
- Indoor secure storage, and sealed containers rather than loose storage

- Where ambient air contains several materials that have similar effects on the same body organs (additive effects).

Fire and Explosions

284. Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
  - Remote from entry and exit points into buildings
  - Away from facility ventilation intakes or vents
  - Have natural or passive floor and ceiling level ventilation and explosion venting
  - Use spark-proof fixtures
  - Be equipped with fire extinguishing devices and self closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time ·
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area. ·
- Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems.
- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment). ·
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.

Corrosive, oxidizing, and reactive chemicals

285. Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls should be observed in the work environment when handling such chemicals: ·

- Corrosive, oxidizing and reactive chemicals should be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills. ·

- Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc). ·

- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water.

Biological Hazards

286. Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures: ·

- If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents cannot be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits.

- Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum. ·

- The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs. ·

- Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in

close co-operation with the local health authorities and according to recognized international standards.

6.3.4 Noise

Impacts

287. The WWTP development will result in different construction equipment and machinery being used which will generate high noise levels at the project site and in the project area.

288. The detailed mapping of sensitive receptors has been conducted and the types of receptors and their respective distances from the work sites are provided earlier. However, any required mitigation measures that shall be proposed will be to control potential impacts on noise to prevent any long-term impacts within the project area.

289. The assessment of the noise impacts on the sensitive receptors that have been identified at various locations in the project area depend upon:

- Characteristics of noise source (instantaneous, intermittent or continuous in nature)
- Time of day at which noise occurs, and
- Location of noise source

290. Each construction phase has its unique noise characteristics due to use of different equipment items. The potential sources of noise during the preparation, construction, and worksite closure phases for the WWTP works include equipment, machinery, and transportation used for the construction activities. The equipment used for construction will be the major source of noise.

291. The construction activities will include use of generators, excavators, concrete mixing trucks and back up alarms, which can generate significant noise.

292. Since various modern machines are acoustically designed to generate low noise levels, any high noise levels that might be generated will only be for a short duration during the construction phase.

293. Depending on the construction equipment used and its distance from the receptors, the community and the workers may typically be exposed to intermittent and variable noise levels. During the day, such noise results in general annoyance and can interfere with sleep during the night. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is

clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level.

294. Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project site. The movement of heavy vehicles, loading, transportation and unloading of construction materials produces significant noise during the construction stage. However, these increased noise levels will prevail only for a short duration during the construction phase.

295. The **Table 6.4** below represents typical noise levels from various construction equipment items. It should be noted that the values indicated in the table may differ depending on the brand and age of machinery provided/used by construction company.

Table 6.4: Construction Equipment Noise Ranges, dB(A)

Equipment	Peak Noise Range at 15 m	Typical Peak Sound Level in a Work Cycle[a] at 15 m	Typical 'Quieted Equipment' Sound Level[b] at 15 m	Construction Phase		
				Earthworks	Structures	Installation
Batching plant	82-86	84	81		Y	
Concrete mixers	76-92	85	82		Y	
Cranes	70-94	83	80		Y	Y
Excavators	74-92	85	82	Y		
Front loader	77-94	85	82	Y	Y	Y
Water bowsers	85-93	88	85	Y	Y	Y
Graders	72-92	85	82	Y		
Bulldozers	65-95	85	80	Y		
Pavers	87-89	88	80	Y		
Pumps	68-72	76	75	Y	Y	Y
Diesel generators	72-82	81	77		Y	Y
Drilling machines	82-98	90	87		Y	Y
Compressors	74-88	81	71		Y	
Dumpers	77-96	88	83	Y	Y	
Dump/flatbed Truck	75-85	80	77	Y	Y	Y

Sources: USEPA, 1971; http://www.waterrights.ca.gov/EIRD/text/Ch11-Noise.pdf; http://www.lacsd.org/LWRP%202020%20Facilities%20Plan%20DEIR/4_6_Noise.pdf; http://newyorkbiz.com/DSEIS/CH18Construction.pdf

Notes:

a. Where typical value is not cited in literature, mean of the peak noise range is assumed

b. Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB reduction is assumed

296. Precise information on the type, quantity and location of equipment to be used during the construction phase is not available at this stage and will be dependent on the working methods of the selected contractors. However, preliminary calculations have been conducted to provide a general magnitude of the noise levels during various construction phases.

297. The mitigation measures listed below shall be implemented to minimize noise levels during the construction activity as far as possible.

Mitigation Measures

298. The following mitigation measures will be implemented:

- Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment. Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers.
- Excessive noise emitting equipment will not be allowed to operate and will be replaced.
- Blowing of horns will be prohibited on access roads to work sites.
- As a rule, the operation of heavy equipment shall be conducted in daylight hours.
- Construction equipment, which generates excessive noise, shall be enclosed or fitted with effective silencing apparatus to minimize noise.
- Well-maintained haulage trucks will be used with speed controls.

6.3.5 Hazardous and Non-Hazardous Waste Management

Impacts

299. In the absence of national or domestic regulations and a waste management system in the project areas, waste disposal of materials containing contents of both hazardous and non hazardous nature such as scrap wood, bricks, concrete, asphalt, plumping fixtures, piping, insultation (asbestos and non-asbestos), metal scraps, oil, electrical wiring and components, chemicals, paints, solvents etc. can potentially become a serious environmental issue, particularly with the local contractors. To avoid any potential issue, the CIU in collaboration with the PMU will need to impose adequate internal controls.

Mitigation measures

300. A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to

disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility.

301. Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused.

302. Training will be provided to personnel for identification, segregation and management of waste.

6.3.6 Camp & Batching Plant Effluent

Impacts

303. The staff and labor camps for the construction of the proposed WWTP will be a source of wastewater generated from the toilets, washrooms and the kitchen. The wastewater will not meet the national environmental standards and will therefore need treatment prior to disposal.

304. The project sites where construction is being conducted must not be treated by the project staff and/or labor as a public toilet or for disposal of camp effluent.

Mitigation measures

305. It will be ensured that no untreated effluent is released to the environment.

306. A closed sewage treatment system will treat the effluent, which will then be disposed of in a soak pit or will be used for plantation. The sewage treatment plants will be installed at each respective labor camp based on the number of laborers residing at the respective camp.

307. Water being released from any batching plant(s) must be treated as per requirements of PEQS prior to release to sewerage system/any other water body.

6.3.7 Soil Erosion and Sedimentation

Impacts

308. The majority of the works proposed for development of the WWTP may result in soil erosion and sedimentation.

Mitigation measures

309. Any drainage structures, culverts or pipes crossing the project site may need to be modified or protected and the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the construction works.

6.3.8 Soil Contamination

Impacts

310. During the project construction, spills of fuel, lubricants and chemicals can take place while transferring from one container to another or during refueling. Also, during maintenance of equipment and vehicles, through leakages from equipment and containers and as a result of traffic accidents.

311. Depending on the nature of the material, location of spill and quantity of spill, the soil can get contaminated.

Mitigation measures

312. It will be ensured that spill prevention trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil.

313. Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities.

314. Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.

6.3.9 Employment Conflicts

Impacts

315. The proposed WWTP project is not likely to create any significant permanent job opportunities. Even unskilled and semi-skilled employment opportunities that are likely to be created will be for a short period, while the biogas project is constructed. As persons with relevant skills may be available locally, people from the project area are likely to fill a significant number of the semi-skilled and skilled jobs.

316. This issue of provision of jobs can become particularly problematic if it is perceived by the local population that a significant number of construction-related jobs opportunities are not given to people from the local community. This can result in friction between local residents and construction workers from outside of the community.

Mitigation measures

317. The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project area will be informed of the employment policy in place and number of people that can be employed for this project.

318. It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of the project area.

319. The PMU will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.

6.3.10 Communicable diseases

Impacts

320. Communicable diseases such as COVID-19 and HIV may be introduced due to the immigration of workers associated with the project.

Mitigation measures

321. A communicable diseases prevention program will be prepared for construction workers or residents near the construction sites.

6.3.11 Vegetation and Wildlife Loss

Impacts

322. The project consists of a semi-urban environment located in the outskirts of Sialkot city with limited human settlements and activities and thus contains limited vegetation cover and limited wildlife of any significance as common in areas located close to urban centers.

323. No impact on vegetation and wildlife is expected since no trees are expected on the project site. There are only minor shrubs and bushes that will be cleared up, if felt necessary, during the site preparation stage of the project.

Mitigation measures

324. No hunting or killing of animals will be permitted.

325. No cutting down of vegetation or using vegetation or trees as firewood will be permitted.

6.3.12 Historical/Archaeological Sites

326. No historical/archaeological sites have been identified in the project area or project site.

Mitigation measures

327. If evidence of any archaeological remains is found during the construction activities, the excavation work will be stopped immediately, and necessary next steps taken to identify the archaeological discovery based on the ‘Chance Find’ procedures provided as **Annexure E**.

6.4 Impacts Associated with Operation of WWTP

328. The potential impacts from operation of the WWTP are provided as **Table 6.5** below.

Operation Phase

Table 6.5: Screening of Possible Impacts during Operation Phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Possible Emergencies and Plant Failure	Unlikely	Major	Medium
2	Odor generation	Likely	Major	Medium
3	Improper Disposal of Sludge	Unlikely	Major	Medium
4	Disease Vector Generation & Transmission	Likely	Major	Medium
5	Improvements in Public Health	Positive impacts expected		
6	Lower Loads on Ecosystem	Positive impacts expected		
7	Generation and use of byproducts i.e. Sludge for agriculture	Positive impacts expected		

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

……..Positive Impacts

6.4.1 Possible emergencies and plant failure

Impacts

329. Operational difficulties may be experienced at plant start up or during periods when process equipment malfunctions, particularly the equipment providing aeration to certain process areas. Even under such scenarios, the effluent discharged would be of limited volume and would still be of better quality and an improvement over the existing condition where raw and untreated wastewater is being directly discharged into the different water bodies. Chlorination of the effluent could be increased under these conditions to kill pathogenic organisms if the need for chlorination is demonstrated.

330. The frequency of such incidents is likely to remain low as long as adequate training of operator personnel is maintained and supplies of spare parts are kept available and utilized as recommended to keep all units operational at close to design efficiency levels. The most likely impact scenario would be that large quantities of sludge would accumulate in the lagoons for an extended time period, leading to untreated wastewater needing to be discharged directly into the environment until the required technical issue has been resolved. This could lead to short term adverse impacts on the fish and other biota during the period of the release and for a period of time thereafter.

Mitigation measures

331. The steps laid out in the Emergency Response Plan, provided as **Annexure D** will be implemented.

332. Operator Personnel training on a pre-defined frequency, atleast once every quarter, shall be ensured to continue refreshing of the Standard Operating Procedures laid out in the Emergency Response Plan in case of possible emergencies and/or plant failure.

333. Preventive maintenance must be ensured on a pre-defined frequency with required spare parts available at the WWTP premises to ensure quick replacement of the faulty component(s) in order to resolve the technical issue and bring the plant back into operation at the earliest.

6.4.2 Improper disposal of Sludge

Impacts

334. The sludge to be produced as a by-product of the operations of the WWTP must be disposed off in accordance with international good practices to ensure there is no environmental degradation and other unexpected impacts such as disease vector generation etc. resulting from the improper disposal of the sludge.

Mitigation measures

335. A detailed strategy will be developed on management and disposal of the sludge to be produced as a by-product of the operations of the WWTP.

336. Licensed third party vendors will be contracted on long term arrangements to manage the disposal of the compost in an environmentally beneficial manner in accordance with international good practices.

6.4.3 Odor generation

Impacts

337. It is possible that the operation of the WWTP and particularly the wastewater as it will be transported to the APs and onwards to the next lagoons for remaining stages of treatment may result in certain odor emissions.

338. Due to anaerobic digestion of solids settling at the bottom of the APs, odor is mainly caused by production of H_2S gas. Hydrogen sulfide, formed mainly by the anaerobic reduction of sulfate by sulfate-reducing bacteria. However, in aqueous solution, hydrogen sulfide is present as either dissolved hydrogen sulfide gas (H_2S) or the bisulfide ion (HS-), with the sulfide ion (S2–) only being formed in significant quantities at high pH. As the pH values normally found in well design anaerobic ponds is usually around 7.5, most of the sulfide is present as the odorless bisulfide ion.

339. Odor is not expected to be a problem if APs are designed on recommended loading rates and sulfate concentration in wastewater is less than 500 mg/l. In wastewater characterization for Si city, sulfate concentration in raw wastewater is in the range of 120-170 mg/l.

340. As APs are designed on recommended loading rate and sulfate concentrations are also within limits, it is anticipated that if APs are properly maintained and not overloaded, there will be minimum chances of nuisance being cause due to odor.

The Wind Rose for Sialkot City (provided as **Figure 4.5**) shows that the predominant wind direction is from the East and South East directions. As a result, the potential impact on the households from any airborne related impacts, particularly during WWTP operations, such as odor, would be insignificant as can be seen in the Corridor of Impact provided as **Figure 6.1** below with only vacant open fields located in this direction.

Mitigation measures

341. As part of the existing detailed design, in order to address any potential odor issue, a buffer zone of 50 feet wide all around the WWTP site consisting of thick plantation will be ensured as a precaution in case settlements do arise in the future in the potential corridor of impact. This boundary of plantation can also be observed in the WWTP layouts.

342. Furthermore, all possible measures must be implemented to curb and control the odor generation from the WWTP operations by using odor controlling equipment at the WWTP and keeping all odor generating processes in a controlled environment.

6.4.4 Disease Vector Generation & Transmission

Impacts

343. Considering the nature of the project with large volumes of wastewater being treated in the APs and subsequent ponds along with sludge being generated from the wastewater treatment process, there is a high risk of spread of different types of diseases due to disease vectors that could be generated from the stagnant water and the sludge, such as mosquitoes (including the specific mosquitoe responsible for spreading of dengue fever), flies, moths etc. that could carry the diseases to the receptors in the project area.

344. Workers and staff at the proposed WWTP facility and fields where treated wastewater or sludge will be applied, as well as operators of sludge collection vehicles, can be exposed to the many pathogens contained in sewage. Processing of sewage can generate bioaerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g., flies), rodents (e.g., rats) and birds (e.g., gulls).[29]

Mitigation measures

345. The following measures must be implemented:

- Comprehensive plan must be developed and implemented to spray chemicals into the influent drains at different frequencies throughout the year based on the seasons;
- Minimize the sludge inventory present at the WWTP as far as possible to prevent breeding of disease vectors;

[29] 3 U.S. Environmental Protection Agency, Environmental Regulations and Policy Control of Pathogens and Vector Attraction in Sewage Sludge (Including Domestic Septage) Under 40 CRF Part 503, EPA/625/R-92/013, Revised July 2003. http://www.epa.gov/ord/NRMRL/Pubs/1992/625R92013.pdf

- Cover the sludge piles present at the WWTP as far as possible;
- Cover all influent drains leading to the APs and inject pesticides and/or chemicals as required to minimize/prevent breeding of disease vectors;
- Maintain good housekeeping in sewage processing and storage areas;
- Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
- Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods;
- Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
- Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure;
- Encourage workers at WWTP to wash hands frequently.

6.4.5 Improvements in Public Health

Impacts

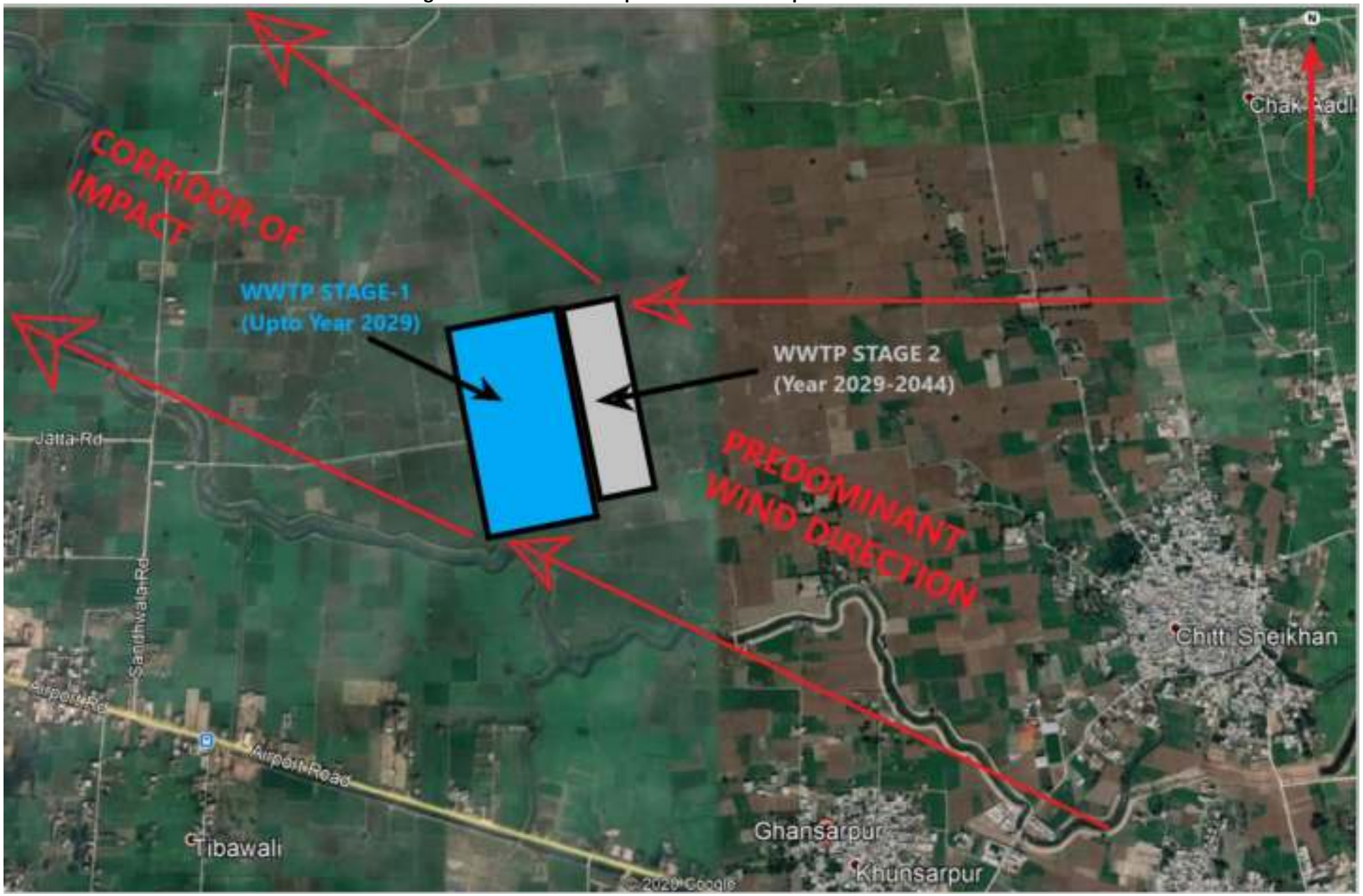
346. The operation of the proposed WWTP will result in discharge of treated wastewater that will be meeting the PEQS standards and thus the different water quality parameters will be ensured to not exceed the pre-set threshold values.

347. This in turn will ensure that a number of the key toxic and hazardous chemical concentrations in the wastewater will be controlled and will not be allowed to enter the discharge water body. This is expected to result in an overall positive impact on the public health by preventing issues such as waterborne diseases, disease vector generation, groundwater aquifer contamination etc.

Mitigation measures

No measures required.

Figure 6.1: Corridor of Impact of AirBorne Impacts from WWTP



6.4.6 Lower loads on Ecosystems

Impacts

348. Wastewater effluent is a major contributor to a variety of water pollution problems. The poor quality of wastewater effluents is responsible for the degradation of the receiving surface water body. The release of raw and improperly treated wastewater onto water courses has both short and long term effects on the environment and human health. There is a significant adverse impact on the ecosystems in case untreated effluent is disposed into the environment, resulting in negative impacts on the aquatic ecology of the receiving body with indirect impacts also taking place on the terrestrial flora and fauna present in the areas in proximity to these water courses.

349. The WWTP operation will result in treated water within the PEQS standards being discharged into the environment and thus is expected to reduce the load on the aquatic and terrestrial habitats present in proximity to the receiving water bodies in the project areas and play a major role in improving the overall ecosystems of the project areas. Significant reductions in the existing nutrient loads from the untreated wastewater are expected with majority of the nitrogen-ammonia being converted via nitrification to nitrates. This is expected to reduce ammonia concentrations to levels below those that have been reported to be toxic to different marine life and is expected to retard potential eutrophication occurring in the different water courses in which the treated wastewater will be discharged.

Mitigation measures

No measures required.

6.4.7 Generation and Use of by-products i.e. Sludge for Agriculture

Impacts

350. The sludge to be generated as a by-product of the WWTP process is expected to be used in agriculture with the WWTP management engaging into long term contracts with third parties to develop value chains for removal of the sludge from the WWTP premises and transport in an environmentally sustainable manner in accordance with international good practices to the pre-identified vendors for use in agriculture.

Mitigation measures

No measures required.

6.5 Cumulative Impacts

351. No other infrastructure works are planned to be conducted in the WWTP project area while these project works shall be conducted. Thus, no cumulative impacts are expected.

6.6 Indirect and Induced Impacts

352. The potential impact of development of the WWTP in the project area has been examined, which indicated that the existing and planned infrastructure such as water supply, wastewater collection and treatment, municipal solid waste collection and disposal would be adequate to accommodate any potential population intake as a result of the proposed WWTP development. Impacts on the environment from air emissions, traffic and community noise, and treated effluent discharge have also been assessed and have found to be acceptable and within the carrying capacities of the environmental media.

353. Thus, negative indirect and induced impacts from the proposed WWTP works are not expected.

7 Environmental Management Plan & Institutional Requirements

7.1 Introduction

354. The Environmental Management Plan (EMP) is developed to eliminate and/or mitigate the impacts envisaged at the design, construction and operation stages.

355. The detailed EMP provided in this document as **Table 7.1** ensures that this sub-project has no detrimental effect on the surrounding environment. The Plan shall act as a guideline for incorporating environmental measures to be carried out by the contractors engaged for the proposed sub-project. It shall also be used for other parties concerned for mitigating possible impacts associated with each sub-project and will form part of the Contract documents to be considered alongside the specifications. This Plan shall act as the Environmental Management and Monitoring Plan during the construction phase of the sub-project and will allow for prompt implementation of effective corrective measures.

7.2 Environmental Management Plan (EMP)

356. The EMP attached with this report ensures the following:

- Delivery of the prescribed environmental outcomes during all phases of this sub-project;
- Formulating a system for compliance with applicable legislative requirements and obligations and commitments for this sub-project;
- Ensure that project design process incorporates best practice environmental design and sustainability principles to minimize potential impacts of construction on the environment and community.
- Ensure that the construction work procedures minimize potential impacts on the environment and community.
- Develop, implement and monitor measures that minimize pollution and optimize resource use.

7.3 Objectives of EMP

357. The EMP provides a delivery mechanism to address potential impacts of the project activities, to enhance project benefits and to outline standardized good practice to be adopted for all project works. The EMP has been prepared with the objectives of:

- Defining the roles and responsibilities of the project proponent for the implementation of EMP and identifying areas where these roles and responsibilities can be shared with other parties involved in the execution and

monitoring of the project;

- Outlining mitigation measures required for avoiding or minimizing potential negative impacts assessed by environmental study;
- Developing a monitoring mechanism and identifying requisite monitoring parameters to confirm effectiveness of the mitigation measures recommended in the study;
- Defining the requirements for communication, documentation, training, monitoring, management and implementation of the mitigation measures.

7.4 Environmental Management/Monitoring and Reporting

358. During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with the City Manager – Sialkot (CMS). The CMS, using the Project Management Consultant (PMC), will supervise the implementation of the proposed mitigation measures and monitor the implementation progress in the field.

359. The specific roles and responsibilities for environmental management and monitoring are provided in **Table 7.1** below. The expected costs for implementing any required mitigation measures are provided in **Table 7.7** below.

7.5 Institutional Arrangements

360. The environmental management plan will require involvement of the following organizations for its implementation:

i. Local Government and Community Development Department (LG&CDD)

361. The Local Government and Community Development Department (LG&CDD) of Punjab will be the executing agency (EA) of the project. Under the guidance of the Project Steering Committee, LG&CDD will be responsible for the overall execution of the project.

362. A Project Management Unit (PMU) has been established within LG&CDD to support LG&CDD.

ii. City Implementation Unit (CIU) – Sialkot

363. The EA has established CIU in each of the two participating cities. The key role of the CIUs will be to support the cities in the implementation of the civil works components of the project.

7.5.1 Role of LG&CDD

364. The LG&CD Department, GoPb will:

- Act as the project executing agency (EA) for PICIIP;
- Establish a PMU, with adequate staff acceptable to ADB;
- Liaise with ADB to address any issues during design and implementation;
- Approve delegation of authorities to PMU and CIUs.

7.5.2 Role of PMU

365. The PMU will support LG&CD Department. The PMU will:

- Provide support to ADB missions;
- Coordinate activities with all stakeholders, review consultants, proposals, and provide overall guidance during various stages of project preparation;
- Act as a Secretariat to PSC headed by Chairman P&D Board;
- Manage and ensure safeguard due diligence and disclosure requirements including resettlement and environmental safeguards in accordance with ADB's Safeguard Policy Statement (2009) and government requirements;
- Manage and ensure effective implementation of the gender action plan;
- Ensure submission of all IEE requirements as per law by responsible entities; and
- Monitoring of activities in CIUs and the whole project.

7.5.3 Role of Municipal Corporation (MC)

366. The MC will:

- Facilitate land acquisition;
- Approve and implement all reforms related system, organizations, plans, and programs as required for the project including service delivery arrangements;
- Transfer assets and completed civil works to WSCs/USCs, as required for the projects and agreements; and
- Fill all vacancies in the MC, as per approved organogram and facilities required for CIU and Staff.

7.5.4 Role of City Implementation Unit (CIU)

367. The CIU will support the Municipal Corporations of Sialkot in the following aspects:

- Conduct city level progress monitoring and reporting;
- Facilitate all monitoring requirements and reporting of GoPb and ADB;
- Ensure safeguard compliance and reporting in line with loan agreements;
- Monitor and ensure effective implementation of the gender action plan;
- Monitor city level activities for reporting and compliance.

7.5.5 Role of the ADB

368. The ADB will:

- Support the coordination and administration of the project;
- Provide guidance to LG&CD Department, PMU, MCs, and CIUs on implementation issues and project design;
- Disclose all safeguards documents, and monitor safeguards implementation;
- Monitor and report project performance;
- Conduct periodic review of the project;

7.5.6 Role of Project Contractor

369. The project contractor will be responsible for following items:

- Implementation of, or adherence to, all provisions of the IEE and EMP;
- Preparation of site specific EMPs (SSEMPs) as required.
- Contractor's environmental performance will rest with the person holding the highest management position within the contractor's organization. Reporting to their management, the contractor's site managers will be responsible for the effective implementation of the EMP.
- The Contractor will be required to have qualified Environmental Specialists in their team to ensure all mitigation measures are implemented during the different development phases of the project.

7.6 Monitoring Parameters

370. A monitoring plan for the construction phase of the project, indicating environmental parameters, frequency and applicable standards is provided below as **Table 7.3** below.

371. During the procurement/pre-construction period, the monitoring activities will focus on (i) checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and (ii) checking that the contract documents' references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

372. During the construction period, the monitoring activities will focus on ensuring that any required environmental mitigation measures are implemented to address possible impacts.

373. In general, the construction impacts will be manageable, and no insurmountable impacts are predicted, provided that the EMP is implemented to its full extent as required in the Contract documents. However, experience suggests that some Contractors may not be familiar with this approach or may be reluctant to carry out some measures. For the proposed sub-project, in order that the Contractor is fully aware of the implications of the EMP and to ensure compliance, environmental

measures must be costed separately in the tender documentation and listed as BoQ items, and that payment milestones must be linked to environmental performance, vis a vis the carrying out of the EMP.

374. The effective implementation of the EMP will be audited as part of the loan conditions and the executing agency must be prepared for this. In this regard, the PMC will guide the design engineers and Contractors on the environmental aspects.

7.7 Environmental Training

7.7.1 Capacity Building and Training

375. Capacity building and training programs are necessary for the project staff in order to control the negative impacts resulting from the project construction and during its operation phase. They will also require trainings on monitoring and inspecting of such a project for environmental impacts and for implementation of mitigation measures.

376. The details of this capacity building and training program are presented in the **Table 7.7** below.

Table 7.1: Environmental Management Plan

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
Design/Pre-Construction Phase	1.1	Lack of Integration of IEE/EMP requirements into bidding documents	The proposed 'Safeguards unit' that should be developed at the PMU should be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ.	CIU	PMU	BC: during detailed designing of the sub-project
	1.2	Material Haul routes	The construction vehicles hauling materials along the Sialkot city roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the CIU will establish a route plan to minimize this disruption which shall be appended to the EMP.	CIU	PMU	BC: during detailed designing of the sub-project
	1.3	Identification of Locations for Labor Camps and ancillary facilities	▪ In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All necessary facilities and amenities shall be	CIU	PMU	BC: during detailed designing of the sub-project

			provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc. ▪ The use of proper planning while identifying locations for the labor camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.			
	1.4	Contractor's Environmental Safeguards Capacity	So far, local contractor firms in Pakistan working on large and medium scale environmentally sensitive projects have an unsatisfactory record for complying with workplace and environmental safety regulations. To address this, the contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures should be developed and approved by the PMU in collaboration with the CIU before the contractor commences any physical works	CIU	PMU	BC: during detailed designing of the sub-project

			on ground.			
Construction Phase	2.1	Air Quality	▪ At the WWTP site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions. ▪ All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations. ▪ Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions. ▪ Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions. ▪ Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin. ▪ Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area should be avoided.	Contractor	PMC, CIU	DC

Construction Phase (Continued…)			▪ Concrete plants to be controlled in line with statutory requirements and close to sensitive receptors. ▪ Stack height of generators will be at least 3 meters above the ground. ▪ Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area. ▪ A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community. ▪ The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m^3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use. It shall be ensured that the following			

			measures are taken to control emissions from vehicles being used in the construction activity: 1. Periodically check and conduct maintenance of the construction machinery and haul vehicles. 2. Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics. 3. Use of catalytic converters and low Sulphur fuels. 4. The stack height of generators will be at least 3 meters above the ground. 5. Training of the technicians and operators of the construction machinery and drivers of the vehicles. Air quality monitoring at the project site during the construction phase.			
	2.2	Community Health and Safety	▪ Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents,	Contractor	PMC, CIU	DC

			particularly children stay away while excavated areas being prepared for laying of pipelines and WWTP related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition. ▪ Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children. ▪ Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible. ▪ Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.			
	2.3	Occupational Health and Safety	1. Ensuring that all workers are provided with and use appropriate Personal Protective Equipment (helmet, hand gloves, boots, masks etc); 2. Follow standard practices of safety checks as prescribed before use of equipment;	Contractor	PMC, CIU	DC

			3. Provide on-site Health and Safety Training for all site personnel; 4. The Contractor will be required to prepare and implement an effective Worker Health and Safety Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard Worker Health and Safety measures and contractors will be bound to implement these fully. This will include mandatory wearing of dust masks for any cement handling operations or at any area were cement dust is in the air. 5.Monitoring will be required to ensure that the health and safety plan based on contract specifications is followed. Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.			
	2.4	Noise	▪ Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment. Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers.	Contractor	PMC, CIU	DC

			▪ Excessive noise emitting equipment will not be allowed to operate and will be replaced. ▪ Blowing of horns will be prohibited on access roads to work sites. ▪ As a rule, the operation of heavy equipment shall be conducted in daylight hours. ▪ Construction equipment, which generates excessive noise, shall be enclosed or fitted with effective silencing apparatus to minimize noise. ▪ Well-maintained haulage trucks will be used with speed controls.			
	2.4	Hazardous and Non-Hazardous Waste Management	▪ A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility. ▪ Licensed waste contractors will be engaged to dispose off all non-hazardous	Contractor	PMC, CIU	DC

			waste material that cannot be recycled or reused. ▪ Training will be provided to personnel for identification, segregation and management of waste.			
	2.5	Untreated disposal of effluent from worker camps and batching plants	▪ It will be ensured that no untreated effluent is released to the environment. ▪ A closed sewage treatment system will treat the effluent, which will then be disposed of in a soak pit or will be used for plantation. The sewage treatment plants will be installed at each respective labor camp based on the number of laborers residing at the respective camp. ▪ Water being released from any batching plant(s) must be treated as per requirements of PEQS prior to release to sewerage system/any other water body.	Contractor	PMC, CIU	DC
	2.7	Soil erosion and sedimentation	Any drainage structures, culverts or pipes crossing the project site may need to be modified or protected and the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the construction works.	Contractor	PMC, CIU	DC

	2.8	Soil Contamination	▪ It will be ensured that spill prevention trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil. ▪ Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities. ▪ Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.	Contractor	PMC, CIU	DC
	2.9	Employment Conflicts	1. The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project areas of Sialkot will be informed of the			

			employment policy in place and number of people that can be employed for this project. 2. It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of Sialkot city and adjoining areas. 3.PMU will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.			
	2.10	Communicable diseases	A communicable diseases prevention program will be prepared for construction workers or residents near the construction sites.	Contractor	PMC, CIU	DC
	2.11	Vegetation and Wildlife Loss	▪ No hunting or killing of animals will be permitted. ▪ No cutting down of vegetation or using vegetation or trees as firewood will be permitted.	Contractor	PMC, CIU	DC
	2.12	Historical/Archaeological Sites	If evidence of any archaeological remains is found during the construction activities, the excavation work will be stopped immediately and necessary next steps taken to identify the archaeological discovery based on the 'Chance Find' procedures	Contractor	PMC, CIU	DC

Operation Phase	3.1	Possible emergencies and plant failure	▪ The steps laid out in the Emergency Response Plan, provided as **Annexure D** will be implemented. ▪ Operator Personnel training on a pre-defined frequency, atleast once every quarter, shall be ensured to continue refreshing of the Standard Operating Procedures laid out in the Emergency Response Plan in case of possible emergencies and/or plant failure. ▪ Preventive maintenance must be ensured on a pre-defined frequency with required spare parts available at the WWTP premises to ensure quick replacement of the faulty component(s) in order to resolve the technical issue and bring the plant back into operation at the earliest.	O&M Contractor	Sialkot Waste Utility	DO
	3.2	Improper disposal of Sludge	▪ A detailed strategy will be developed on management and disposal of the sludge to be produced as a by-product of the operations of the WWTP. ▪ Licensed third party vendors will be contracted on long term arrangements to manage the disposal of the compost in an	O&M Contractor	Sialkot Waste Utility	DO

			environmentally beneficial manner in accordance with international good practices.			
	3.3	Odor generation	▪ As part of the existing detailed design, in order to address any potential odor issue, a buffer zone of 50 feet wide all around the WWTP site consisting of thick plantation will be ensured to save the surrounding population from any adverse nuisance due to odor. This boundary of plantation can also be observed in the WWTP layouts. ▪ Furthermore, all possible measures must be implemented to curb and control the odor generation from the WWTP operations by using odor controlling equipment at the WWTP and keeping all odor generating processes in a controlled environment.	O&M Contractor	Sialkot Waste Utility	DO
	3.4	Disease Vector Generation & Transmission	▪ Comprehensive plan must be developed and implemented to spray chemicals into the influent drains at different frequencies throughout the year based on the seasons; ▪ Minimize the sludge inventory present at the WWTP as far as possible to prevent	O&M Contractor	Sialkot Waste Utility	DO

			breeding of disease vectors; ▪ Cover the sludge piles present at the WWTP as far as possible; ▪ Cover all influent drains leading to the APs and inject pesticides and/or chemicals as required to minimize/prevent breeding of disease vectors; ▪ Maintain good housekeeping in sewage processing and storage areas; ▪ Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors; ▪ Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods; ▪ Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;			

			▪ Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure; ▪ Encourage workers at WWTP to wash hands frequently.			

PMC : Project Management Consultant

BC : Before Construction

DC : During Construction

CIU : City Implementation Unit

DO During Operation

Table 7.2: 'Pre-Construction' Environmental Monitoring Plan for Baseline Development

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Ambient Air Quality	To establish baseline air quality levels	CO,NO_x & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in the project area	Once	PMC
Ambient Noise	To establish baseline noise levels	Ambient noise level near receptors in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour, and then averaged	At three random receptor locations in the project area	Once	PMC

Water Quality of River Chenab	To establish baseline for surface water quality at discharge point of treated effluent into River Chenab	Water quality at discharge point of treated effluent into River Chenab	Water sample for comparison against PEQS parameters	At discharge point of treated effluent into River Chenab	Once	PMC
Groundwater Quality in vicinity of WWTP site	To establish groundwater quality in project area	Groundwater quality in project area	Water samples for comparison against PEQS parameters	At two locations around the WWTP site in the project area	Once	PMC

Table 7.3: Construction Phase Monitoring Requirements

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Noise Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level at different locations in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour at 15 m from receptors, and then averaged	At three random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, PMC

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Air Quality Dust emissions from construction vehicles and equipment	To determine the effectiveness of dust control program on dust at receptor level	CO,NO_x & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, PMC
		Visible dust	Visual observation of size of dust clouds, their dispersion and the direction of dispersion	Construction site	Once daily during peak construction period	Contractor's Environmental officer, PMC
Safety precautions by Safety workers	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Construction site	Once Daily	Contractor's Environmental officer, PMC
Soil Contamination	To prevent contamination of soil from oil and toxic chemical spills and leakages	Incidents of oil and toxic chemical spills	Visual inspections	At construction site and at vehicle and machinery refuelling & maintenance areas	Once a month	Contractor's Environmental officer, PMC
Solid Waste & Effluent disposal Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal will be undertaken at all work sites in project area	Visual inspections	At work sites in project area	Once daily.	Contractor's Environmental officer, PMC

Table 7.4: 'Operation Phase' Environmental Monitoring Plan

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Water Quality of River Chenab	To assess quality of treated wastewater being discharged into River Chenab	Water quality at discharge point of treated effluent into River Chenab	Water sample for comparison against PEQS parameters	At discharge point of treated effluent into River Chenab	Bi-annual	PMC
Groundwater Quality in vicinity of WWTP site	To assess whether WWTP operation is causing any seepage into the groundwater aquifers in project area and contaminating it.	Groundwater quality in project area	Water samples for comparison against PEQS parameters	At two locations around the WWTP site in the project area	Bi-annual	PMC

Table 7.5: Capacity Development and Training Programme

Provided by	Organized by	Contents	No. of training events	Duration	Cost (PKR)
Pre-construction Phase Monitoring Consultants/Organizations offering specialized services in environmental management and monitoring	CIU & PMU	Short seminars and courses on: Environmental Management Plan and Environmental Monitoring Plan	Two seminars for Contractor management staff and project staff	1 day	100,000
Construction Phase Monitoring	CIU & PMU	Short seminars on Environmental risks	Two seminars for Contractor	1 day	100,000

Consultants/Organizations offering specialized services in social management and monitoring		associated with construction phase. Development of Environmental Performance Indicators Occupational Health and Safety (OHS) issues	management staff and project staff dealing in environment and social issues		
Total			**200,000 (PKR 0.2 million)**		

7.8 Environmental Management Costs

377. The **Table 7.7** below provides cost estimates for 'Pre-Construction phase' monitoring while **Tables 7.7** and **7.8** provides cost estimates for 'Construction phase' and 'Operation phase' monitoring of key environmental parameters.

378. The costs associated with implementation of the EMP and the necessary mitigation measures are provided as **Table 7.9** below. The **Table 7.10** below provides the 'Capacity development and training programme' for project contractors for the proposed project.

Table 7.6: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring[30]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NOx, PM_{10}	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per reading
Contingencies			9,000	5% of monitoring cost
Total (PKR)			**189,000**	

Table 7.7: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring[31]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NOx, PM_{10}	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per reading
Contingencies			36,000	5% of monitoring cost
Total (PKR)			**756,000**	

[30] For air quality monitoring: 'Passive samplers' such as test tubes can be used or 'Active samplers' with sorbent turbes can also be used.

For noise monitoring: sampling equipment with duration greater than 1 hour can be used.

Table 7.8: Annual Cost Estimates for 'Operation Phase' Environmental Monitoring[32]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Water Quality of River Ravi	PEQS	2 (bi-annual basis)	60,000	2 readings @ PKR 30,000 per sample
Groundwater Quality in vicinity of WWTP site	PEQS	4 (bi-annual basis @ 2 locations)	120,000	4 readings @ PKR 30,000 per reading
Contingencies			9,000	5% of monitoring cost
Total (PKR)			**189,000**	

Table 7.9: Estimated Costs for EMP Implementation

Item	Sub-Item	Estimated Total Cost (PKR)
Staff, audit and monitoring cost[1]	1 person for 24 months (@ 100,000 per month)	**2,400,000**
Monitoring Activities	Provided separately in Tables 7.7 and 7.8.	-
Mitigation Measures	As prescribed under EMP and IEE.	**40,00,000**
(i) Water sprinkling	To suppress dust emissions	800,000
(ii) Solid waste collection & disposal	From construction sites (based on initial estimates)	700,000
(iii) Plantation around project boundary to control odor levels	To plant vegetation all along the WWTP boundary to limit odor emissions	15,00,000
(iv) Chemicals/pesticides to prevent/minimize disease vector generation	Chemicals to be injected into the influent streams in order to minimize/prevent disease vector generation	10,00,000
Contingencies	5% of EMP implementation cost	320,000
Total Estimated Cost (PKR)		**6,720,000**

1: To cover staff cost and expenses of Environmental Specialist for Contractor

Table 7.10: Capacity Development and Training Programme for Project Contractor(s)

Provided by	Organized by	Contents	Target Audience	Venue	Duration
Pre-construction Phase PMC offering specialized services in environmental management and monitoring	CIU & PMC	Short seminars and courses on: Environmental Management Plan and Environmental Monitoring Plan	Contractor staff	CIU Office, Sialkot	One day long training seminar
Construction Phase PMC offering specialized services in social management and monitoring	CIU & PMC	Short seminar on Environmental risks associated with construction phase. Development of Environmental Performance Indicators Occupational Health and Safety (OHS) issues	Contractor staff	CIU Office, Sialkot	One day long training seminar

8 Public Consultation and Information Disclosure

379. Details on the public consultations conducted are provided below with the pictorial evidences and persons consulted provided as **Annexure A**.

8.1 Approach

380. The following approach was adopted for conducting due diligence to assess the potential impacts from the proposed works:

- Review of available information including SPS 2009, project design components;
- Field site visits along with the design team to identify and assess project impacts;
- Public consultations with the travellers, educational & health institutions in the proximity of project site to seek their views on the project and to discuss probable project impacts and mitigation measures.

381. Public consultations included meetings and interviews with the general public and other stakeholders. The consultation was carried out in accordance with the IR policy requirements of ADB's SPS 2009 and its outcome is discussed in the proceeding sections. Consultations were also held with the PMU, Local Government Board and the design consultants.

382. In this regard, eight (3) focus group discussions and ten (10) interviews were conducted in the northern zone of Sialkot;

383. There are three villages adjacent to WWTP area in the Northern Zone of Sialkot listed below:

- Chak#Kala
- Chitti Shiekhan and
- Tonkan Wali

8.2 Information Disclosure and Consultation

8.2.1 Scope of Consultations

384. Discussions and consultations on social safeguard aspects of project were held with the educational, health institutions PMU team, CIU team, travelers, students, community in proximity of the project site, and design consultants during the month of May & June 2020. During the consultations, participants were requested to express their concerns with the proposed WWTP and suggestions or measures that can address potential consequences and enhance project benefits. During the consultation meetings, participants were informed about the WWTP, scope of the project and its various components. They were also informed about the

stakeholder's involvement and their roles and responsibilities in this project. The importance of Grievance Redress Mechanism (GRM) and the role of community in GRM was also the agenda of consultations.

8.2.2 General Response regarding construction of WWTP

385. The general response regarding WWTP can be summarized as follows:

- They considered this program of PICIIP as positive step for the development of the city as well as for uplifting the quality of life of the people.
- DPs of both villages were not agreed on the rates provided to them by the DPAC. They are ready to give their land if they get rates as per their desire.
- The Agricultural land is the only income source of DPs and where they will go in case of losing Land and also less compensate rate is provided to them.
- The project will cause pollution to the area.
- DPs raised their concerns about the assessment of compensation for land and other assets and schedule for payment.
- They were keenly interested about the project and its interventions.

8.2.3 General Response regarding water Sanitation sector

386. The general responses regarding Sanitation sector can be summarized as follows:

- They considered this program of PICIIP as positive step for the development of the city as well as for uplifting the quality of life of the people.
- The sewerage system is very bad in city.
- Blockage of sewer lines is the routine matter in the city.
- Sewer water flows in the streets.
- Smell of stagnant sewer water is really very hazardous for the inhabitants of the city.
- In rainy season, the situation becomes worst when the rainwater does not found any proper and timely drainage.
- The sewer water flows in streets and it results in disruption of traffic flow.
- This contaminated water gives rise to a number of harmful diseases.
- Silting of sewers/open drains is resulting in choking/blocking of the network in many places.
- Unplanned and haphazard sewers have been installed for the past many years resulting overflowing of the main sewers.
- Ponding problems in low lying areas during rainy season are evident.
- Non-operation/ non-function of existing disposal stations.

- Untreated sewage discharge into canals/drains and in open fields used for local and downstream irrigation may cause unhygienic conditions and potential health hazards.
- Non-availability of sewage treatment facilities.

8.2.4 Gender Responses/Issues

387. The issues discussed were as follows:

- Females also said that there should be a female in MC specifically to listen and register the complaints of females regarding the irregularity in any sewerage related issue. In this way they can easily go to MC to get the water services in a better way.
- Another opinion of females regarding the complaint registration system that it should be so smart that females can easily register their matters through online application by generating any software in this regard.
- It restricts the movements of the children outside as the parents don't let their children to play in streets spoiled with sewer water.
- Stagnant water is also causing bad and unhygienic breathing.
- They said that many infectious diseases are spreading due to the ponding of sewer water.
- They also agreed upon that people should not throw their garbage in sewer lines which ultimately resulted in blockage of sewer lines.
- Women consulted at the project site showed serious concerns about restricting their movement due to movement of labor force during construction.
- The construction contractor will make sure that the movement of the labor force is confined within the construction camp and walking/movement routes and passages of the passerby especially women/handicapped of the nearby localities are open and are not blocked.

8.2.5 Recommendations

388. The recommendations made by the stakeholders were as follows:

- Public safety should be on top priority during construction.
- The traffic should be managed properly during the execution of the Project.
- The pressure of the water should be adequate enough to accomplish all the household tasks with ease and simultaneously the sewer pipes should be capable enough to cater all the sewerage in an efficient manner.
- There should be arrangements for frequent tests to check the quality of water supply after the execution of the project so that reliability and validity of the water supply system will remain intact.
- There should be arrangements to properly segregate the water supply lines and the sewerage lines.
- As the existing water and sanitation is not in a good condition, so this sub-project should be executed on urgent basis with due diligence.
- The mechanism should be developed in such a way that the non availability of electricity should not affect the drainage system of sewerage.

- There should be awareness campaigns to guide public in a way that they may start discouraging the wastage of water and throwing the garbage in sewer lines.
- The contractor should comply with the mitigation measures proposed in the Environmental and Management and Monitoring Plan (EMMP) and HSE compliance policy.
- Contractor's activities should be confined to minimize any inconvenience to the public.
- Dust produced due to construction activities may create different health problems, therefore water sprinkling should be carried out regularly to suppress the dust emissions;
- During construction, labour force movement should be controlled so that activities of the community are not disturbed;
- The participants/representatives also stressed the need for timely completion of the project.
- The movement of the heavy machinery should be controlled to avoid harm to other associated properties/structures;
- Grievance redressal mechanism (GRM) at the PMU level should be formalized to address any complaints from the stakeholders at site.
- Awareness campaigns by using Print, Electronic and Social media are highly required to create civic sense among masses.

9 Grievance Redressal Mechanism

9.1 General

389. The ADB Policy (SPS 2009) requires establishment of a local grievance redress mechanism to receive and facilitate resolution of the Displaced/Affected Persons concerns and grievances regarding the project's social and environment performance. The measures have been identified to mitigate any potential environmental and social impacts to be caused due to implementation of the WWTP works.

390. However, in spite of best efforts, there is every chance that the individuals / households affected by the project or other stakeholders are dissatisfied with measures adopted to address adverse social impacts of the project. To address, such situation an effective Grievance Redress Mechanism (GRM) will be established to ensure timely and successful implementation of the project. It will also provide a public forum to the aggrieved to raise their objections and the GRM would address such issues adequately. It will receive, evaluate and facilitate the resolution of displaced persons' concerns, complaints and grievances about the social and environmental performance at the level of the project.

391. The GRM will aim to investigate charges of irregularities and complaints receive from any displaced persons and provide a time-bound early, transparent and fair resolution to voice and resolve social and environmental concerns link to the project.

392. The PIU shall make the public aware of the GRM through public awareness campaigns. The name of contact person(s) and his/her phone number, PMU contact numbers will serve as a hotline for complaints and shall be publicized through the media and placed on notice boards outside their offices, construction camps of contractors, and at accessible and visible locations in the project area. The project information brochure will include information on the GRM and shall be widely disseminated throughout the project area. Grievances can be filed in writing, via web-based provision or by phone with any member of the PIU.

393. First tier of GRM. The PIU is the first tier of GRM which offers the fastest and most accessible mechanism for resolution of grievances. The PIU staff for environment and social safeguards will be designated as the key officers for grievance redressal. Resolution of complaints will be completed within seven (7) working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, traffic police, etc.).

Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number will be assigned for each grievance, including the following elements:

- Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered;
- Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures);
- Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed-off.

394. The updated register of grievances and complaints will be available to the public at the PIU office, construction sites and other key public offices in the project area. Should the grievance remain unresolved, it will be escalated to the second tier.

395. **Second Tier of GRM.** The PIU will activate the second tier of GRM by referring the unresolved issue (with written documentation) to the Sialkot Waste Management Company (SWMC) who will pass unresolved complaints upward to the Grievance Redress Committee (GRC). The GRC will be established by SWMC before start of site works. The GRC will consist of the following persons: (i) Project Director; (ii) representative District; (iii) representative of the affected person(s); (iv) representative of the local Deputy Commissioners office (land); and (v) representative of the PEPA (for environmental-related grievances). A hearing will be called with the GRC, if necessary, where the affected person can present his/her concerns/issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within fifteen (15) working days. The contractor will have observer status on the committee. If unsatisfied with the decision, the existence of the GRC will not impede the complainant's access to the Government's judicial or administrative remedies.

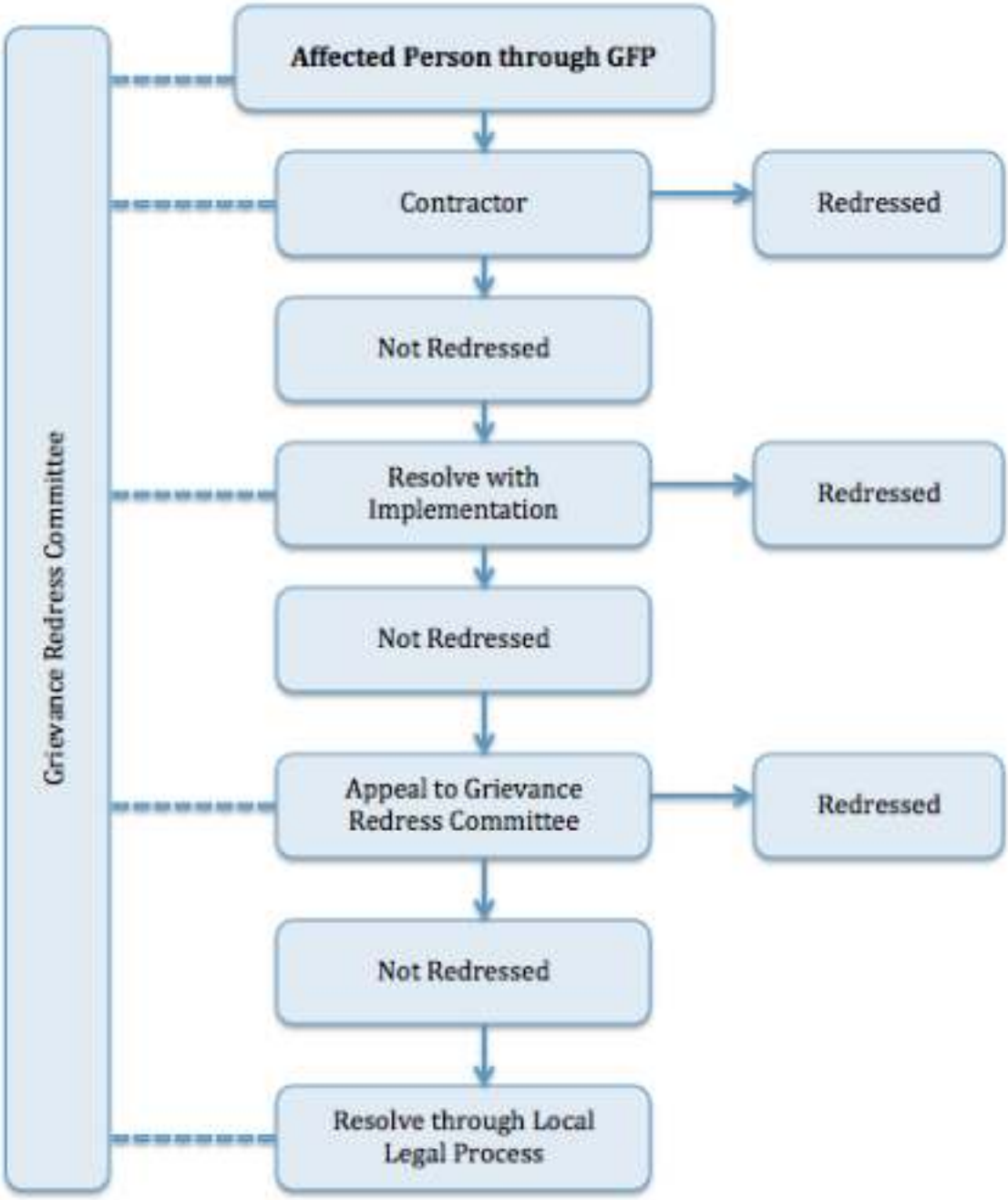
396. The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues and including dust, noise, utilities, power and water supply, waste disposal, traffic interference and public safety as well as social issues and land acquisition (temporary or permanent); asset acquisition; and eligibility for entitlements, compensation and assistance; (ii) reconfirm grievances of displaced persons, categorize and prioritize them and aim to provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC.

397. The SWMC officers will be responsible for processing and placing all papers before the GRC, maintaining a database of complaints, recording decisions, issuing minutes of the meetings and monitoring to see that formal orders are issued and the decisions carried out.

398. **Third tier of GRM**. In the event that a grievance cannot be resolved directly by the PIU (first tier) or GRC (second tier), the affected person can seek alternative redressal through the district or sub-district committees as appropriate. The PIUs or GRC will be kept informed by the district, municipal or national authority. The grievance redress mechanism and procedure are depicted in the **Figure 9.1** below. The monitoring reports of the EMP and RP implementation will include the following aspects pertaining to progress on grievances: (i) Number of cases registered with the GRC, level of jurisdiction (first, second and third tiers), number of hearings held, decisions made, and the status of pending cases; and (ii) lists of cases in process and already decided upon may be prepared with details such as Name, ID with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, closed, pending).

399. In order to provide greater clarity, the pictoral description of the GRM is provided in **Figure 9.1** below.

Figure 9.1: Grievance Redressal Mechanism



10 Conclusion and Recommendations

400. Due diligence visits were conducted to the project sites and to the project areas in general where the proposed WWTP works in North zone of Sialkot are to be conducted. Based on the findings of these visits, this IEE document in order to update the existing umbrella IEE report has been prepared.

401. Since the impact analysis presented earlier in the umbrella IEE report was quite generic and briefly covered all projects to be implemented in Sailkot, thus a comprehensive yet focused impact analysis and EMP specifically for the proposed WWTP works has been prepared as part of this IEE report.

402. The EMP contained within this IEE document is considered sufficient for issuance as part of the Contracts to the successful bidder(s) and for subsequent use during the project works for the two Lots. It should be mentioned that prior to the commencement of works, this EMP must be further updated by the Contractor for each of the two Lots into two site specific EMPs (SSEMPs) for review and approval of ADB. In these two SSEMPs, aspects such as a detailed traffic management plan, identification of locations for disposal of debris and spoil and any other details which shall become available later must be included for efficient implementation of all proposed mitigation measures and the subsequent monitoring of these measures.

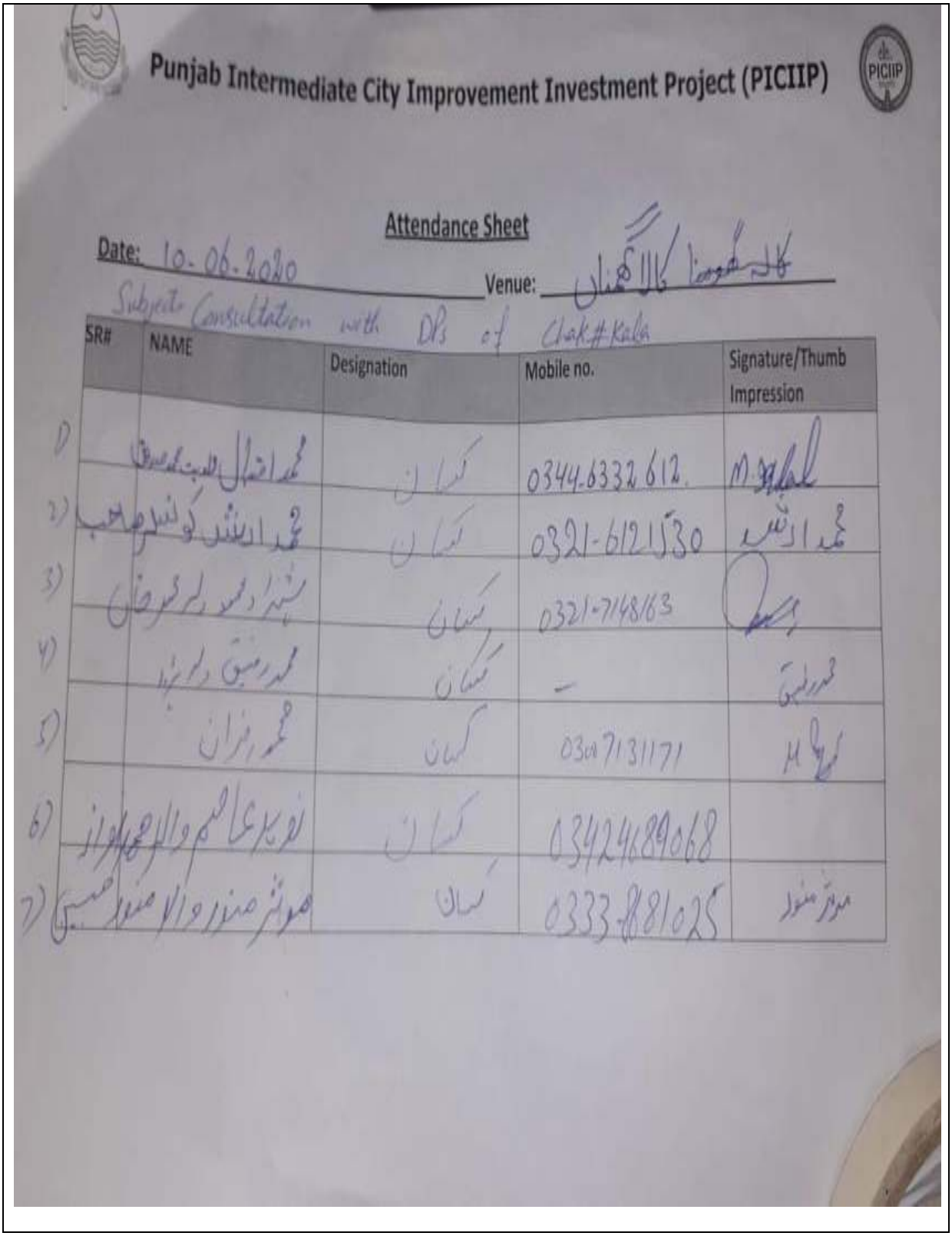
403. This IEE document is considered sufficient to proceed with commencement of the required works.

ANNEXURES

Annexure A

Photographs of public consultations

Consultation with DPs of Chak# Kala, Sialkot, Dated 10-06-2020



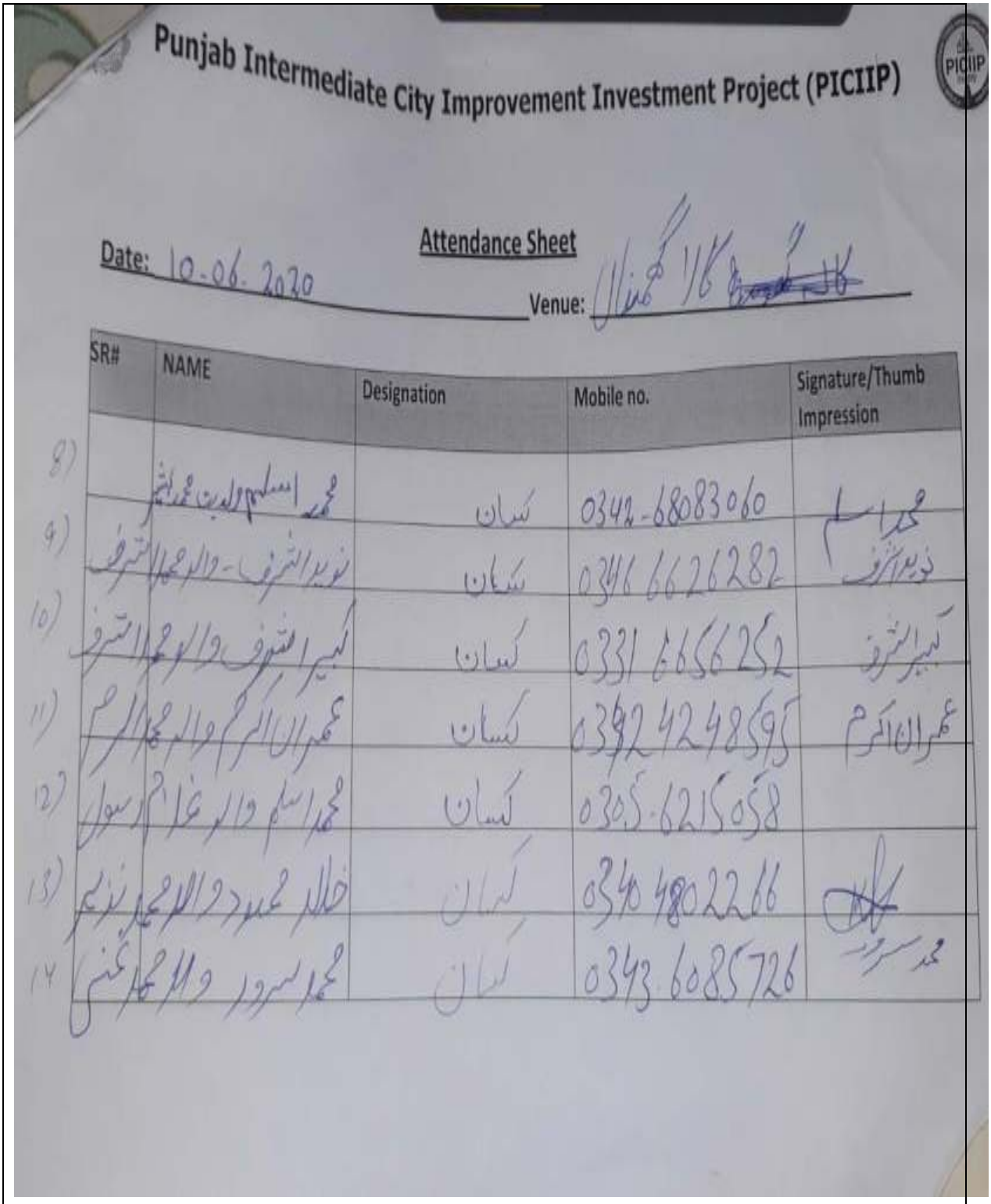
Punjab Intermediate City Improvement Investment Project (PICIIP)

Attendance Sheet

Date: 10-06-2020 Venue: [illegible] کالا گھمیاں

Subject: Consultation with DPs of Clak# Kala

SR#	NAME	Designation	Mobile no.	Signature/Thumb Impression
1)	محمد اقبال طیب المعروف	کسان	0344-8332612	M. Iqbal
2)	محمد ارشد کونسلر صاحب	کسان	0321-6121530	محمد ارشد
3)	شہزاد رسول لیر خورشن	کسان	0321-7148163	
4)	محمد رمضان ولد نبی	کسان	-	محمد رمضان
5)	محمد عمران	کسان	0347131171	
6)	نوید عالم والد محمد نواز	کسان	03424689068	
7)	صوبہ منزر والد منور حسین	کسان	0333-8881025	صوبہ منزر

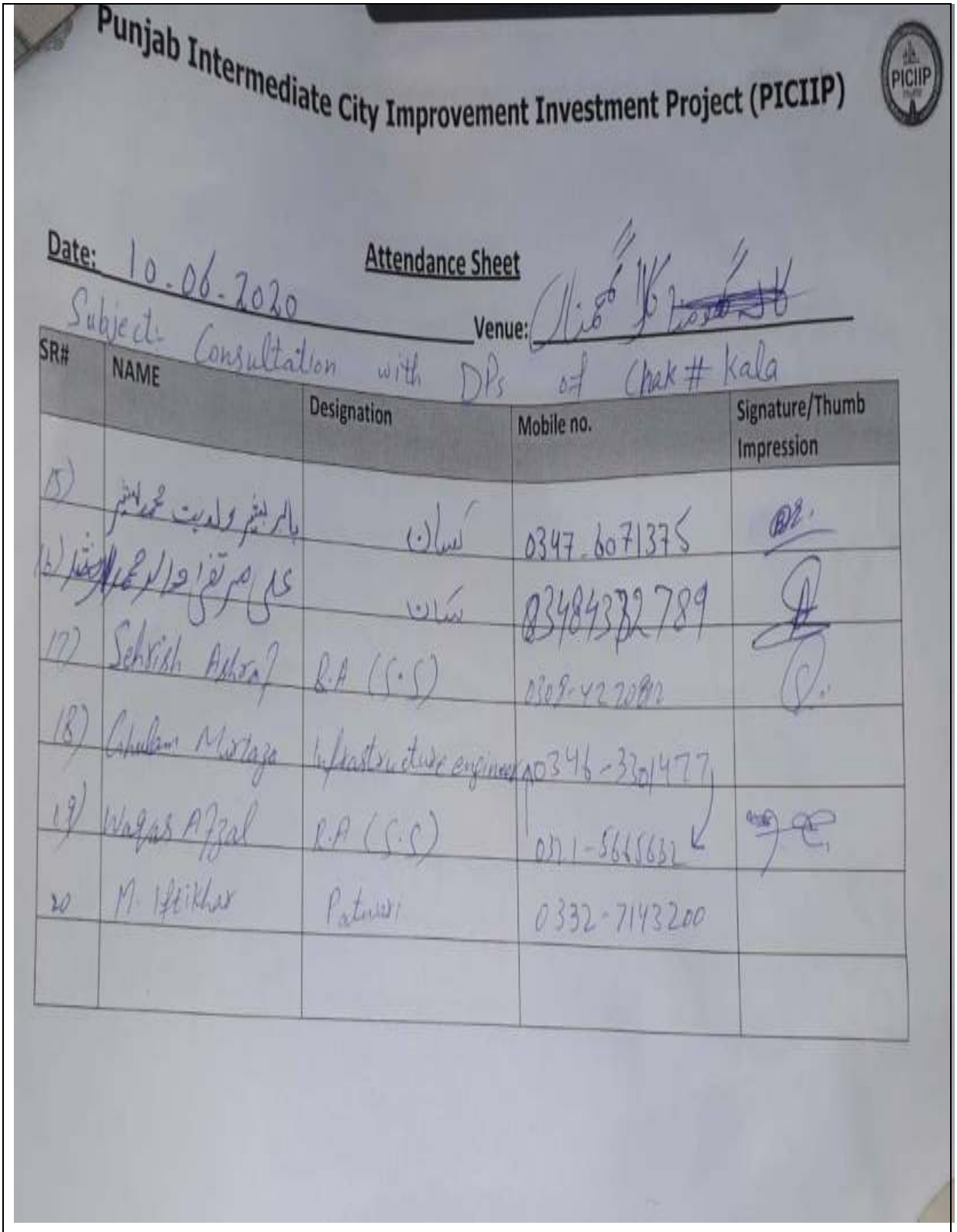


Punjab Intermediate City Improvement Investment Project (PICIIP)

Attendance Sheet

Date: 10-06-2020 Venue: [illegible]

SR#	NAME	Designation	Mobile no.	Signature/Thumb Impression
8)	محمد اسلم ولد بشیر	کسان	0342-6883060	محمد اسلم
9)	نوید اشرف ولد محمد اشرف	کسان	0346 6626282	نوید اشرف
10)	کبیر اشرف ولد محمد اشرف	کسان	0331 6656252	کبیر اشرف
11)	عمران اکرم ولد محمد اکرم	کسان	0392 4248595	عمران اکرم
12)	محمد اسلم ولد غلام رسول	کسان	0305-6215058	
13)	خالد محمود ولد محمد نذیر	کسان	0340 8022266	
14)	محمد سرور ولد محمد غنی	کسان	0343 6085726	محمد سرور



Punjab Intermediate City Improvement Investment Project (PICIIP)

Attendance Sheet

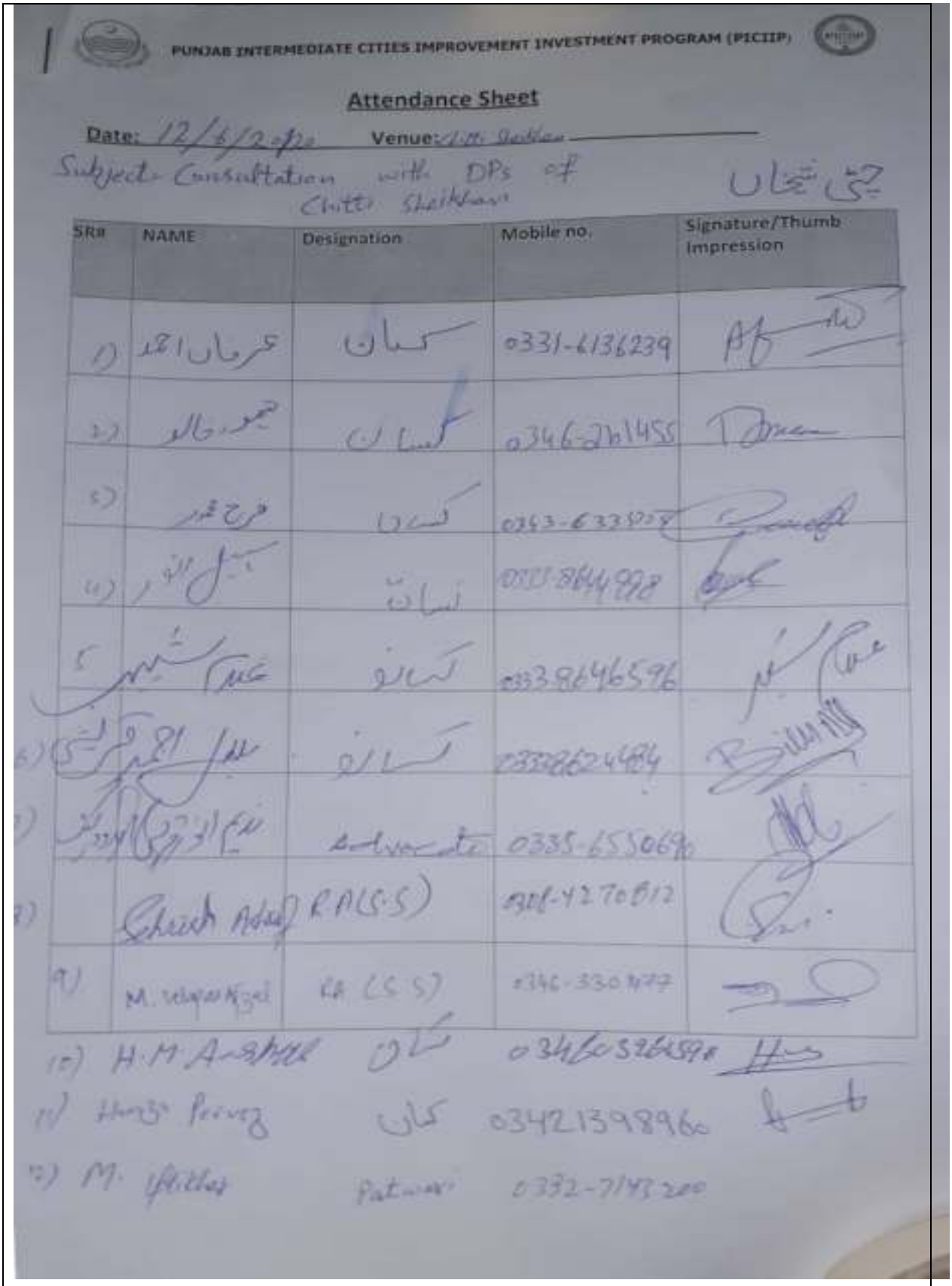
Date: 10.06.2020

Venue:

Subject: Consultation with DPs of Chak # kala

SR#	NAME	Designation	Mobile no.	Signature/Thumb Impression
15)			0347-6071375	
16)			03484382789	
17)	Sehrish Asghar	R.A (S.S)	0309-4270892	
18)	Ghulam Murtaza	Infrastructure engineer	0346-3301477	
19)	Waqas Afzal	R.A (S.S)	0321-5615632	
20	M. Iftikhar	Patwari	0332-7143200	

Consultation with DPs of Chitti Shiekhan, Sialkot Dated 12-06-2020



PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM (PICIIP)

Attendance Sheet

Date: 12/6/2020 Venue: [illegible]

Subject: Consultation with DPs of Chitti Shaikhan

SR#	NAME	Designation	Mobile no.	Signature/Thumb Impression
1)	[illegible]	[illegible]	0331-6136239	
2)	[illegible]	[illegible]	0346-2161455	
3)	[illegible]	[illegible]	0343-6331958	
4)	[illegible]	[illegible]	0321-8644998	
5	[illegible]	[illegible]	03338646596	
6)	[illegible]	[illegible]	03338624484	
7)	[illegible]	Advocate	0335-6553069	
8)	Sheikh Asad	RA (S-S)	321-4270812	
9)	M. [illegible]	CA (S-S)	0346-3307477	
10)	H.M. [illegible]	[illegible]	0346-5264598	
11)	[illegible] Parvez	[illegible]	03421398960	
12)	M. [illegible]	Patwari	0332-7143200	

Consultation with DPs of Village Tonkan Wali, Sialkot Dated 12-06-2020

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM (PICIIP)

Attendance Sheet

Date: 12-6-2020 Venue: Tonkan Wali

Subject: Consultation with DPs of Tonkan Wali

SR#	NAME	Designation	Mobile no.	Signature/Thumb Impression
1)	عدیل ارشد	کسان	03338645058	
2)	عامر اعجاز قریشی	کسان	0300-9453632	
3)	محمد اسلم قریشی	کسان	0333-8606652	
4)	میاں ابرار احمد قریشی	کسان	03476139728	Abrar Ahmad
5)	سرفراز احمد برخوردار	کسان	03446374967	Sarfraz Ahmad
6)	اشفاق احمد	کسان		اشفاق احمد
7)	M. Waqas Afzal	RA (S.S)	0346-3301477	
8)	Sehrish Ashraf	R.A (S.S)	0308-4270812	
9)	M. Iftikhar	Patwari	0332-7143200	

Annexure B

Environment Screening & Categorization Forms (ESCF)

- **Punjab Intermediate City Improvement Investment Project (PICIIP)**

- **Environment Screening & Categorization Form (ESC**

I
n
s
t
r
u
c
t
i
o
n
s

(i) The CIU staff may complete this form to support the environmental categorization of a project and submit to the ADB for verification and approval.

(ii) This checklist focuses on environmental issues and concerns. To ensure that the Social dimensions are adequately considered, refer also to the Checklists on involuntary resettlement and Indigenous Peoples.

(iii) This form is to be completed assuming the "without mitigation" case. The purpose is to identify potential impacts.

2. **Project Name: Construction of North Zone Waste Water Treatment Plant (WWTP) Sialkot**

2. Project Scope of Work (list the major interventions): The north zone WWTP is proposed for north side of Sialkot city. It is proposed that WWTP will be designed to cater for the sewerage generation up to 2044. Waste Stabilization Ponds (WSP) technology will be use in this sewage treatment plant to treat the sewerage water of north side of Sialkot city. The degree of proposed treatment plant would be such that treated effluents can safely be reused for agriculture purpose as per WHO guidelines and discharge into inland water as per Punjab Environmental Quality Standards (PEQS). The total capacity of proposed WWTP is 24.6MGD.

3. **Project Location:** Sialkot

4. **Total Project Cost (million PKR):** 3128.27Million

5. Project GPS Co-ordinates[2] 30.717813"N 73.025188"E

6. **The proposed project activity is NOT listed in the Prohibited Investment Activities List (PIAL) (please refer to Annexure I below).**

YES **No** ☑ ☐

Based on mapping of GPS Co-ordinates onto Google Earth (Annexure II), please respond to the following:

7. Is the project site(s) located adjacent to or within any environmentally sensitive areas (National Park, Protected Area, Buffer zone of Protected Area, Wetland, Mangrove?) If so, provide details and explain the potential risks to the sensitive areas from the proposed project activities:

S.No	Issues	Yes	NO
1.	Is the sub-project area adjacent to or within the cultural heritage site?		√
2.	Is the sub-project area adjacent to or within environmentally protected area?		√
3.	Is the sub-project area adjacent to or within Wetland?		√
4.	Is the sub-project area adjacent to or within the Forest?		√
5.	Is the sub-project area adjacent to or within Biodiversity hotspot?		√
6.	Is the sub-project area adjacent to or within Buffer zone of		√

[1] Required to assess categorization under Pak EPA guidelines

[2] In case of cluster of projects, please provide GPS Co-ordinates for each project location

Is project(s) located in a densely populated area ? NO

8. Use the satellite imagery to identify the numbers and types (as far as possible) of sensitive receptors (SR) below:

SR Type 1: School **Approx. Number of SR1:** 0

SR Type 2: Mosque **Approx. Number of SR2:** 0

SR Type 3: Hospital/Clinic **Approx. Number of SR3:**0

SR Type 4: Public building **Approx. Number of SR4:** 0

SR Type 5: Grave yard **Approx. Number of SR5:** 0

9. Will the proposed project activity require dislocation of people? If so, please mention the estimated number of people to be displaced.

Yes

10. Will any land acquisition be required for the proposed project activity? If so, please provide details.

Yes

The north zone WWTP has been proposed on a private piece of land.

11. Please provide details of any significant expected impacts (''without mitigation'' case) due to the proposed project activities on the identified sensitive receptors:

Sr. No	Type of expected impact	Details on Severity of expected impacts
1	Generation of high dust levels in sensitive areas during construction.	Medium
2	High noise levels in sensitive areas due to blasting and civil works.	Minimal

3	Occupational and community health and safety risks.	Medium
4	Impact on water bodies due to disposal of Chemicals/oils/lubricants and other hazardous/semi-hazardous substances.	Minimal

5	Risks to community health and safety caused by (any or all of the below) (i) Management and disposal of waste and/or (ii) Civil or electrical works and/or (iii) Accidental and natural hazards, particularly where structural elements or components of project are accessible to members of affected community and/or (iv) Fire, electric shock or failure of civil structures during operation.	Medium
6	Generation of disease vectors due to project activities.	Minimal
7	Depletion and/or Contamination of ground water reservoirs due to leaching of chemicals, oil, lubricants and other hazardous/semi- hazardous substances.	Medium
8	Improper sanitation and liquid waste disposal system.	Minimal
9	Degradation of land and ecosystem (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests).	NO
10	Road blocking and temporary flooding due to land excavation during rainy season.	Medium
11	Dislocation or involuntary resettlement of people.	Yes
12	Impacts on vulnerable groups such as the poor, women and children and indigenous peoples.	NO
13	Degradation of cultural property and loss of cultural heritage and tourism reserves.	NO
14	Impact on Flora and Fauna, particularly on any endangered species located in project area(s).	Endangered species are not present in project area.
15	Social conflicts	High
16	Interference with other utilities and blocking of access to building	Minimal

Project Category Recommendation

12. It is recommended that based on the available project information and subsequent analysis, the project should be placed in (please tick one):

☐ Category 'A' ☑ Category 'B' ☐ Category 'C'

13. Please provide an explanation to justify the Categorization above:

There are no sensitive receptors at project site and severity of expected impacts as evident from above table are less adverse and few site specific impacts are irreversible and As per ADB Safeguard Policy, a proposed project is classified as category "B" if it is likely to have few site specific adverse environmental impacts. So Initial Environmental Examination (IEE) would be require.

Screening & Categorization Conducted by: **Endorsed by:**

_____ _____

Environment Officer, CIU **Head of PMU**

Approved by: **Endorsed by:**

_____ _____

ADB Environment Safeguards Focal Point Project Officer, ADB

Annexure C

Occupational Health and Safety Plan

Occupational Health and Safety covers all personnel working under the project and will be in line with the World Bank EHS guidelines on health and safety.

The Occupational Health and Safety program will aim to ensure that the workplace is safe and healthy by: addressing the hazards and risks at the workplace; outlining the procedures and responsibilities for preventing, eliminating and minimizing the effects of those hazards and risks; identifying the emergency management plans for the workplace or workplaces; and, specifying how consultation, training and information are to be provided to employees at various workplaces.

Some of the risks/hazards associated with workplaces are due to working close to or at sites associated with the various project construction activities. Other risks associated with the project construction phase include risk of increase of vector borne and other different diseases.

The following sections will be implemented during the construction phase to address and ensure workers' health and safety.

a. Screening and regular unannounced checking of workers.

As per the procedure for hiring workers, all contractors and labor agencies are required to make all prospective workers undergo medical tests to screen for diseases and sicknesses, prior to selection and employment of any worker. The contractor is also responsible for ensuring that no worker who has a criminal record is employed at the project site. It will be ensured that all workers undergo medical tests to screen diseases at source and at sites in consultation with the designated Health Officer.

In addition to this, the Project Management will also undertake sudden, unannounced checks on workers to look for diseases such as HIV, STDs, and hepatitis and take necessary steps as mandated by the Contractual agreement between the Contractor and the Worker(s).

b. Minimizing hazards and risks at the workplace.

To ensure safety at all work sites, the following will be carried out:

i. Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.

ii. Construction of barricades around construction sites and deep excavated pits, to cordon off and deter entry of unauthorized personnel and workers into these areas.

iii. Providing a safe storage site/area for large equipment such as power tools and chains, to prevent misuse and loss.

iv. Proper Housekeeping: Ensuring that materials are all stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse. Brick stacks will not be more than 7 feet in height and for concrete blocks they will not be more than 6 feet high.

v. Removing all scrap timber, waste material and rubbish from the immediate work area as the work progresses.

vi. Where scaffolds are required, ensuring that each scaffold or its components shall be capable of supporting its own weight and at least 4 times the maximum intended load applied or transmitted to it. The platform/scaffold plank shall be at least 15 inches wide and 1.5 inches thick. The rope should be capable of supporting at least 6 times the maximum intended load applied or transmitted to that rope. Pole scaffolds over 60 feet in height shall be designed by a registered professional engineer and shall be constructed and loaded in accordance with that design. Where scaffolds are not provided, safety belts/safety nets shall be provided;

vii. Ensure that all ramps or walkways are at least 6 feet wide, having slip resistance threads and not inclined at more than a slope of 1 vertical and 3 horizontal.

viii. Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks from falling back into the excavated area and injuring those working inside excavated sites.

ix. Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.

x. Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.

xi. Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

c. Provision of Personal Protective Equipment

Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) to all workers. This will be included in the construction cost for each Contractor. Depending on the nature of work and the risks involved, contractors must provide

without any cost to the workers, the following protective equipment:

i. High visibility clothing for all personnel during road works must be mandatory.

ii. Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.

iii. Safety belt shall be provided to workers working at heights (more than 20 ft) such as roofing, painting, and plastering.

iv. Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.

v. Ear protecting devices shall be provided to all workers and will be used during the occurrence of extensive noise.

vi. Eye and face protection equipment shall be provided to all welders to protect against sparks.

vii. Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.

viii. Safety nets shall be provided when workplaces are more than 25 feet (7.5 m) above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors or safety belts is impractical.

The specific PPE requirements for each type of work are summarized below.

Table C.1 PPE Requirement List

Type of Work	PPE
Elevated work	Safety helmet, safety belt (height greater than 20 ft), footwear for elevated work.
Handling work safety	Helmet, leather safety shoes, work gloves.
Welding and cutting work	Eye protectors, shield and helmet, protective gloves.
Grinding work	Dust respirator, earplugs, eye protectors.
Work involving handling of chemical substances	Dust respirator, gas mask, chemical-proof gloves. Chemical proof clothing, air-lined mask, eye protectors.

Wood working	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Blasting	Hard hat, eye and hearing protection.
Concrete and masonry work	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Excavation, heavy equipment, motor graders, and bulldozer operation	Hard hat, safety boots, gloves, hearing protection.
Quarries	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.

d. Procedures to Deal with Emergencies such as Accidents, Sudden Illness and Death of Workers

First aid kits will be made available at all times throughout the entire construction period by the respective contractors. This is very important, because most work sites will be at some distance from the nearest hospital. In addition to the first aid kits, the following measures should be in place:

i. Provision of dispensaries by the individual EPC contractor.

ii. A vehicle shall be on standby from the Project Office so that emergency transportation can be arranged to take severely injured/sick workers to the nearest hospital for immediate medical attention.

iii. A designated Health Officer/worker for the Project will be identified as a focal person to attend to all health and safety related issues. This employee's contact number will be posted at all work sites for speedy delivery of emergency services. The focal person shall be well versed with the medical system and facilities available at the hospital.

iv. Communication arrangements, such a provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

e. Record Maintenance and Remedial action

The Project Management will maintain a record of all accidents and injuries that occur at the work site. This work will be delegated by the contractor to the site supervisor and regularly reviewed every quarter by project management. Reports prepared by the contractor shall include information on the place, date and time of the incident, name of persons involved,

cause of incident, witnesses present and their statements. Based on such reports, the management can jointly identify any unsafe conditions, acts or procedures and recommend for the contractor to undertake certain mitigative actions to change any unsafe or harmful conditions.

f. Compensation for Injuries and Death

Any casualty or injury resulting from occupational activities should be compensated as per the local labor laws of Kyrgyz Republic. Where compensation is sought by the injured party, proper procedures for documentation of the case will be followed, including a detailed report on the accident, written reports from witnesses, report of the examining doctor and his/her recommendation for treatment. Each individual contractor will be responsible for ensuring compensation for the respective workers.

g. Awareness Programs

The Project management will undertake awareness programs through posters, talks, and meetings with the contractors to undertake the following activities:

i. Dissemination sessions will clarify the rights and responsibilities of the workers regarding interactions with local people (including communicable disease risks, such as HIV/AIDS), work site health and safety, waste management (waste separation, recycling, and composting), and the illegality of poaching.

ii. Make workers aware of procedures to be followed in case of emergencies such as informing the focal health person who in turn will arrange the necessary emergency transportation or treatment.

h. Nomination of a Health and Safety Focal Person

Within each site (especially if different sites are being implemented by different contractors), a Health and Safety Focal Person will be appointed. The Terms of Reference for the focal person will mainly be as follows:

i. Function as the focal person/representative for all health and safety matters at the workplace;

ii. Responsible for maintaining records of all accidents and all health and safety issues at each site, the number of accidents and its cause, actions taken and remedial measures undertaken in case of safety issues;

iii. Be the link between the contractor and all workers and submit grievances of the workers to the contractor and instructions/directives on proper health care and safety from the contractors back to the workers;

iv. Ensure that all workers are adequately informed on the requirement to use Personal Protective Equipment and its correct use;

v. Also responsible for the first aid kit and making sure that the basic immediate medicines are readily available.

Annexure D

Emergency Response Plan

D.1 PURPOSE

The purpose of this Emergency Response Procedure is to provide measures and guidance for the establishment and implementation of emergency preparedness plans for the BNBR project. The aim of the Emergency Response Procedure is to:

(i) Ensure all personnel and visitors to the office/job sites are given the maximum protection from unforeseen events.

(ii) Ensure all personnel are aware of the importance of this procedure to protection of life and property.

D.2 EMERGENCY PREPARATION AND RESPONSE MEASURE SCOPE

The emergency management program is applied to all Project elements and intended for use throughout the Project life cycle. The following are some emergencies that may require coordinated response.

(i) Construction Accident

(ii) Road & Traffic Accident

(iii) Hazardous material spills

(iv) Structure collapse or failure

(v) Trauma or serious illness

(vi) Sabotage

(vii) Fire

(viii) Environmental Pollution

(ix) Loss of person

(x) Community Accident

D.3 RESPONSIBILITIES

The detailed roles and responsibilities of certain key members of the Emergency Response team available to assist in emergency are provided in **Table D.1** below.

Table D.1 Emergency Response Team

Action Group	Responsibility
Emergency Coordinator	▪ Overall control of personnel and resources. ▪ The Emergency Coordinator will support and advise the Site Safety Supervision as necessary. ▪ Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.
Site Safety Supervision (Emergency Commander)	▪ Overall responsibility for activating emergency plan and for terminating emergency actions. ▪ Be alternative of emergency response chairpersons. ▪ Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth. ▪ Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger. ▪ Notify outside authorities if assistance is required. ▪ Carries the responsibility for coordinating actions including other organizations in accordance with the needs of the situation. ▪ Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency. ▪ Establish and appoint all emergency organization structure and team. ▪ Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency. ▪ Ensure resources available to purchase needed emergency response equipment and supplies. ▪ Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan. ▪ Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency. ▪ The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.
	▪ Ensure that the exit route is regularly tested and maintained in good working order. ▪ Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized

Security Team	personnel and equipment may enter, prevent access to the site of unauthorized personnel. ▪ Assist with strong/activation of services during an emergency. ▪ Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.
Rescue & Medical Team	▪ Protect the injured from further danger and weather. ▪ Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital. ▪ Remain familiar with the rescue activities and rescue apparatus. ▪ Assist outside medical services personnel when they arrive
General Administration Team	Response to support any requested general facilities for assisting Emergency Response Team in their work.
Government Relation Team	▪ Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team. ▪ Coordinate emergency plan with the government authorities, local community.
Environment Team	In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.
Department Heads	▪ Call up of personnel into the safe location for protective life and property. ▪ Take immediate and appropriate action while Emergency Response Team is being mobilized. ▪ Keep in touch with the Emergency Commander ▪ Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary. ▪ Provide and maintain emergency equipment of their responsible areas.
Other Staff and Employees	▪ All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team. ▪ Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.

D.4 PROCEDURE

Emergency situation and injuries to person can occur at any time or place either on Project site or elsewhere. The most two common types of emergencies on site are fire and serious

accident.

Figure D.1 Emergency Procedure for Fire

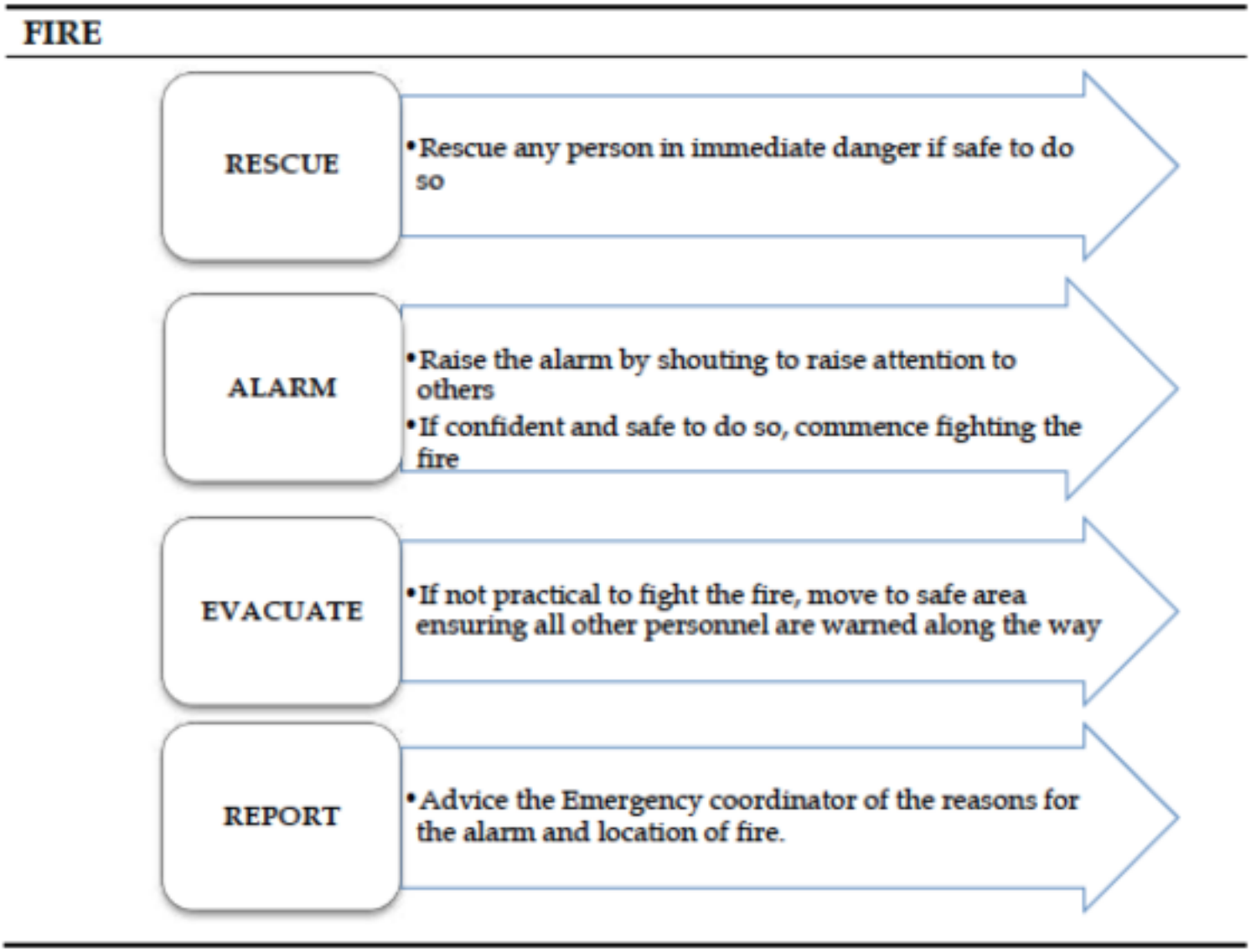
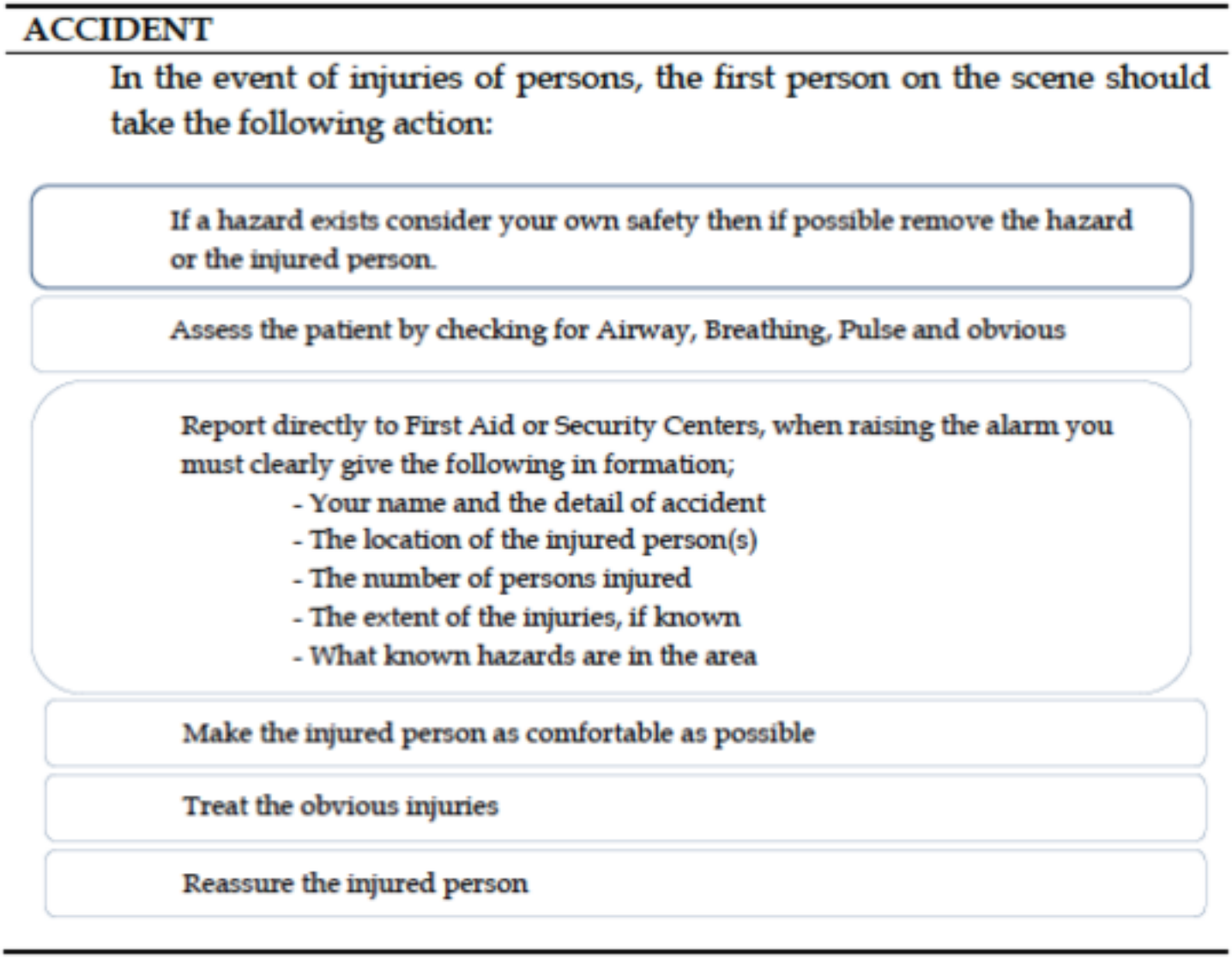


Figure D.2 Emergency Procedure for Serious Accident



D.5 COMMUNICATION WITH AUTHORITIES / PRESS AT SITE

In the event of an accident or incident, only senior staff is permitted to give factual information to the authorities for resource of liability exposure. The press must be avoiding politely, at all costs, with the terse comment that “the matter is under investigation and relevant information when available will be provided by our Head Office” Do not ever give your opinion or story.

First Aid Persons

Upon advice of medical emergency, make immediate assessment to response required and if necessary, advise security to summon ambulance or medical assistance, the qualified first aid

attendant should also,

- Provide treatment to the victim(s) to the best of his/her ability.
- Ensure the safety of victims by ceasing any work activity in the area.
- Protect the injured from further danger and weather.
- Assist medical services personnel when they arrive.

General Administration Team

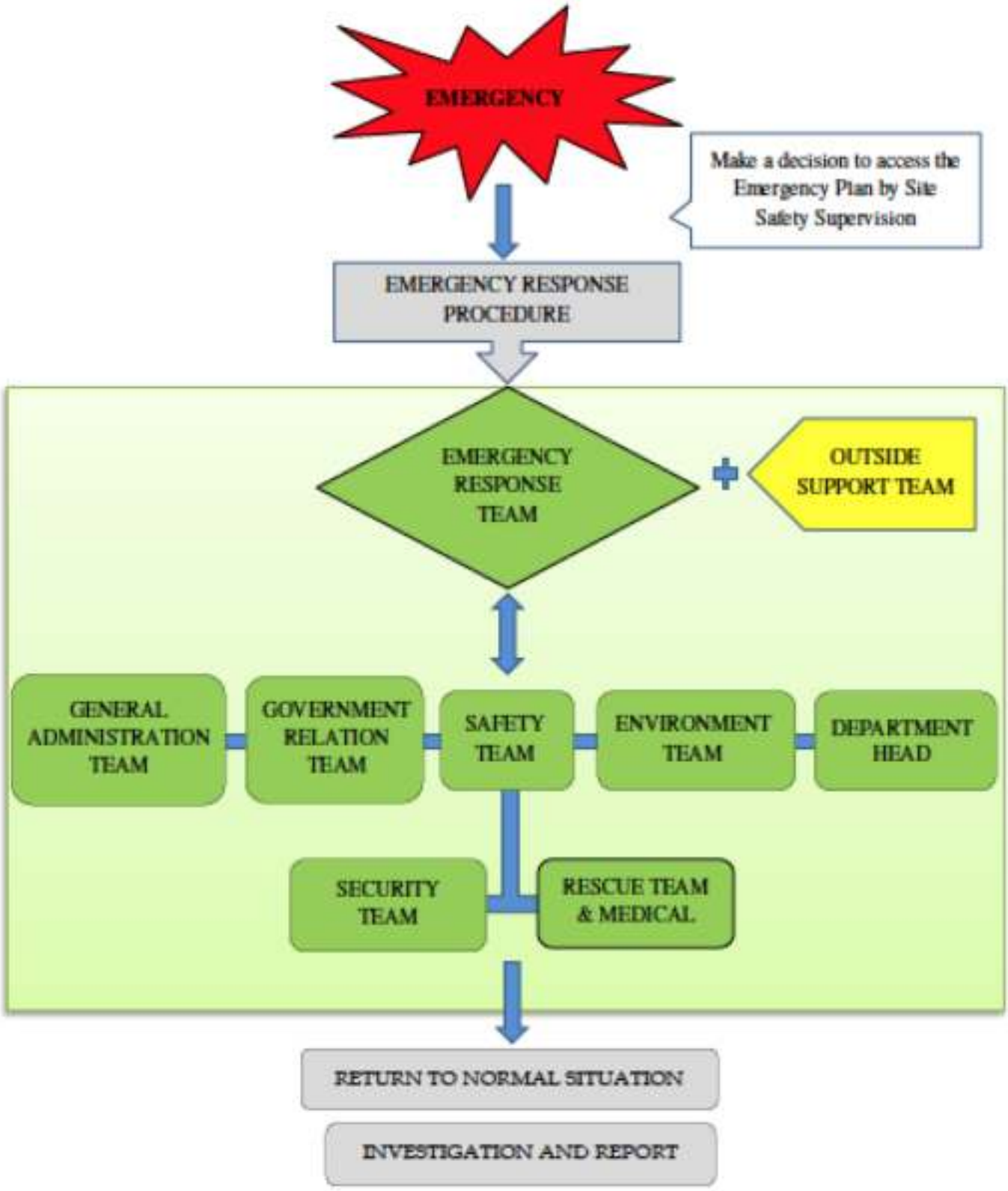
Upon advice of medical emergency, maintain contact with first aid personnel and summon ambulance if required.

Security Team

- If ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct vehicle closest to the scene.
- Prevent access to the site of unauthorized personnel (press, etc.).

Emergency Coordinator

- The Emergency Coordinator shall assist emergency personnel at the scene as required through allocation of company resources.
- The Emergency Coordinator shall ensure next-of-kin are properly notified as soon as possible and give whatever company support and assistance is necessary to assist them bundle the situation
- The Emergency Coordinator shall ensure that senior management personnel are advised of the emergency as soon as practical after the event.



Note: Name of contact person and call number from Owner/Contractor to be determined.

Section A: Identification Data

Report No:	Date of Reported:	Reporter:	Sign:
Job Title:		Company Name:	

Section B: Violence Rate

Accident Violence: ☐ 01-Death ☐ 02-Serious Injury ☐ 03-Lost Time Injury ☐ 04-First Aid ☐ 05- Not Injury ☐ 06-Near Miss

Property Damage Cost: ☐ 1-2,000 USD ☐ 2,001-10,000 USD ☐ 10,001-50,000 ☐ > 50,001

Section C: Environmental Impact

Affected area	☐ Construction area	☐ Public area	
Receptor	☐ None	☐ Workers	☐ Community
Type of pollution	☐ Physical	☐ Chemical	☐ Biological
Toxicity	☐ Non-toxic	☐ Low - toxic	☐ High - toxic
Return to Normal	☐ 1 day	☐ 1 day to 1 week	☐ ≥ 1 week
Cumulative impact	☐ Non-cumulative	☐ Cumulative	

Section D: Injured/Illness Employee

1.Name:	Sex: ☐ Male ☐ Female	Date of Birth: Month / Day / Year	Age:	Regular Job Title:	Experience: In this job title Years Weeks	In this Project Years Weeks

Site:	Company:	Reference:	Phone No:	Social Security Number

Part of Body Injured or Affected:

☐ Head	☐ Hands	☐ Face	☐ Nose
☐ Eyes	☐ Legs	☐ Teeth	☐ Neck
☐ Trunk	☐ Toes	☐ Elbow	☐ Shoulder
☐ Back	☐ Ankle	☐ Wrist	☐ Foot
☐ Arms	☐ Thump	☐ Fingers	☐ Internal

Remark: .....

Nature of Injury or Illness:

☐ Laceration	☐ Amputation	☐ Puncture	☐ Fracture
☐ Strain & Sprain	☐ Burns	☐ Contusion	☐ Dry Heat Friction
☐ Hernia	☐ Foreign Body	☐ Chemical	☐ Contamination
☐ Skin (Occupationnel)	☐ Rash	☐ Irritation	

Remark: .....

2.Name:	Sex: ☐ Male ☐ Female	Date of Birth: Month / Day / Year	Age:	Regular Job Title:	Experience: In this job title Years Weeks	In this Project Years Weeks

Site:	Company:	Reference:	Phone No:	Social Security Number

Part of Body Injured or Affected:

☐ Head	☐ Hands	☐ Face	☐ Nose
☐ Eyes	☐ Legs	☐ Teeth	☐ Neck
☐ Trunk	☐ Toes	☐ Elbow	☐ Shoulder
☐ Back	☐ Ankle	☐ Wrist	☐ Foot
☐ Arms	☐ Thump	☐ Fingers	☐ Internal

Remark: .....

Nature of Injury or Illness:

☐ Laceration	☐ Amputation	☐ Puncture	☐ Fracture
☐ Strain & Sprain	☐ Burns	☐ Contusion	☐ Dry Heat Friction
☐ Hernia	☐ Foreign Body	☐ Contamination	☐ Chemical
☐ Skin (Occupationnel)	☐ Rash	☐ Irritation	

Remark: .....

Section E: Accidents/incident Details

Date Accident/Incident Occurred:	Time Accident/Incident Occurred:	Exact Location of the Accident / Incident:

Details of the actual Job Being done at the time:

Details of Accident / Incident / What actually happened?

Section F: Accident Cause (Basic cause mark X / Contributing cause, if any mark O)

UNSAFE CONDITIONS		UNSAFE ACTS	
1	☐ Inadequately Guarded	1	☐ Operating Without Authority / Training
2	☐ Unguarded	2	☐ Operating at Unsafe Speed
3	☐ Defective Tools, Equipment, or Substance	3	☐ Marking SHE Device Inoperative
4	☐ Unsafe Design or Construction	4	☐ Using Unsafe Equipment or Equipment Unsafely
5	☐ Hazardous Arrangement	5	☐ Unsafe Loading, Placing, Mixing
6	☐ Unsafe Illumination	6	☐ Taking Unsafe Position
7	☐ Unsafe Ventilation	7	☐ Working on Moving or Dangerous Equipment
8	☐ Unsafe Clothing	8	☐ Distraction, Teasing, Horse Play
9	☐ Insufficient Instruction	9	☐ Failure to use Personal Protective Devices
10	☐ Lack of system of work	10	☐ Lack of effective instruction or supervision

Why was the unsafe act committed? _____ Why did the unsafe condition exist? _____

Section G: Guide to Corrective Action (Base on the cause checked above, I am taking the following corrective action)

UNSAFE ACT	UNSAFE CONDITION	If Supervisor can't handle, then recommend to
☐ Stop the Behaviour	☐ Remove	☐ Site Engineer, or
☐ Study the job	☐ Guard	☐ Site Manager, or
☐ Instruct (tell-show-try-check)	☐ Warn	☐ Project Manager, or
☐ Follow Up	☐ Supervisory Training	☐ Safety Committee
☐ Enforce		

Detail below any immediate remedial actions that have been taken:

Detail below any corrective and preventative actions that could be taken to prevent future re-occurrence:	Responsible	Completion Date

Section H: Witness Statement	
Witness Name	**Interviewer Name**

Section I: Reviewed & Recommend by			
Recommendation:			
Reviewed By:	Position:	Signature:	Date:

Remarks : If Accident or Incident happened with lost time injury and affected to the publicity must further report to Safety Department;

: First Aid Cases will not applicable to this form;

: The accident report shall submit to Safety Department within 3 days

: Attached the photograph or sketch the location of accident / incident;

Annexure E

Archaeological 'Chance Find' procedure

Background

The purpose of this document is to address the possibility of archaeological deposits becoming exposed during ground altering activities within the project area and to provide protocols to follow in the case of a chance archaeological find to ensure that archaeological sites are documented and protected as required.

Archaeological sites are an important resource that is protected for their historical, cultural, scientific and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents. The objectives of this 'Archaeological Chance Find Procedure' are to promote preservation of archaeological data while minimizing disruption of construction scheduling It is recommended that due to the moderate to high archaeological potential of some areas within the project area, all on site personnel and contractors be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

Potential Impacts to Archaeological Sites

Developments that involve excavation, movement, or disturbance of soils have the potential to impact archaeological materials, if present. Activities such as road construction, land clearing, and excavation are all examples of activities that may adversely affect archaeological deposits.

Archaeological 'Chance Find' Procedure

If you believe that you may have encountered any archaeological materials, stop work in the area and follow the procedure below:

The following 'chance-find' principles will be implemented by the contractor throughout the construction works to account for any undiscovered items identified during construction works:

(i) Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance.

(ii) Should any potential items be located, the site supervisor will be immediately contacted and work will be temporarily stopped in that area.

(iii) If the site supervisor determines that the item is of potential significance, an officer from the department of Archaeology (DoA) will be invited to inspect the site and work will be stopped until DoA has responded to this invitation.

(iv) Work will not re-commence in this location until agreement has been reached between DoA and IPIG as to any required mitigation measures, which may include excavation and recovery of the item.

(v) A precautionary approach will be adopted in the application of these procedures.

Detailed Procedural Steps

- If the Director, department of Archaeology receives any information or otherwise has the knowledge of the discovery or existence of an antiquity of which there is no owner, he shall, after satisfying himself as to the correctness of the information or knowledge, take such steps with the approval of the Government, as he may consider necessary for the custody, preservation and protection of the antiquity.
- Whoever discovers, or finds accidentally, any movable antiquity shall inform forth with the Directorate within seven days of its being discovered or found.
- If, within seven days of his being informed, the Director decides to take over the antiquity for purposes of custody, preservation and protection, the person discovering or finding it shall hand it over to the Director or a person authorized by him in writing.
- Where the Director decides to take over an antiquity, he may pay to the person by whom it is handed over to him such cash reward as may be decided in consultation with the Advisory Committee.
- The Director or any officer authorized by him with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose.
- The owner or occupier of the premises, place or area shall afford all reasonable opportunity and assistance to the Director.
- No photograph, copy of reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made.
- Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.
- If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department

to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part as for a public purpose.

Annexure F

Dust Management Plan

The purpose of this plan is to describe the measures that the project shall take to ensure that the risk of emissions from dust generated by site operations during construction are minimized and that best practice measures are implemented.

Dust emissions from construction can cause ill health effects to Contractor staff along with nuisance and annoyance to members of the local community. Dust will be controlled through:

- Elimination
- Reduction/Minimisation
- Control

This dust management plan shall be implemented based on the measures already provided in the Environmental Management Plan (EMP) relating to controlling dust emissions.

Methodology

The following methodology will be undertaken for each project section:

Step 1 – Identify the dust generating activities

Construction activities that are likely to produce dust will be identified. The activities that will be taken into account are:

Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant

- Roads, surfaces and public highways
- Static and mobile combustion plant emissions
- Tarmac laying, bitumen surfacing and coating

Materials Handling, Storage, Spillage and Disposal

- Storage of material
- Stockpiles
- Spillages
- Storage of Waste

Site Preparation and Restoration after Completion

- Earthworks, excavation and digging
- Storage of spoil and topsoil

Demolition

Construction and Fabrication Processes

Step 2 – Identify Sensitive Receptors

Sensitive receptors have already been identified. The nature and location of the sensitive receptors will be taken into account when implementing control measures.

Step 3 – Implement Best Practice Measures to Control

Based on the nature of the activity producing the dust, the likelihood of dust being produced and the possible consequence of dust based on the sensitive receptors, the most effective control measure will be identified and implemented.

Step 4 – Monitor effectiveness of control

Construction Supervision Staff (CSC) will have the responsibility to ensure that dust control measures are being implemented and are effective.

Step 5 – Record and report result of monitoring

All inspections, audits and results of monitoring will be recorded and kept as part of the site filing system.

Method Statements and Risk Assessments

The Contractor's Risk Assessments and Method Statements will be required to be approved by the CSC prior to commencing work and will be required to contain environmental aspects of the task, including dust control measures where required.

Where dust has been identified within the risk assessment as a significant issue, the method statement will be required to cover the following:

- Methods and materials that will be used to ensure that dust generation is minimized.
- The use of pre-fabricated materials where possible.
- Optimum site layout:
  - Dust generating activities to be conducted away from sensitive receptors
  - Supply of water for damping down.
- Good housekeeping and management

All employees will be briefed on the Risk Assessment and Method Statement before starting work.

Training

All Contractor staff will be required to attend training seminars as already mentioned in the EMP document. A site-specific induction will also be required before being allowed to work on site. These will include site-specific sensitive receptors and details regarding dust control measures to be taken. Toolbox talks on air pollution and minimizing dust emissions will be provided on a regular basis to Contractor staff.

Identification of Dust Generating Sources and Control Methods

Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant	
Dust Source	**Dust Control Methods**
Major haul roads and traffic routes	Haul roads will be dampened down via a mobile bowser, as required.
Public Roads	Road sweeper will be used to clean public roads as required.
Site traffic management	▪ Site traffic will be restricted to constructed access roads as far as possible. ▪ Site speed limit will be set at 10 mph as this will minimize the production of dust.
Road Cleaning	A mechanical road sweeper will be readily available and used.
Handling, Storage, Stockpiling and Spillage of Dusty materials	
Material handling operations	The number of times a material will have to be handled will be kept to a minimum to prevent double handling and ensure dusty materials are not handled unnecessarily.
Transport of fine dusty materials and aggregates.	Closed tankers will be used or sheeted vehicles.
Vehicle loading/unloading materials on to vehicles and conveyors.	▪ Dusty materials will be dampened down ▪ Drop heights will be kept to a minimum and enclosed where possible.
Storage of Materials	
Bulk cement, bentonite etc.	This will be delivered in tankers and stored in dedicated enclosed areas.
Fine dry materials	These will be protected from the weather and by storing in appropriate containers and indoors, where necessary.
Storage location	Material will be stored in dedicated lay-down areas.
Storage of Stockpiles	
Stockpile location	Stockpiles will be placed so as to minimize double handling and facilitate the site restoration.

Building stockpiles	Stockpiles, tips and mounds will not be stored at an angle greater than an angle of repose of the material.
Small and temporary stockpiles	▪ Where possible, stockpiles will be placed under sheeting. ▪ Dusty material will be damped down. ▪ Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.
Large and long term stockpiles	▪ Long-term stockpiles will be vegetated and stabilized as soon as possible. ▪ Stock plies will be dampened down until stabilized, where necessary. ▪ Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.
Waste Material from Construction	
Disposal method	A dedicated lay-down area will be available for waste. Waste will not be allowed to build up and will be disposed off at the designated locations as per EMP.
Site Preparation and Restoration	
Earthworks, excavation and digging	These activity areas will be kept damp where required and if possible, will be avoided during dry and windy periods.
Completed earthworks	Surfaces will be stabilized by re-vegetation as soon as possible, where applicable.
Construction and Fabrication Process	
Crushing of material for reuse, transportation and disposal	▪ Authorization will be obtained from IPIG and ADB before using any mobile plant on site for activities such as crushing and screening. ▪ Any crushing or screening activities will be located away from sensitive receptors.
Cutting, grinding, drilling, sawing, trimming, planning, sanding	▪ These activities will be avoided wherever possible. ▪ Equipment and techniques that minimize dust will be implemented. ▪ Water will be used to minimize dust.
Cutting roadways, pavements, blocks	Water sprinkling to be used.
Angle grinders and disk cutters	Best practice measures will be used such as dust extraction.

Monitoring Arrangements

Monitoring will be conducted at sensitive receptor locations in the project area as provided in the EMP. Furthermore, at locations where PM levels are exceeding applicable guidelines, additional

stringent measures will be implemented at the respective location(s) in the project area to ensure dust levels are controlled as far as possible.

ANNEXURE G

Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor

Guide for Development of SSEMP

Step 1: Define Boundaries

Step 2: Identify Sensitive Receptors

Step 3: Specify construction activities

Step 4: Conduct Risk Assessment

Step 5: Assign Environment Management measures

Step 6: Prepare Site Plans

Step 7: Prepare Environment Work Plans (if required)

Step 8: Monitoring

Step 1: The project area needs to be clearly defined.

Step 2: The mapping of sensitive receptors has already been conducted and needs to be presented clearly in a map.

Step 3: The tentative construction activities to be conducted are as follows:

- **Site Surveying and Vegetation (Trees and plants) Clearance**
- **Establishment of Work Camp, Batching and Asphalt plant and access roads**
- **Dismantling of Asphalt and existing structures including Utilities**
- **Preparation of ground for Asphalting**
- **Asphalting**
- **Landscaping**

Step 4: The Risk Assessment matrix template is provided in the table below.

Risk is assessed as the likelihood that the activity will have an effect on the environment as well as the consequence of the effect occurring. It is often described like this:

Risk = Likelihood × Consequence

Likelihood Scale

Likelihood	Definition	Scale
Certain	Will certainly occur during the activity at a frequency greater than every week if preventative measures are not applied	5
Likely	Will occur more than once or twice during the activity but less than weekly if preventative measures are not applied	3
Unlikely	May occur once or twice during the activity if preventative measures are not applied	2
Rare	Unlikely to occur during the project	1

Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities e.g. extreme loss of soil and water resources and quality from stormwater runoff extreme pollution of soil and water resources including major contamination from hazardous materials widespread effects on ecosystems with deaths of fauna/flora widespread community impacts resulting in illness, injury or inconvenience loss or destruction of archaeological or historical sites Occurrence will almost certainly result in the work being halted and a significant fine.	5

Major	The action will cause major adverse damage on the environment or surrounding communities e.g. major loss of soil and water resources and quality from stormwater runoff major pollution of soil and water resources including contamination from hazardous materials significant effects on ecosystems with isolated deaths of non-vulnerable flora and fauna significant annoyance or nuisance to communities major damage to or movement required to archaeological or historical sites Occurrence may result in work being halted and a fine	3
Moderate	No or minimal adverse environmental or social impacts e.g. no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits little noticeable effect on ecosystems no or isolated community complaints no or unlikely damage to archaeological or historical sites no likelihood of being fined	2
Minor	No or minimal adverse environmental or social impacts e.g. no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits little noticeable effect on ecosystems no or isolated community complaints no or unlikely damage to archaeological or historical sites no likelihood of being fined	1

Risk Score Table

Likelihood	**Consequence**				
		Catastrophic	Major	Moderate	Minor
	Certain	**25**	**15**	**10**	5
	Likely	**15**	**9**	6	3
	Unlikely	**10**	**6**	4	2
	Rare	5	3	2	1

Risk: **Significant: 15-25**
Medium: 6-10
Low 1-5

Any Medium to Significant risk requires an environmental management measure to manage the potential environmental risk. Judgement will be required concerning the application of an environmental management measure to mitigate low risk situations.

The higher the risk the more intensive the required mitigation measure will need to be; e.g. where site sedimentation is deemed to be low risk, then silt fences may be needed but as the risk increases, then sediment traps may be required. The selection of the appropriate mitigation measure will require judgement based on the level of risk and the specific site parameters.

Step 5: The Environmental Management measures are to be extracted from the IEE study for this project and should be added in the last column of the table below.

No.	Construction Activity	Hazards to Consider	Likelihood that the site or sensitive receptors will be affected?	Consequence of the site or sensitive receptors being affected?	Risk Score (consequence x likelihood)	Environmental Management Measures
i	**Site Surveying & vegetation clearance**	Damage to vegetation beyond project footprint				These can be taken from the EMP provided in the IEE report (If Risk Score is 6 or more)
		Erosion of exposed areas and sediment				
		Loss of topsoil				
		Dust generation				
		Noise				
ii	**Establishment of Work Camp, Batching plant etc.**	Soil deposited onto roads from tires				
		Stockpile erosion				
		Noise & Vibration				
		Traffic congestion				

		Fuel spills				
iii	**Dismantling of Asphalt and existing structures including Utilities**	Noise and vibration				
		Dust generation				
		Community safety				
		Worker safety				
		Traffic Congestion				
iv	**Preparation of Sub-Base**	Noise and vibration				
		Dust generation				
		Traffic Congestion				
v	**Asphalting**	Noise and vibration				
		Dust generation				
		Traffic Congestion				
		Community safety				

		Labor safety (PPEs)				
vi	**Landscaping**	Dust generation				
		Sediment runoff				
		Failure of vegetation to take root				

Step 6: The Site plans are a critical part of the SSEMP and will need to be prepared, otherwise the ADB will consider the document as incomplete.

The site plan will need to provide the following:

- **Indication of North and scale**
- **Existing and planned supporting infrastructure (e.g. access roads, water supplies and electricity supplies)**
- **Location of planned work**
- **Contours**
- **Drainage systems**
- **Locations of sensitive receptors**

Step 7 (if required)[33]: The completed SSEMP provides details of all the environmental management requirements for all stages of the construction process. For individual work teams who are responsible for only a small part of the overall construction works it can be confusing as to what is required for their particular work component. For example, the work team responsible for stripping soil for the construction areas are not going to be interested in the requirements for pouring concrete for footings and foundations. However, it is essential that the soil stripping team knows exactly what to clear and what to leave and where to put stockpiles of soil for later use.

In situations where different work activities are required at different times or at different locations, environmental work plans can be prepared. These are similar to the work method statements that are often produced for major construction projects.

Step 8: A detailed monitoring plan will be provided along with frequency and responsibilities to ensure all key environmental parameters are monitored to ensure compliance with both national and ADB requirements.

Template for SSEMP

1. **Introduction**
   - 1.1 Project Overview
   - 1.2 Scope of SSEMP
   - 1.3 Objectives of SSEMP

[33] ADB, Safeguards Unit for Central & West Asia Department, *Environmental Management for Construction Handbook.*

ANNEXURE H

Ambient Laboratory Monitoring

ASIAN ENVIRONMENTAL SERVICES
www.asianenvirolab.com

Monitoring Location
Airport Road

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

Air Quality

ASIAN ENVIRONMENTAL SERVICES (PVT) LTD
www.asianenvirolab.com

Ambient Air Monitoring Report

Monitoring Details			
Reference Number	AES-062-LG/2020	**Reporting Date**	11-05-2020
Monitoring Coordinates	32°32'12.5"N 74°27'32.5"E	**Date of Monitoring**	05 & 06 May, 2020
Project name	Rehabilitation/Improvement of Water Supply and Sewerage system in North Zone Sialkot(Phase-I)		

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	12:30	0.82	10.7	15.4	26.1	18.1
2	13:30	0.74	11.1	15.8	26.9	17.7
3	14:30	0.70	11.9	16.3	28.2	19.3
4	15:30	0.81	11.6	16.1	27.7	17.6
5	16:30	0.87	11.0	16.9	27.9	20.4
6	17:30	0.89	10.8	15.8	26.6	21.3
7	18:30	0.90	11.2	16.0	27.2	19.8
8	19:30	0.92	11.8	16.4	28.2	18.2
9	20:30	0.88	10.7	17.0	27.7	16.9
10	21:30	0.89	11.4	17.5	28.9	17.7
11	22:30	0.92	12.0	16.5	28.5	16.9
12	23:30	0.88	12.6	15.0	27.6	17.0
13	00:30	0.86	11.4	15.5	26.9	15.2
14	01:30	0.89	10.6	15.9	26.5	17.3
15	02:30	0.85	10.1	16.4	26.5	18.1
16	03:30	0.81	9.5	16.1	25.6	19.9
17	04:30	0.78	9.3	15.9	25.2	16.6
18	05:30	0.79	10.7	14.0	24.7	18.8
19	06:30	0.80	11.3	14.6	25.9	19.1
20	07:30	0.83	11.9	15.1	27.0	21.6
21	08:30	0.85	12.3	16.6	28.9	23.5
22	09:30	0.81	10.8	15.7	26.5	25.3
23	10:30	0.80	10.4	16.1	26.5	23.1
24	11:30	0.85	11.9	17.7	29.6	23.9
Average Concentration		**0.84**	**11.12**	**16.01**	**27.13**	**19.30**

Environmental Services (Pvt) Ltd. LAHORE

Lead Field Operations

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

ISO 9001

Ambient Air Monitoring Report

Monitoring Details			
Reference Number	AES-062-LG/2020	**Reporting Date**	11-05-2020
Monitoring Coordinates	32°32'12.5"N 74°27'32.5"E	**Date of Monitoring**	05 & 06 May, 2020
Project name	Rehabilitation/Improvement of Water Supply and Sewerage system in North Zone Sialkot(Phase-I)		

Parameters	Units	Monitoring Duration	LDL	Average Obtained Concentration	PEQS
Nitrogen Dioxide (NO_2)	$\mu g/m^3$	24Hours	1.00	16.01	80.0
Nitrogen Oxide (NO)	$\mu g/m^3$	24Hours	1.00	11.12	40.0
NO_x	$\mu g/m^3$	24Hours	1.00	27.13	120.0
Sulpher Dioxide (SO_2)	$\mu g/m^3$	24Hours	1.00	19.30	120.0
Carbon Monoxide (CO)	mg/m^3	24Hours	0.01	0.84	05.0
Particulate Matter (PM_{10})	$\mu g/m^3$	24Hours	1.00	126	150
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	24Hours	1.00	25	35
Suspended Particulate Matters(SPM)	$\mu g/m^3$	24Hours	1.00	237	500

Abbreviation:
LDL= Lower Detection Limit **PEQS**= Punjab Environmental Quality Standard $\mu g/m^3$ = Micro Gram per Meter Cube
mg/m^3 = Mili Gram per Meter Cube

Lead Field Operations

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

Noise Levels

ASIAN ENVIRONMENTAL SERVICES (PVT) LTD
www.asianenvirolab.com

Noise Level Monitoring Report

Monitoring Details			
Reference Number	AES-062-LG/2020	**Reporting Date**	11-05-2020
Monitoring Coordinates	32°32'12.5"N 74°27'32.5"E	**Date of Monitoring**	05 & 06 May, 2020
Project name	Rehabilitation/Improvement of Water Supply and Sewerage system in North Zone Sialkot(Phase-I)		

Sr. No.	Time	Noise dB(A)		PEQS
1	12:30	49		
2	13:30	47		
3	14:30	45		
4	15:30	48		
5	16:30	46	Day Time	65
6	17:30	45		
7	18:30	43		
8	19:30	41		
9	20:30	40		
10	21:30	38		
11	22:30	40		
12	23:30	41		
13	00:30	39		
14	01:30	41		
15	02:30	42	Night Time	55
16	03:30	40		
17	04:30	43		
18	05:30	41		
19	06:30	44		
20	07:30	43		
21	08:30	45		
22	09:30	47	Day Time	65
23	10:30	46		
24	11:30	48		

Page 11 of 12

Lead Field Operations

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

ISO 9001