ZEPHYR
WASTE SOLUTIONS (PVT.) LTD
FOR LIFE ON EARTH

ISO 9001 ISO 45001 ISO 14001

Dated: 3rd November, 2025

The Director General,
Environmental Protection Agency, Punjab
Address: Gate No. 8, National Hockey Stadium, Gaddafi Stadium
Ferozepur Road, Lahore
Phone:042 – 99232230

Subject: *Application for 'Environmental Approval/NOC letter' for the project 'Installation of 500kg incinerator at the PSIC Taxila, Rawalpindi', by M/s Zypher Waste Solutions Pvt Ltd.*

Respected Director,

1. I am writing to formally submit an application for environmental approval for the installation of a 500kg incineration facility at the Pakistan Small Industries Corporation (PSIC) site in Taxila, Rawalpindi, proposed to be carried out by Zypher Waste Solutions.
2. The proposed incineration facility aims to enhance waste management capabilities by providing an efficient means of disposal for hazardous/infectious and non-hazardous waste generated in the region. This facility is designed to operate under stringent environmental standards to minimize emissions and ensure compliance with all relevant regulations.
3. Zypher Waste Solutions is committed to adhering to EPA guidelines and positively impacting local waste management. We will implement best practices in waste management and emissions control. We have conducted a comprehensive Environmental Impact Assessment to identify potential impacts, propose mitigation measures, and monitor compliance. Reports along with all the required information and documents are attached to this letter for your kind consideration.
4. We request your office to review this application and grant the necessary environmental approval for the proposed incineration facility.

Thank you for considering our application. We look forward to your positive response and are eager to contribute to sustainable waste management solutions in Rawalpindi.

Sincerely,

Habib Hussain
CEO
Zypher Waste Solutions Pvt Ltd.

Karachi Office:
Building 10-C, 12th Commercial Street Ext. DHA Phase-2 Karachi.
Tel: 021-35312729-30, Cell: 0333-2575524

Islamabad Office:
Al Meraj Center 1st Floor,, Flat #1 Room # 1 G-11/1 Islamabad.
Tel: 051-2370000

E-mail: info@zephyrwaste.com Website: www.zephyrwaste.com

[Attachment: Required Documents]

Required document details	Submissions	STATUS
1. Schedule -IV (Application form)	1 original	✓
2. Proponent CNIC	1 copy	✓
3. Pay order of 30k (review fee)	1 original	✓
4. Affidavit	1 original	✓
5. Schedule VIII(Undertaking)	1 copy	✓
6. Witness CNIC	1 copy	✓
7. EIA REPORT	4 copies	✓
8. Google Earth Map of project site	1 copy	✓
9. Land documents	1 copy	✓
10. Monitoring lab reports	a. Incinerator reports b. Project Site reports	✓

Habib Hussain

CEO

Zypher Waste Solutions

EIA REPORT

Environmental Impact Assessment Report

Installation of 500kg/hr Incinerator Plant at PSIC, Taxila, Rawalpindi

2025

CONSULTANT

TERRE VERDE ENVIRONMENTAL SOLUTIONS

Environmental Impact Assessment (EIA)

INSTALLATION OF 500KG/HR INCINERATOR PLANT AT PSIC, TAXILA, RAWALPINDI

BY

ZYPHER WASTE SOLUTIONS

September 2025

DOCUMENT ISSUE & REVISION RECORD

REFERENCE	EIA/2025/02
TITLE	Environmental Impact Assessment (EIA)
SUBJECT	Installation of 500kg/hr incineration facility at the PSIC Taxila, Rawalpindi, by Zypher Waste Solutions.
CLIENT	Zypher Waste Solutions Pvt Ltd
CONSULTANT	Terre Verde Environmental Solutions Pvt Ltd
DATED	September 2025

REVISION RECORD

Rev.	Date	Issue, Modification	Prepared	Checked	Approved

For Contact

Terre Verde Environmental Solutions (SMC-Pvt) Ltd

Email: tves.pakistan@yahoo.com

Tel: +92 331 5251606

DOCUMENT CERTIFICATION

This project report on Environmental Impact Assessment has been prepared by a team of *Terre Verde Environmental Solutions (SMC-Pvt) Ltd, Islamabad,* duly registered(H172472) as Environmental Consultants.

We, the undersigned, certify that the particulars in this report are correct and true to the best of our knowledge.

EIA/ CONSULTANTS

Dr. Bibi Ilmas

PhD Environmental Sciences

CEO

Terre Verde Environmental Solutions SMC-Pvt Ltd, Islamabad

Signature: …… Date: ……

PROPONENT

Muhammad Habib Hussain

CEO

Zypher Waste Solutions Pvt Ltd

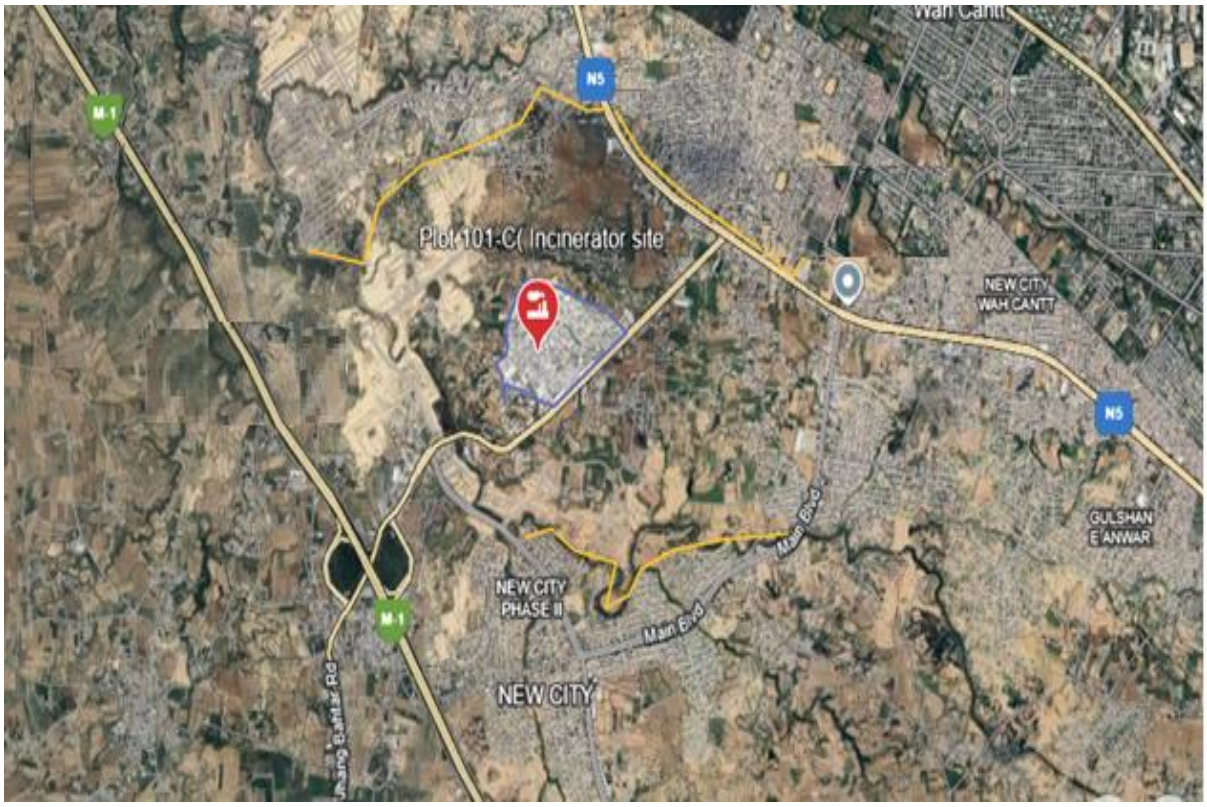
Signature: …… Date: ……

ABBREVIATIONS

1. BOD - Biochemical Oxygen Demand
2. CO - Carbon Monoxide
3. CO_2 - Carbon Dioxide
4. COD - Chemical Oxygen Demand
5. EIA - Environmental Impact Assessment
6. EMoP - Environmental Monitoring Plan
7. EMP - Environmental Management Plan
8. EPA - Environmental Protection Agency
9. HCl - Hydrogen Chloride
10. HSE - Health, Safety, and Environment
11. IEE- Initial Environmental Examination
12. KPI - Key Performance Indicator
13. mg - Milligrams
14. mg/Nm^3 - Milligrams per Normal Cubic Meter
15. MW - Medical Waste
16. NEQS - National Environmental Quality Standards
17. Nm^3 - Normal Cubic Meters
18. M1-Motorway 1
19. NOx - Oxides of Nitrogen
20. PM - Particulate Matter
21. PSI - Pounds per Square Inch
22. Pvt. Ltd. - Private Limited
23. SOx - Sulfur Dioxide
24. TVES- Terre Verde Environmental Solutions
25. W/Q - Waste/Quality
26. ZWS - Zypher Waste Solutions

EXECUTIVE SUMMARY

This Environmental Impact Assessment (EIA) report presents a comprehensive evaluation of the potential environmental and socio-economic impacts associated with the proposed project titled "Installation of Hazardous/Medical Waste Incinerator at PSIC Punjab, Taxila, Rawalpindi" to be implemented by Zypher Waste Solutions (Pvt.) Ltd. at Punjab Small Industrial Estate, Taxila, District Rawalpindi, Punjab. The site location is accessible from multiple directions: from the north via the M-1 motorway at Fateh Jang, from the south using the motorway or GT Road towards Bahtar, from the east through towns in Wah or Rawalpindi, and from the west via major routes like the M1 towards Fateh Jang and Bahtar.



The primary objective of the project is to establish a modern, environmentally sound facility for the treatment and safe disposal of hazardous and biomedical waste generated from healthcare facilities, laboratories, and allied institutions within the region. The project aims to ensure compliance with National Environmental Quality Standards (NEQS) and to reduce environmental and public health risks associated with improper waste management and open burning practices.

The EIA study has been conducted in accordance with the Pakistan Environmental Protection Act (PEPA) 1997, and the IEE/EIA Regulations 2000 (as amended). As per Schedule II of the

Regulations, incineration of hazardous or toxic waste (including hospital waste) falls under Category G, requiring a full Environmental Impact Assessment prior to commencement of the project. The study identifies and evaluates the likely impacts of the proposed installation on the physical, biological, and socio-economic environment, and recommends effective mitigation and monitoring measures to ensure environmental sustainability.

The EIA document is structured into eight chapters detailing a study's comprehensive framework and findings. Chapter 1 introduces the study's background, objectives, scope, and methodology. Chapter 2 outlines the legislative and policy framework guiding the project. Chapter 3 provides an overview of project activities, while Chapter 4 discusses the environmental and social baseline conditions of the project area. Chapter 5 presents the outcomes of public consultations and information disclosures. Chapter 6 screens alternatives and assesses the potential environmental and social impacts, along with mitigation measures. Chapter 7 outlines the Environmental Management and Monitoring Plan (EMMP), and Chapter 8 concludes with findings and recommendations based on the Environmental Impact Assessment (EIA) study.

The proposed project site lies within the Punjab Small Industrial Estate, Taxila, which provides suitable infrastructure and utilities for industrial activities. The site is easily accessible from GT Road, Motorway and local link roads, facilitating safe transportation of waste from generation points to the incineration facility. The surrounding land use is primarily industrial with limited residential settlements at a safe distance, thereby minimizing the risk of exposure to nearby communities.

The proposed incinerator model, ICC WI-500, is a dual-chambered, high-efficiency unit with a capacity of 500 kg/hr. The system operates on controlled combustion technology designed to achieve high thermal destruction efficiency while minimizing air emissions. The primary chamber facilitates waste combustion at high temperature, while the secondary chamber ensures complete oxidation of gases and particulate matter. The flue gases are treated through a wet scrubber system to remove acidic and particulate pollutants before release through a chimney designed in compliance with NEQS emission limits.

The project involves the installation of incineration, air pollution control, waste storage, and ash handling systems. The bottom ash and scrubber sludge generated during operations will be collected, stored in lined containment areas, and disposed of at approved hazardous waste disposal sites. Adequate provisions have been made for segregation, labelling, and temporary storage of waste to prevent cross-contamination and occupational hazards.

Baseline environmental studies were conducted by EPA EPA-approved laboratory to establish the existing environmental conditions in and around the project area. Parameters

such as air quality, noise, water quality, soil characteristics, and ecology were assessed. The results indicate that the current environmental conditions are within permissible limits of NEQS. The area exhibits a semi-urban industrial setting with no sensitive ecological or cultural receptors in the immediate vicinity.

Potential environmental impacts during the construction phase include dust emissions, noise, waste generation, and minor disturbances to nearby activities. These impacts are temporary and can be effectively managed through good construction practices, the use of PPE, and proper waste disposal.

During the operational phase, the primary environmental concerns relate to air emissions, waste handling, and worker safety. The Operational incinerator Plant was monitored at the factory site by the vendor, which showed that gaseous concentrations remain well within NEQS limits, indicating minimal impact on local air quality (Table ES-1).

Table ES-1: Emissions from the proposed model incinerator while operational

S. No	Parameter	Unit	Result	NEQS
1.	Particulate Matter	mg/Nm^3	70.1	300
2.	Carbon monoxide (CO)		420	800
3.	Oxides of Nitrogen (NO_x)		126	400
4.	Sulphur dioxide (SO_x)		120	1700
5.	Hydrogen Chloride (HCl)		2.1	400
6.	Carbon Dioxide (CO_2)		10.2	--
7.	Smoke	Rignlemann scale	1.3	2

Socially, the project is expected to generate positive impacts through the creation of employment opportunities, capacity building, and enhancement of regional healthcare waste management infrastructure. Stakeholder consultations held with local community members and estate management authorities indicated overall support for the project, recognizing its contribution to public health and environmental safety.

An Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) have been developed as integral components of this EIA. These plans define responsibilities, monitoring indicators, reporting mechanisms, and emergency preparedness procedures to ensure effective environmental performance throughout construction and operation. Routine monitoring of stack emissions, ambient air, wastewater, and solid waste management will be carried out to ensure continuous compliance with NEQS and environmental regulatory requirements.

In conclusion, the EIA findings demonstrate that the proposed installation of the ICC WI-500 hazardous/medical waste incinerator by Zypher Waste Solutions (Pvt.) Ltd. is technically feasible, environmentally sustainable, and socio-economically beneficial. The project will significantly enhance hazardous and biomedical waste management capacity in the region while maintaining full compliance with national environmental regulations. It is therefore recommended that the Punjab Environmental Protection Agency (EPA) grant environmental approval for the project, subject to adherence to the mitigation measures and continuous monitoring commitments outlined in this report.

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Chapter 1

INTRODUCTION

1.1 General

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

This EIA report presents the findings of the Environmental Impact Assessment (EIA) study conducted for the installation of a waste incinerator (Model: ICC WI-500) at Punjab Small Industrial Estate (PSIC), Taxila, Rawalpindi, by Zypher Waste Solutions (ZWS) Pvt Ltd (referred hereinafter as the Proponent) for thermo destruction of healthcare waste. The exact location of the facility will be Plot 101C, PSIC, Taxila. Through the project, the proponent intends to install an advanced incinerator having a burning capacity of 500kg/hr. The proposed incinerator will be gas-fired.

Zypher Waste Solutions Pvt Ltd (ZWS) (Proponent) contracted Terre Verde Environmental Solutions (SMC) Pvt Ltd (TVES) (Consultant) to conduct the EIA study in compliance with the mandatory requirements of Section 12 of the Pakistan Environmental Protection Act, 1997, and the rules & regulations framed thereunder." The other relevant regulations and guidelines considered while preparing this EIA report include:

- Policy and procedures for filing, review, and approval of the environmental assessments.
- Guidelines for the preparation and review of environmental reports.
- Guidelines for public participation
- Guidelines for sensitive and critical areas.
- Detailed sector guidelines.

This EIA identifies, describes, and evaluates the potential environmental impacts that could result from the implementation of the project, and includes possible cumulative impacts from all the activities. It also identifies the required environmental permits relevant to the project. As appropriate, the affected environment and environmental consequences of the project may be described in terms of a regional overview or site-specific descriptions. The Report also identifies

measures to prevent or minimize environmental impacts. The report highlights existing environmental, social, physical, and other aspects of the area. It also provides the necessary measures to be taken to mitigate any environmental impact. The monitoring plan is also described in the report. The EIA Report describes environmental, socio-economic, physical, and land use, crops, forestry, water bodies, biodiversity and other relevant aspects associated with this project. It also describes mitigation measures to be adopted. The EIA Report also provides information as desired under the format used to help decision makers, PAK EPA, in the present case, before issuing the desired NOC.

1.2 Project Proponent

Mr. Habib Hussain

CEO

CNIC: 42201-3538007-5

Zypher Waste Solutions (ZWS) Pvt Ltd

Islamabad Office: Flat # 01, 1st floor, Al-Mehraj Centre, G 11/1, Islamabad

Head Office: 3/F Mezzanine Floor, Western Plaza 10-C 12th Commercial Street Ext. DHA, Phase-2 Karachi, Pakistan

Email: info@zephyrwaste.com

Contact No: 92 300 8264129

1.3 EIA Consultant

Terre Verde Environmental Solutions SMC-Pvt Ltd

CEO: Dr Ilmas

Email: tves.pakistan@yahoo.com

Tel: +92 331 5251606

1.4 ZWS- Proponent Brief Profile

Zypher Waste Solutions (ZWS) founded in 2007, is an established environmental services company dedicated to providing comprehensive, safe, and sustainable waste management solutions across various sectors all over Pakistan [Figure 1.1]. Founded with the goal of reducing the environmental impact of waste, ZWS adopts an innovative, responsible, and customer-centered approach to its operations. The company's core values highlight environmental stewardship, public health, safety, service quality, and a commitment to continuous improvement. ZWS envisions becoming a leading force in transforming waste into valuable resources while ensuring the preservation of the environment for future generations. Its mission is focused on delivering high-quality, sustainable waste management services by utilizing advanced technologies, adhering to all applicable regulations, and meeting client expectations in a responsible, safe, and ethical manner. The range of services offered by ZWS encompasses the full spectrum of waste handling and environmental consulting. In solid waste management, ZWS provides

collection, transport, and disposal services for municipal and commercial solid waste, along with sanitation services that promote clean and healthy urban environments.

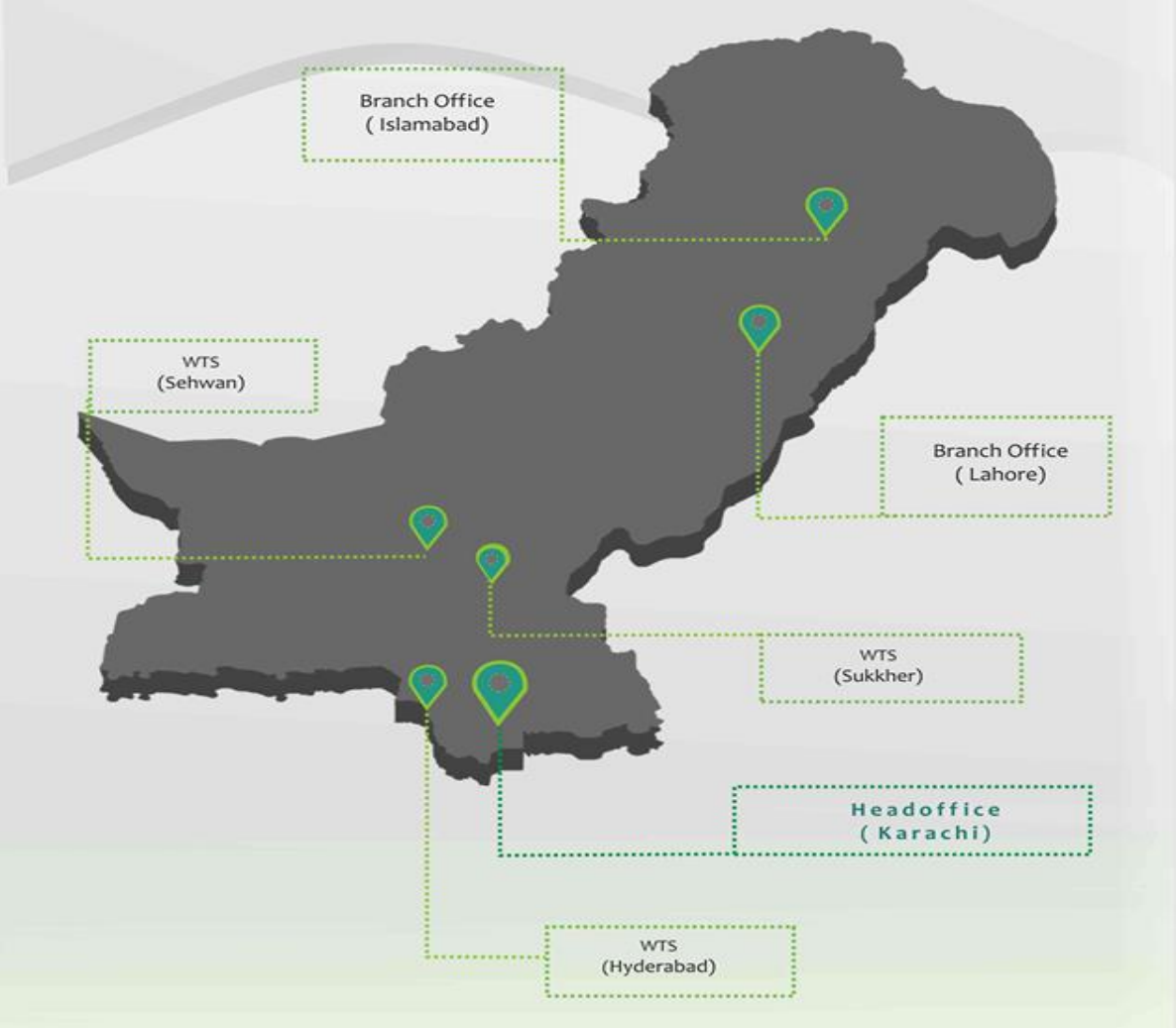
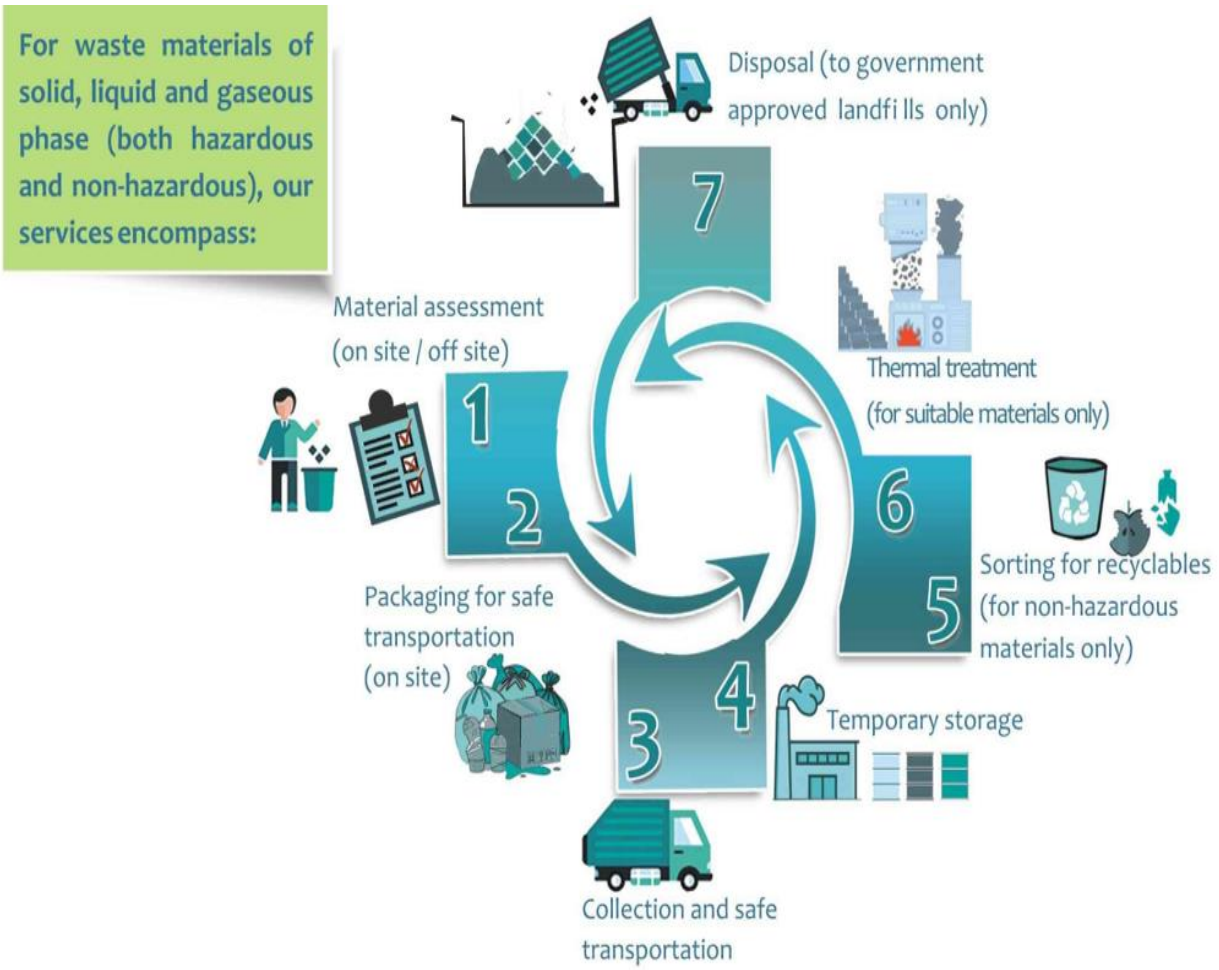


Figure 1.1: ZWS operational offices all over Pakistan

Regarding hazardous waste disposal, the company safely handles chemically reactive, toxic, and flammable materials, ensuring compliance with environmental and safety standards during transportation.

For medical waste handling, ZWS focuses on the collection, treatment, and disposal of biomedical and infectious waste, tailored specifically for hospitals, clinics, laboratories, and pharmaceutical companies. The company also addresses industrial waste management by offering disposal solutions for manufacturing waste, process residues, and contaminated materials, customizing services to meet industry-specific regulatory requirements.

ZWS is committed to supporting recycling efforts through the segregation and processing of recyclable materials, including plastics, paper, metals, and glass, thereby promoting circular economy practices and minimizing waste.



To support its extensive operations, ZWS is equipped with a robust logistical and technical infrastructure, which includes a modern fleet of waste collection and transportation vehicles and specialized containers and packaging materials for hazardous and biomedical waste. Overall, Zypher Waste Solutions is dedicated to being a key player in advancing environmental protection, public health, and regulatory compliance, while seeking to make a positive impact on communities and the environment. The company's detailed profile is attached as Annexe-1.

1.4.1 Company certifications and Registrations

ZWS operates in strict compliance with national and international regulatory frameworks, ensuring quality, safety, and sustainability across all operations. The company maintains the following registrations and certifications (attached in Annexe 2).

- **SECP Registration** – Incorporated under the Securities and Exchange Commission of Pakistan (SECP), ensuring legal compliance and corporate governance.
- **ISO 9001: Quality Management System** – Certified for implementing robust quality control processes, continuous improvement, and customer satisfaction.

- **ISO 14001: Environmental Management System** – Certified for adopting sustainable practices, minimizing environmental impact, and ensuring responsible resource utilization.
- **ISO 45001: Occupational Health & Safety Management** – Certified for maintaining safe and healthy workplace practices in line with global standards.
- **Environmental & Workplace Compliance** – Regular audits and inspections ensure alignment with **National Environmental Quality Standards (NEQS)** and international best practices.

  Through these registrations and certifications, ZWS demonstrates its commitment to regulatory compliance, product safety, operational excellence, and environmental responsibility.

1.5 Legal Basis for Environmental Impact Assessment

1.5.1 Punjab Environmental Protection Act Section 12 – Requirement of IEE or EIA

(1) No proponent of a project shall commence construction or operation unless:

a) They have filed an IEE or EIA, depending upon the nature and scope of the project and scale of impacts associated with the project to the Punjab Environmental Protection Agency (EPA), and

b) Obtained approval in writing.

(2) The Punjab EPA will:

c) Review the IEE/EIA,

d) Invite public comments (in case of EIA), and

e) Grant or refuse approval.

(3) Any project started without approval is deemed illegal, and the EPA can issue an order to stop work, close, or impose penalties.

1.5.2 IEE & EIA Regulations 2022

It operationalizes it by classifying projects, prescribing procedures, setting timelines, and ensuring public participation.

a) **Schedule I (IEE projects):** Smaller-scale projects with limited environmental impact (e.g., small industries, medium-scale infrastructure, small housing schemes).

b) **Schedule II (EIA projects):** Larger projects with significant environmental impact (e.g., mega industrial estates, highways, large dams, power plants, oil refineries).

Schedule I categorizes those projects which are small-scale projects or which have a narrow range of environmental impacts pertaining to these activities. Schedule II includes projects which are expected to impose severe environmental impacts and need thorough evaluation before the commencement of project activities. Waste projects are categorized based on their capacity and nature. Toxic hospital waste disposal through incineration is listed in Schedule II under the category G:

Category G: Waste Disposal: "Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)". Accordingly, EIA for the project needs to be conducted and submitted to EPA for issuance of environmental approval.

1.6 Scope and Objectives of the EIA Study

The project requires the Environmental Impact Assessment to identify the environmental impacts of the operational phases of the proposed project of ZWS.

The scope of EIA is as follows:

- The identification and assessment of all major and minor impacts during operational phases. ▪
- Identification of all significant impacts that may require detailed assessment.
- Propose mitigation measures to minimize, eliminate or compensate the potential adverse impacts that may arise during operational phases of the project.
- Public consultation with all the stakeholders of the proposed project
- Preparation of Environmental Management Plan.
- Conclusions and recommendations
- Preparation of an Environmental Report for submission to the Punjab Environmental Protection Agency. The Terms of Reference for the EIA report has been attached in Annexure-3.

1.7 Methodology of EIA

1.7.1 Review of Project Activities

The EIA study starts with review of project activities using the information from the client. In a scoping session with the Proponent, different aspects of the Project were discussed in terms of various environmental issues. Details of the past and proposed project activities were collected from the proponent. The impacts associated with the project were reviewed and mitigation measures were specified. In subsequent meetings with the Proponent the observations were communicated.

1.7.2 Review of Policy, Legislation and Guidelines

The relevant national legislations, guidelines were reviewed to set the environmental standards and environmental management plan that the project would be required to adhere to during the construction and operation phase of the project.

1.7.3 Review of Secondary Data

The project related information provided by the client was reviewed by the EMC experts to identify key areas of study and analysis/assessment. Besides information from the proponent, available

secondary data including environmental studies on similar projects by EMC and other consultants was also reviewed. Available literature on project area was reviewed to gather information for development of social and environmental baseline profiles for the subject EIA covering the following:

- Physical environment: topography, geology, soils, water resources, ambient air and climate
- Biological environment: habitat types, flora and fauna, habitats within the proposed site and its surroundings
- Socio-economic environment: settlements, socio-economic conditions, infrastructure and land use; and
- Heritage aspects: sites of cultural, archaeological or historical significance.

1.7.4 Field Data Collection

TVES team carried out site surveys to gather primary data on the physical, biological and socioeconomic conditions of the project area. Social Survey was conducted in the study area and discussions were held with all the relevant stakeholders of the projects including nearby colony residents, neighbor industries, Estate Management office and their officials. Consultations were also held with local residents to acquire their views and concerns regarding the project activities. Site was surveyed to assess present environmental conditions of the site with respect to geology, topography, air and noise quality and hydrology etc.

1.7.5 Identification and Assessment of Impacts

Potential impacts which may arise from proposed project activities were identified. These include effects on physical, biological, and socio-economic environment. Impacts were identified, in particular, on the air quality, and social sensitivities of the project area and assessed on the basis of field data collected from project site, stakeholder consultation and software-based assessments. Besides this, secondary data, professional judgment, and monitoring results were also used and reviewed during impact assessment.

1.7.6 Recommendations for Mitigation and Monitoring Measures

Keeping in view the baseline data collected and impacts identified, mitigation measures were recommended to minimize, reduce, eliminate, or compensate for the potential environmental and social impacts on the project zone of influence. Mitigation measures were recommended on the basis of the past experience, best industry practices, legislative requirements and professional judgment.

1.7.7 Development of Environmental Management Plan (EMP)

Environmental Management Plan (EMP) was developed for effective implementation of the recommended mitigation measures in the EIA report. EMP included suggested measures and management plan to minimize the identified negative impacts, and monitoring programme to monitor

residual impacts, if any, during the operation. The EMP includes the following:

- Mitigation and monitoring plan
- Defining roles and responsibilities of the proponent and contractors
- Requirements for communication, documentation and training during implementation of the project
- Change management plan to cover unforeseen events / environmental conditions during the project; and
- Training program

1.7.8 Reporting

Upon completion of all field and desktop work, the findings and outcomes of the EIA study were documented in the EIA report. The format of the EIA report conforms to the guidelines provided by the Punjab EPA.

1.8 Structure of the Report

The EIA report is presented as one volume and describes the proposed project activities, environmental conditions of the project area, relevant legislation and guidelines, assessment of the project impacts, recommendations for mitigation measures and an environmental management and monitoring plan. The text is supported by photographic records, maps, figures and tables as needed in different sections of the EIA report.

The current EIA document is structured as follows:

- Chapter 1 presents the background, objectives, scope and approach and methodology adopted for the study;
- Chapter 2; Describes the legislative and policy framework for the project
- Chapter 3; Provides an overall description of project activities
- Chapter 4; Provides environmental and social baseline conditions of the project area;
- Chapter 5; Provides an outcome of Public Consultation and information disclosure
- Chapter 6; presents screening of alternatives and potential environmental and social impacts of the project, and appropriate mitigation measures.
- Chapter 7; Provides Environmental Management and Monitoring Plan (EMMP);
- Chapter 8; Provides conclusion and recommendations based on findings of EIA study

Chapter 2

LEGISLATIVE & ADMINISTRATIVE FRAMEWORK

2.1 Introduction

This chapter provides synopsis of policies, legislation, and guidelines that may have relevance to the project. The proponent of this project will comprehensively follow the relevant requirements of the policy documents and legislative framework as well as those recommendations as described in the national and international guidelines. Many of those guidelines have been incorporated in the mitigation measures and the Environmental Management Plan (EMP) which has been formulated for the better environmental management.

Consequent to the 18th Amendment, the Environment has become the exclusive domain of the provincial governments. The main consequences of this change are as follows: i) The Ministry of Environment at the federal level have been abolished. Its functions related to the national environmental management haves been transferred to the provinces. The international obligations in the context of environment will be managed by various ministries and departments of the federal government, ii) The Pakistan Environmental Protection Act, 1997 (PEPA 1997) is technically no longer applicable to the provinces and is applicable only in the Islamabad Capital Territory. The provinces are required to enact their own legislation for environmental protection. The environmental Law governing the proposed project is Pakistan Environmental Protection Act 1997 and rules and regulations made there under.

The proponent will be required to comply with legal provisions for the project during all stages of project.

2.2 Administrative & Institutional setup for Environmental Management in Punjab

The Federal government has established the Pakistan Environmental Protection Agency, which is headed by the Director General who exercises the powers and performs the functions assigned to him/her under the provisions of PEPA 1997 and the rules and regulations made thereunder. The Agency has technical and legal staff and may form advisory committees.

Some key functions and powers of the Pak EPA under the PEPA 1997 are to:

- administer and implement this Act and the rules and regulations made;
- prepare, in co-ordination with the appropriate Government Agency and in consultation with the concerned sectoral Advisory Committees, national environmental policies for approval by the Council;
- Take all necessary measures for the implementation of the national environmental policies

approved by the Council;

- prepare and publish an annual National Environment Report on the state of the environment;
- prepare, establish and revise the National Environmental Quality Standards with approval of the Council:
- ensure enforcement of the National Environmental Quality Standards;
- establish standards for the quality of the ambient air, water and land, by notification in the official Gazette in consultation with the Provincial Agency concerned summon and enforce the attendance of any person and require him to supply any information or document needed for the conduct of any enquiry or investigation into any environmental issue;
- arrange for test and analysis of the samples at a certified laboratory;
- The proposed project would be located in the federal Capital. Hence, this EIA Report will be submitted to the Federal EPA for review and issuance of environmental approval. Coordination of the environmental monitoring activity will be the responsibility of Pak EPA; in this case, Pak EPA has been authorized to enforce environmental compliance.
- Pak EPA has powers to enter or inspect under a search warrant issued by the Environmental Protection Tribunal or a Court search at any time, any land or building etc., where there are reasonable grounds to believe that an offence under this Act has been or is being or likely to be committed. EPA may also take samples, arrange for testing or confiscate any article in discharge of their duties.

2.3 National Environmental Policies & Plans

2.3.1 National Conservation Strategy

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan (GoP) on national environmental issues. The Strategy approved by the Federal Cabinet in March 1992 was also recognized by International Financial Institutions, principally the World Bank. The NCS had identified 14 core areas, including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage. It had also recommended immediate attention to the stated core areas to preserve the environment of Pakistan.

A mid-term review of the NCS in 2000 concluded that achievements under the NCS were primarily awareness raising and institutional building rather than meaningful improvement of the environment and natural resources, and that the NCS was neither designed nor adequately focused as a national sustainable development strategy (GoP), November 2002. Thus, the need for a more focused National Environmental Action Plan (NEAP) was formulated and approved by the Pakistan Environmental Protection Council in 2001 to practically improve the national environment with emphasis on poverty reduction, and economic as well as sustainable development.

NEAP now constitutes the national environmental agenda and its core objective is to initiate actions

that would safeguard public health, promote sustainable livelihoods and enhance the quality of life for the people of Pakistan.

The GoP and United Nations Development Program (UNDP) have jointly initiated an umbrella support Program called the NEAP-Support Program that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-Support Program is environmental sustainability and poverty reduction in the context of economic growth. The objectives of new policy has total 171 guidelines on sectoral and cross sectoral issues. The objectives of new policy include assurance of sustainable development and safeguard of natural wealth of country. The following are the approved Sectoral Guidelines:

- Water Supply and Management.
- Air Quality and Noise.
- Waste Management.
- Forestry.
- Biodiversity and Protected Areas.
- Climate Change and Ozone Depletion.
- Energy Efficiency and Renewable.
- Agriculture and Livestock.
- Multilateral Environmental Agreements

2.3.2 National Environmental Policy 2005

The National Environmental Policy provides an overreaching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, and loss of biodiversity, desertification, natural disasters and climatic change.

It also gives direction for addressing the cross-sectional issues as well as the underlying causes of environmental degradation and meeting international obligations.

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

The National Environmental Policy aims to protect, conserve and restore Pakistan's environment to improve the quality of life for the citizens through sustainable development.

2.3.3 Biodiversity Action Plan, 2000

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

2.3.4 National Climate Change Policy 2012

The National Climate Change Policy provides a framework for addressing the issues that Pakistan faces or will face in future due to the changing climate. The main objectives of Pakistan's climate change policy include:

- To pursue sustained economic growth by appropriately addressing the challenges of climate change;
- To integrate climate change policy with other interrelated national policies;
- To focus on pro-poor gender sensitive adaptation while also promoting mitigation to the extent possible in a cost-effective manner;
- To ensure Water Security, Food Security and Energy Security of the country in the face of challenges posed by climate change;
- To minimize the risks arising from expected increase in frequency and intensity of extreme weather events: floods, droughts, tropical storms etc.;
- To strengthen inter-ministerial decision making and coordination mechanism on climate change;
- To facilitate effective use of the opportunities, particularly financial, available both nationally and internationally;
- To foster the development of appropriate economic incentives to encourage public and private sector investment in adaptation measures;
- To enhance the awareness, skill and institutional capacity of relevant stakeholders;
- To promote conservation of natural resources and long-term sustainability.

2.4 National Laws and Legislations

2.4.1 Pakistan Penal Code, 1860

Section XIV of PPC deals with the offences affecting the public health, safety, convenience, decency and morals. Person may be guilty of public nuisance if his act or omission causes common injury, danger or annoyance to the public or results in spread of infection of diseases dangerous to life. The

section also deals with environmental pollution. Provisions under this Act relating to environment are no longer being enforced after promulgation of the Pakistan Environmental Protection Act, 1997. However, pollution offences can still be tried under the Pakistan Penal Code, 1860.

2.4.2 Antiquities Act, 1975

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

There are no structures of historical or cultural significance within or proximity of project site.

2.4.3 Hospital waste management rules, 2005

Ministry of Environment, Government of Pakistan has prepared the Hospital Waste Management Rules in August 03, 2005. According to these Rules, every hospital is responsible for proper management of waste generated by it till its final disposal in accordance with provisions given in these Rules 16 to 22. The Rules require each healthcare facility to constitute a waste management team, and to prepare and implement a waste management plan. The Rules also include guidelines for waste segregation, collection, transportation, storage, accidents & spillages, waste minimizations and reuse, inspection and disposal. These Rules will be applicable to the proposed project.

Proper management of Healthcare Waste (HCW) and effective implementation of the Hospital Waste Management Rules (HWM) of 2005 can minimize the risks both within and outside healthcare facilities. The first priority is to segregate wastes, preferably at the point of generation, into reusable and non-reusable, hazardous and non-hazardous components. Other important steps are the institution of a sharps management system, waste reduction, avoidance of hazardous substances whenever possible, ensuring worker safety, providing secure methods of waste collection and transportation, and installing safe treatment and disposal mechanisms.

The rules provide responsibility for waste management, duties and meetings of waste management team, constitution of waste management team and assigning the responsibilities to all team members against the subject rules. Waste collection, segregation and transportation is explained in detail.

The HWM rules define the roles and responsibilities of personnel w.r.t waste management including senior administration, waste management officer and hospital engineer etc. These rules also provide guidelines on waste segregation, transportation, storage, disposal, accidents, spillages, and other waste management aspects. NIRM will be mandated to comply to the provisions of HWM rules during the project execution for management of hospital waste.

2.4.4 NFPA 58 Requirements & Safety Rules

Below are some of the main rules and best practices from NFPA 58 (and related standards) must adhere to if a company plans to store cylinders as backup fuel.

Requirement / Topic	Key Provisions / Notes
Separation Distances / Location	Cylinders stored outside must maintain minimum distances from buildings, openings, property lines, ignition sources, etc. (For instance: at least **5 ft** away from doorways or building openings in many cases.
Open Venting / Enclosure Requirements	If stored under covers or roofs, at least 50% of the perimeter must be open to the atmosphere (to prevent gas accumulation).
Cylinder Orientation & Relief Valves	Cylinders must be upright, and relief devices must vent into vapor space, not obstructed.
Fire Protection / Extinguishers	Fire extinguishers of adequate capacity must be nearby.
Maximum Quantities / Inside Storage Limits	If cylinders are stored inside, limits apply (e.g. NFPA may restrict total LPG amount or container size).
Distance from Ignition / Openings	Cylinders or container vents should be at least a certain distance (e.g. 10 ft) from ignition sources or air intake openings of buildings.
Handling & Security	Cylinders must be secured (to avoid tipping), protected from damage or tampering, and away from heat sources.
Inspection / Compliance	Must comply with NFPA 58 (or local code adoption). Permits or approval may be necessary depending on volume.

2.5 Policies, laws, legislations and governing bodies in Federal Capital

2.5.1 Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997 (PEPA) is the fundamental legislation empowering the government to formulate regulations for protecting the environment. It is broadly applicable to air, water, soil, marine and noise pollution, as well as to the handling of hazardous waste. Penalties have been prescribed for those contravening the provisions of the Act. The powers of the federal and provincial Environmental Protection Agencies (EPAs) have also been considerably enhanced under this legislation. In addition, the EPAs have been empowered to conduct inquiries into possible breaches of environmental law either upon the registration of a complaint or on their own accord. Under section 12 of PEPA (1997), no project involving construction activities or any change in the physical environment can be undertaken unless an Initial Environmental Examination (IEE) or Environmental Impact

Assessment (EIA), as required, is conducted and a report submitted to the federal EPA.

2.5.2 Punjab EPA (Review of IEE/EIA) Regulations, 2000

The Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 categorize projects into two separate schedules depending on whether a project requires an IEE (Schedule-I) or an EIA (Schedule-II). The Regulations also require that all projects located in environmentally sensitive areas ensure submission of an EIA.

Schedule I categorizes those projects which are small-scale projects or which have narrow range of environmental impacts pertaining to these activities. Schedule II includes projects which are expected to impose severe environmental impacts and need thorough evaluation prior to commencement of project activities.

Waste projects are categorized based on their capacity and nature. Toxic hospital waste disposal through incineration is listed in Schedule II under the following category:

Category G: Waste Disposal: "Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)"

Accordingly, an EIA for the project needs to be conducted and submitted to the EPA for the issuance of environmental approval.

2.5.3 Pakistan Environmental Assessment Guidelines

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

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

b) Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997: The guidelines on the preparation and review of environmental reports target project proponents and specify:

   i. The nature of the information to be included in environmental reports

   ii. The minimum qualifications of the EIA conductors appointed

   iii. The need to incorporate suitable mitigation measures at every stage of project implementation

iv. The need to specify monitoring procedures.

c) The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the Study Area, a detailed assessment thereof, and mitigation measures.

d) Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May 1997: These guidelines support the two guidelines mentioned above. They deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.

The EIA report submission and approval procedure is summarized below:

e) Ten hard copies of the EIA and two soft copies will be submitted together with a review fee and form included as Schedule V of the IEE-EIA Regulations.

f) The EPA will conduct a preliminary scrutiny and reply within 10 days of the submittal of the report

   a. confirming completeness, or

   b. asking for additional information, if needed, or

   c. returning the report requiring additional studies, if necessary.

g) If accepted, the EPA will set a date for a public hearing and publish a notice in the print media. According to the law, a minimum of 15-day notice is required for the public hearing.

h) The EPA will review the EIA, taking into account any public comments received during the hearing or otherwise.

i) The EPA is required to make every effort to complete the EIA review process within four (04) months of the issue of confirmation of completeness under regulation 9.

j) The approval granted at the end of the review process is valid for three years to start construction.

k) Once the project construction is complete, the proponent is required to submit a request to EPA for confirmation of compliance. An environmental management plan for the operation phase is to accompany the request.

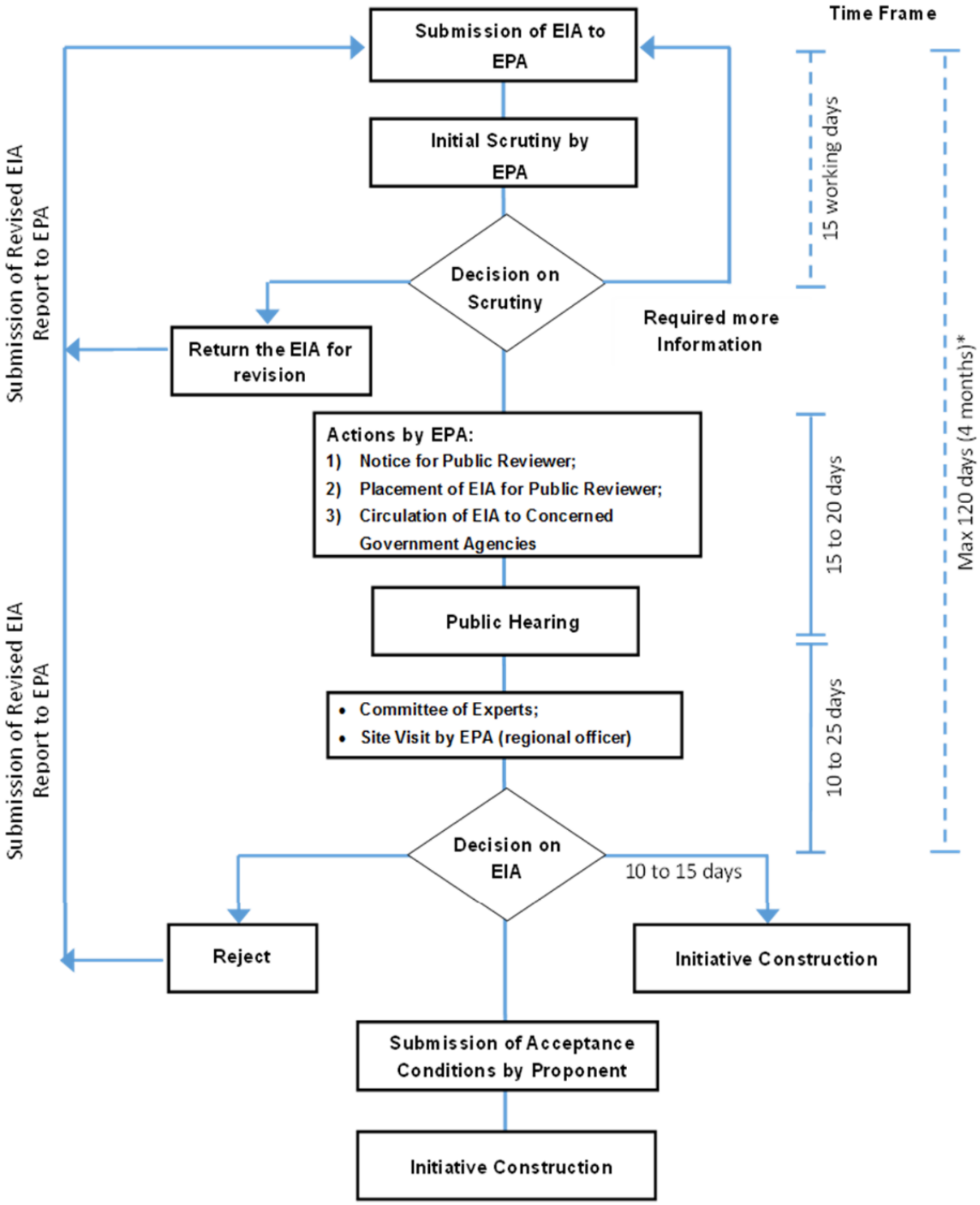


Figure 2.1: EIA Review and Approval

2.5.4 Pakistan Environmental Protection Agency

Federal EPA is headed by the Director General (DG) with the aim to exercise the powers and perform the functions assigned to it under the provisions of this Act and the rules and regulations made thereunder. The Agency shall have technical and legal staff and may form advisory committees.

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

Some key functions and powers of Pak EPA under the PEPA 1997 are to:

a) administer and implement this Act and the rules and regulations made;
b) prepare, in co-ordination with the appropriate Government Agency and in consultation with the concerned sectoral Advisory Committees, national environmental policies for approval by the Council;
c) take all necessary measures for the implementation of the national environmental policies approved by the Council;
d) prepare and publish an annual National Environment Report on the state of the environment;
e) prepare, establish and revise the National Environmental Quality Standards with approval of the Council:
f) ensure enforcement of the National Environmental Quality Standards;
g) establish standards for the quality of the ambient air, water and land, by notification in the official Gazette in consultation with the Provincial Agency concerned
h) summon and enforce the attendance of any person and require him to supply any information or document needed for the conduct of any enquiry or investigation into any environmental issue;
i) arrange for test and analysis of the samples at a certified laboratory.

2.5.5 National Environmental Quality Standards (NEQS)

The NEQS promulgated under the PEPA 1997 specify standards for industrial and municipal effluents, gaseous emissions, vehicular emissions, and noise levels.

Table 3.1: National Environmental Quality Standard for Ambient Air

Pollutant	Time-weighted average	Concentration in Ambient Air	Method of measurement
Sulfur Dioxide (SO_2)	Annual Average*	80µgm^3	Ultraviolet Fluorescence Method
	24 hours**	120µgm^3	
Oxides of Nitrogen as (NO)	Annual Average*	40µgm^3	Gas Phase Chemiluminescence
	24 hours**	40µgm^3	
Oxides of Nitrogen as	Annual Average*	40µgm^3	

(NO_2)	24 hours**	80µgm^3	Gas Phase Chemiluminescence
O_3	1 hour	130µgm^3	Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	360µgm^3	High volume Sampling, (Average flow rate not less than 1.1m^3/minute)
	24 hours**	500µgm^3	
Respirable Particulate Matter (PM_{10})	Annual Average*	120µgm^3	B Ray absorption method
	24 hours**	150µgm^3	
Respirable Particulate Matter ($PM_{2.5}$)	Annual Average*	15µgm^3	B Ray absorption method
	24 hours**	35µgm^3	
	1 hour	15µgm^3	
Lead (Pb)	Annual Average*	1µgm^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5µgm^3	
Carbon Monoxide (CO)	8hours**	5mg/m^3	Non Dispersive Infra Red (NDIR) method
	1hours	10mg/m^3	
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval. **24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.			

Table 3.2: The Motor Vehicle Ordinance (1965) and Roles (1969)		
Parameter	**Standards (maximum permissible limit)**	**Measuring method**
Noise	85dB(A)	Sound-meter at 7.5 meter from the source

Table 3.3: Proposed National Environmental Quality Standard for Noise			
S. #	**Category of Area / Zone**	**Noise Limit it in dB(A) Leq***	
		Day Time	**Night Time**
1	Residential area (A)	55	45
2	Commercial area (B)	65	55
3	Industrial area (C)	75	65
4	Silence Zone (D)	50	45

Note:

1. Day time hours: 6.00 a. m to 10.00 p. m
2. Night time hours: 10.00 p. m to 6.00p. m
3. Silence zone; Zone which are declared as such by the competent authority. An area comprising not less than 100 meters
around hospitals, educational institutions and courts.
4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent
authority.

*dB(A)Leq: Time weighted average of the level of sound in decibels on scale A, which is relatable to human hearing.

Water quality: The national environmental quality standards for municipal and liquid industrial effluents have been established and have gone through modifications since 1993 as Statutory Notification by the Ministry of Environment, Local Government and Rural Development, Pakistan. The Standards are shown in Table 3.4.

Table 3.4 National Environmental Quality Standard for Municipal and Liquid Industrial Effluents					
S. No.	**Parameter**	**Into Inland Waters**	**Into Sewage Treatment**	**Into Sea**	**Unit**
1	Temperature or Temp. increase	<3	<3	<3	^{o}C
2	pH value (H^{+})	6-9	6-9	6-9	-
3	Biological Oxygen Demand $(BOD)_5$ at 20 ^{o}C	80	250	80	mg/l
4	Chemical Oxygen Demand $(COD)_{Cr}$	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l

9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-)total	1.0	1.0	1.0	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate(SO^{2-})	600	1000	SC	mg/l
14	Sulphide(S^{2-})	1.0	1.0	1.0	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l
32	Chlorine	1.0	1.0	1.0	mg/l

2.1.1 ICT Development Laws and Regulations

The Capital Development Authority (CDA) has the responsibility for the overall planning, provision and supervision of public health services, covering adequate sanitation and garbage disposal within the territorial limits of the Islamabad Capital Territory (ICT). It also has the responsibility for the coordination of public health services with other relevant agencies. This includes collection, transportation and safe disposal of liquid and solid waste collected from residential areas, commercial areas, open spaces etc.

The CDA operations are governed generally by the provisions of the Islamabad Capital Territory Municipal Bye Laws, 1968, as amended from time to time, and specifically by the Islamabad Regulations 1979 (Upkeep of Cleanliness) as amended from time to time.

2.1.2 Islamabad Fire Prevention and Life Safety Regulations 2010

These regulations authorize the CDA to enter and inspect the buildings in ICT regarding the fire provisions and fire safety arrangements for the building. It authorizes CDA to seal the building and /or impose a penalty on the building management in case of violations regarding fire safety arrangements.

2.1.3 Islamabad Capital Territory Municipal Bye Laws 1968

The ICT Municipal bye-laws are required for regulating the erection and re-erection of, management of, or additions and alterations to buildings in the Federal Capital. Under these regulations, guidance has been provided with respect to:

- Drainage and Sanitation
- Fire Resistant and Fire Precautions
- Fire Resistance and Fire Precautions
- Temporary Works in Connection with Building Operations

2.2 International Laws and Legislations

2.2.1 Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste

A European Community programme of policy and action in relation to the environment and sustainable development, supplemented by Decision No 2179/98/EC on its review (5), sets as an objective that critical loads and levels of certain pollutants such as nitrogen oxides (NOx), Sulphur dioxide (SO_2), heavy metals and dioxins should not be exceeded, while in terms of air quality the objective is that all people should be effectively protected against recognized health risks from air pollution. That Programme further sets as an objective a 90 % reduction of dioxin emissions of identified sources by 2005 (1985 level) and at least 70 % reduction from all pathways of cadmium (Cd), mercury (Hg) and lead (Pb) emissions in 1995.

A high level of environmental protection and human health protection requires the setting and maintaining of stringent operational conditions, technical requirements and emission limit values for plants incinerating or co-incinerating waste within the Community. The limit values set should prevent or limit, as far as practicable, negative effects on the environment and the resulting risks to human health.

2.2.2 IFC Guidelines

This provides a summary of EHS issues associated with health care facilities (HCF) which occur during the operations phase, along with recommendations for their management.

Recommendations for the management of EHS impacts common to most large industrial facilities during the construction and decommissioning phases are provided in the General EHS Guidelines.

Health care facilities should establish, operate and maintain a health care waste management system (HWMS) adequate for the scale and type of activities and identified hazards. Facility operators should undertake regular assessment of waste generation quantities and categories to facilitate waste management planning, and investigate opportunities for waste minimization continuously. In addition to the guidance provided on solid and hazardous waste management in the General EHS Guidelines.

At the point of generation, waste should be identified and segregated. Non-hazardous waste, such as paper and cardboard, glass, Aluminium and plastic, should be collected separately and recycled. Food waste should be segregated and composted. Infectious and/or hazardous wastes should be identified and segregated according to its category using a colour-coded system.

Facilities receiving hazardous health care waste should have all applicable permits and capacity to handle specific types of health care waste. Wastes from each category should be treated according to the treatment methods and technologies described in Table 1 of the guidelines. When selecting a waste disposal technology, operators should consider other potential health and environmental issues that may be generated by the treatment. Incineration is a high-temperature dry oxidation process to reduce organic, combustible waste to significantly smaller quantities of inorganic, incombustible matter. Incineration may produce gaseous air emissions, ash residues, and wastewater. Depending on the amount of waste generated and the other factors, HCFs may operate on-site incinerators, or waste may be transported to an off-site incineration facility. Incinerators should have permits to accept health care waste and be properly operated and maintained.

2.2.3 IFC- Environmental, Health, and Safety Guidelines for Waste Management Facilities

The EHS Guidelines for Waste Management cover facilities or projects dedicated to the management of municipal solid waste and hospital waste, including waste collection and transport; waste receipt, unloading, processing, and storage; landfill disposal; physico-chemical and biological treatment; and incineration projects.

Hazardous wastes may be so defined because they share the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics which may pose a potential risk to human health or the environment if improperly managed.

(https://www.ifc.org/wps/wcm/connect/b8d0bf00488658d4b732f76a6515bb18/wastemgmt.pdf?MOD=AJPERES).

2.2.4 NFPA 82- Standard on Incinerators and Waste and Linen Handling Systems and Equipment

This standard presents the minimum fire protection requirements for the construction, installation, maintenance, and use of waste and recyclables storage rooms, containers, handling systems, incinerators, compactors, and linen and laundry handling systems. However, it does not include design criteria for the purpose of reducing air pollution. This standard requires the design and construction of the incinerator to be in a manner that the incinerator and all associated components shall be such that, in service, they will not crack, warp, or otherwise fail structurally to permit flame passage or emission of combustion gases or sparks into the building. NFPA 82 also requires that incinerators be built in accordance with the following requirements:

- All combustion shall take place within the combustion chamber designed for combustion temperatures.
- Combustion shall not take place in breaching or chimneys unless they are designed as combustion chambers.
- Incinerators designed for positive pressures shall be gastight.
- The combustion chamber, inner walls, roofs, bridges, walls, and curtain walls shall be constructed to withstand the combustion temperatures involved and shall maintain their integrity under all operating conditions.
- Metal stays, lintels, or other supports shall not be exposed to the interior of the combustion chamber.
- An exterior masonry casing shall be reinforced with structural steel framework, and an exterior steel casing shall be reinforced with structural steel members such that the casing will withstand interior thrusts from arches and be capable of supporting all doors and burner equipment.
- The steel casing or framework shall be erected and set plumb before any brickwork is done.
- Cylindrical outer casings made of steel not less than ¼ in. (6.4 mm) thick shall not be required to be reinforced.
- All incinerator structures shall be designed to comply with applicable building codes, and consideration shall be given to the most adverse conditions of seismic, wind, dead, live, moving, concentrated, erection, and thermal loadings; corrosion allowance; or combinations thereof.
- No part of an incinerator shall be used as a wall, roof, or floor of a building.

NFPA 82 also provides guidance on explosion relief, placement, clearance, and residue removal.

Chapter 03

PROJECT DESCRIPTION

The ZWS, in continuation of their services expansion across Pakistan, intends to install a new incinerator to incinerate the healthcare waste (hazardous waste) within the PSIC, Taxila premises located in the district Rawalpindi.

Incineration of waste materials converts the waste into ash, flue gas and heat. Waste volume reduction after incineration is around 95% of the waste burnt. The amount of fuel required to support combustion is determined by the combustibility of the waste itself. The ash that remains is free from all kinds of organic waste. Manufacturer vendor details are annexed in Annexure 4.

3.1 Project Objectives

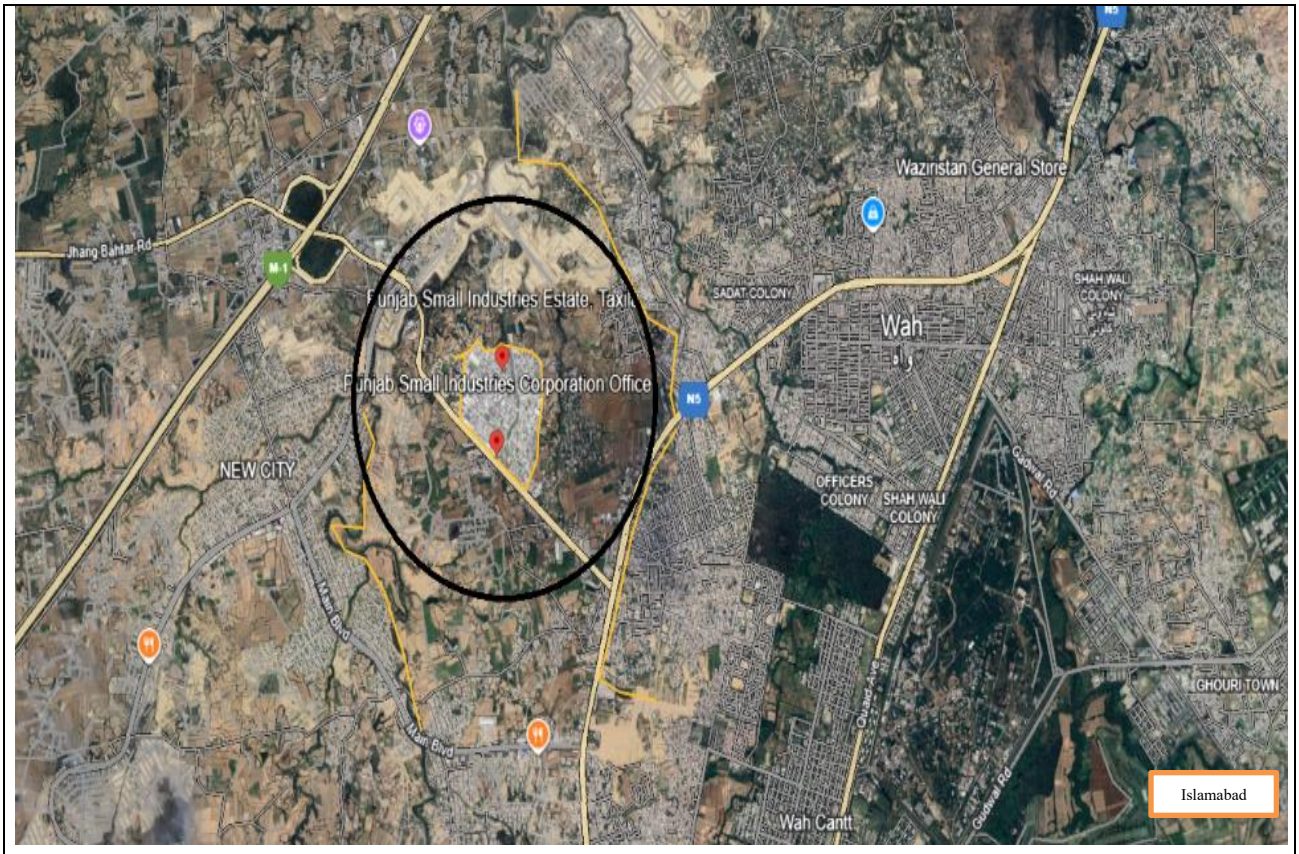
The key objective of the project is to dispose of the hazardous waste from different healthcare facilities/ operations in an environmentally sound manner and in accordance with national and international guidelines for hospital waste management.

The activities of healthcare facilities, because of their characteristics, imply a greater use of single-use materials and, consequently, a steady increase in the production of various types of medical waste. A significant fraction of such waste, hazardous and potentially infectious, involves the use of incineration plants to be properly disposed. The incineration allows the optimization of the management of this waste both from a safety point of view and the economic point of view. The incineration method offers an effective way to treat hazardous waste. Some other advantages of incineration include:

- Reduction in waste volume
- Avoidance of mismanagement of medical waste that can be otherwise harmful to health if not disposed of properly
- Eliminates unpleasant odours
- Environmentally friendly technology

3.2 Project Location and Surroundings

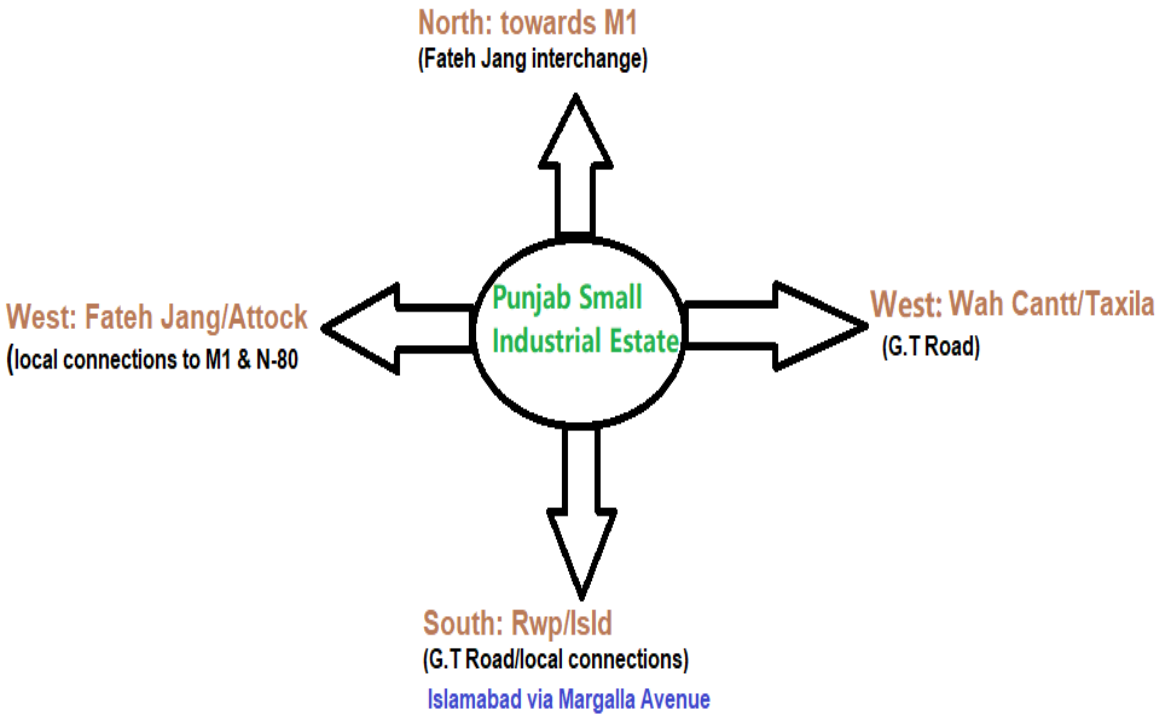
The project site is located in the Punjab Small Industrial Estate (Figure 3.1). Location coordinates for the site are 33.695978"N and 73°00'55.1"E.



N E S W	TERRE-VERDE ENVIRONMENTAL SOLUTIONS (SMC-PVT LTD)	Prepared by: Chaudhary Asif Approved by: Dr. Ilmas
	Date: 23/09/2025	Client: Zypher Waste Solutions Pvt Ltd

Figure 3.1: Site location

Table 3.1: Accessibility of Site Location	
North	Coming from the north (e.g. from M-1 motorway, Islamabad / Attock side), one can exit via the interchange at Fateh Jang or nearby, then take local roads leading south toward Bahtar Road.
South	From the south (towards Islamabad, Rawalpindi direction), using the motorway or GT Road and then connecting via local roads toward Fateh Jang / Bahtar.
East	From the east side, likely via roads coming out of the Wah / Rawalpindi direction, then heading west toward Bahtar Road. Some roads cross through small towns / rural areas.
West	From western Punjab (e.g. from Attock / DB / M1), use M1/other major routes then take turns toward Fateh Jang and approach Bahtar Road.



3.3 Project Overview

The salient features of the project are given in the table below.

Table 3.1: Project Details

Category	Item / Description	Details / Specification	Units / Notes
General Information	Type	Dual-Chamber Solid/Liquid Waste Incinerator	Suitable for medical, industrial, or municipal waste
	Dimensions	20'-0 x10'-0 x7'-11"	
	Manufacturer	Industrial Combustion and Control Pvt Ltd, Karachi	
	Incinerator Made	ICC Fabricated	
	External cladding	Steel	
	Current status of the project	Proposal stage	
	Cost of the Project		
	Operation	Semi-automatic / Fully automatic control	Automatic temperature & burner management
	Fuel	Natural Gas	Quotation based on 8 psig gas pressure
	Utilities	Fuel gas, power, and water to be provided by client	At site and cost of client
Primary Combustion Chamber	Pilot Burner	Auto ignition – On/Off	Reliable flame initiation
	Nozzle Mix Burner	Auto ignition – On/Off	Ensures stable primary combustion
	Temperature Controller	Automatic	Maintains preset combustion temperature
	Burner Control	Safety + Hi/Lo	Over-temperature and flame monitoring
	Refractory Rating	1200	°C
	Working Temperature	800 – 1200	°C
Secondary Combustion Chamber	Pilot Burner	Auto ignition – On/Off	Secondary oxidation of remaining gases
	Nozzle Mix Burner	Auto ignition – On/Off	
	Temperature Controller	Automatic	Independent chamber control
	Burner Control	Auto + Safety	Prevents backfire or overburn
	Refractory Rating	1600	°C
	Working Temperature	1200 – 1600	°C

	Outside Cladding Temperature	< 50	°C (Safe for operators)
Stack (Chimney)	Construction	3 mm & 4 mm Mild Steel Sheet	With corrosion-resistant coating
	Height	30	feet
	Purpose	Safe dispersion of flue gases	Promotes dilution & prevents ground-level impact
Blowers & Motors	Primary Combustion Blower (2 units)	5	kW each
	Secondary / Excess Air Blower	10	kW
	Induced Draft (I.D.) Blower	50	kW
	Purpose	Air regulation and draft maintenance	Supports efficient combustion & gas flow
Utility Requirements	Gas Consumption (Max)	210	m^3/hr
	Gas Consumption (Normal)	105	m^3/hr
	Electrical Supply	220 VAC & 380 VAC, 3 Phase	Standard industrial setup
	Electrical Load (Max)	70	kW
Safety Measures	Temperature Control	Automatic interlock and cut-off	Prevents overheating
	Flame Failure Protection	Auto shut-off	Stops gas flow if flame fails
	Refractory Insulation	High-temperature ceramic lining	Reduces heat loss & enhances durability
	Cladding Temperature	Maintained below 50°C	Protects operators
	Dual-Chamber System	Primary + Secondary combustion	Ensures complete destruction of waste
	Air Control System	Independent blowers	Optimizes oxygen supply, prevents incomplete burning
	Stack Height	30 ft	For safe gas release
	Emergency Shutdown	Automatic safety trip	Activated on overheat or power failure
	Operator Safety	Insulated surfaces and automatic controls	Minimizes manual exposure
	PPE	Ensured necessary PPEs	Minimize staff health risks
Environmental & Emission	Secondary Chamber Temperature	Maintained at ≥1200°C	Destroys dioxins, furans, and other organic pollutants

Control Features	Retention Time	Minimum 2 seconds (standard design assumption)	Ensures complete combustion of volatile gases
	Excess Air Supply	Controlled via blowers	Supports full oxidation and reduces CO formation
	Stack Height & Dispersion	30 feet above ground	Enhances dilution of flue gases
	Air Pollution Control (Optional)	Scrubber, wet or dry filtration (if installed)	For acid gases, particulates, and odor control
	Combustion Efficiency	≥99% (typical for dual-chamber design)	Ensures minimal unburned residue
	Emission Parameters (expected)	CO < 100 mg/Nm³, PM < 50 mg/Nm³, Dioxins/Furans within WHO/EU limits	Depends on feed waste and control equipment
	Ash Residue	<5% of the original waste volume	To be disposed of in lined landfill Further sustainable options are under review
	Noise & Vibration Control	Balanced blower units and insulated housing	Reduces operational noise levels
	Monitoring	Thermocouples and temperature loggers	For regulatory compliance and operator recordkeeping

3.3.1 Operational Process Flow

1. **Startup Phase:**
   - Pilot burners ignite automatically. Temperature gradually increases to the setpoint in the primary chamber.
2. **Primary Combustion:**
   - Main burners operate in Hi/Lo mode; waste begins decomposition and gasification. Combustion gases move to the secondary chamber.
3. **Secondary (Post-) Combustion:**
   - High-temperature oxidation ensures destruction of organic gases and particulates.
   - Temperature controllers maintain 1200–1600°C.
4. **Emission Handling:**
   - Treated flue gases are directed to the **stack** by the I.D. blower for safe release.
5. **Cooling and Ash Removal:**
   - The refractory cools gradually; ash is collected from the bottom for disposal.
6. **Automatic Shutdown:**
   - When the cycle ends or upon emergency trigger, the system shuts fuel supply and stops burners.

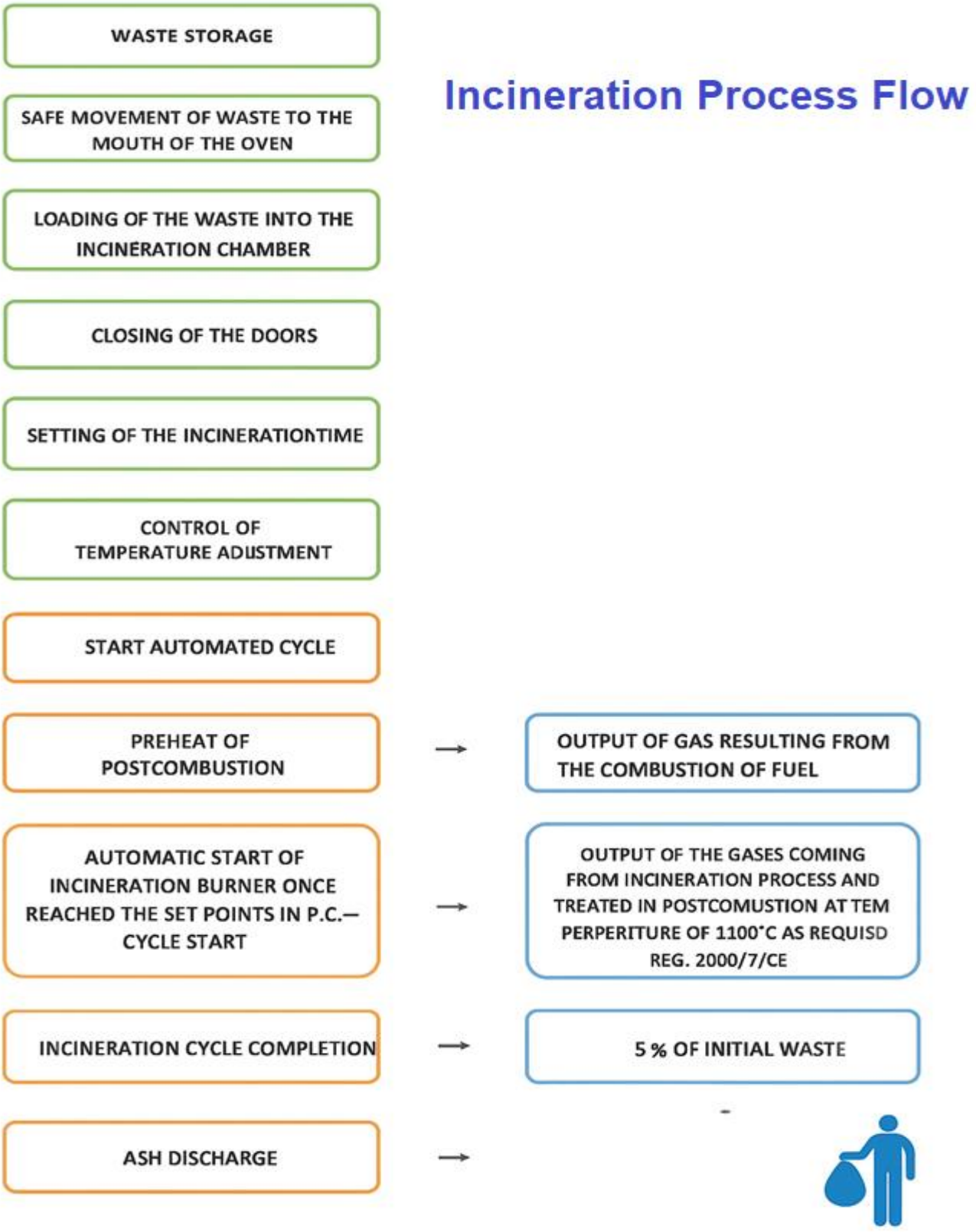
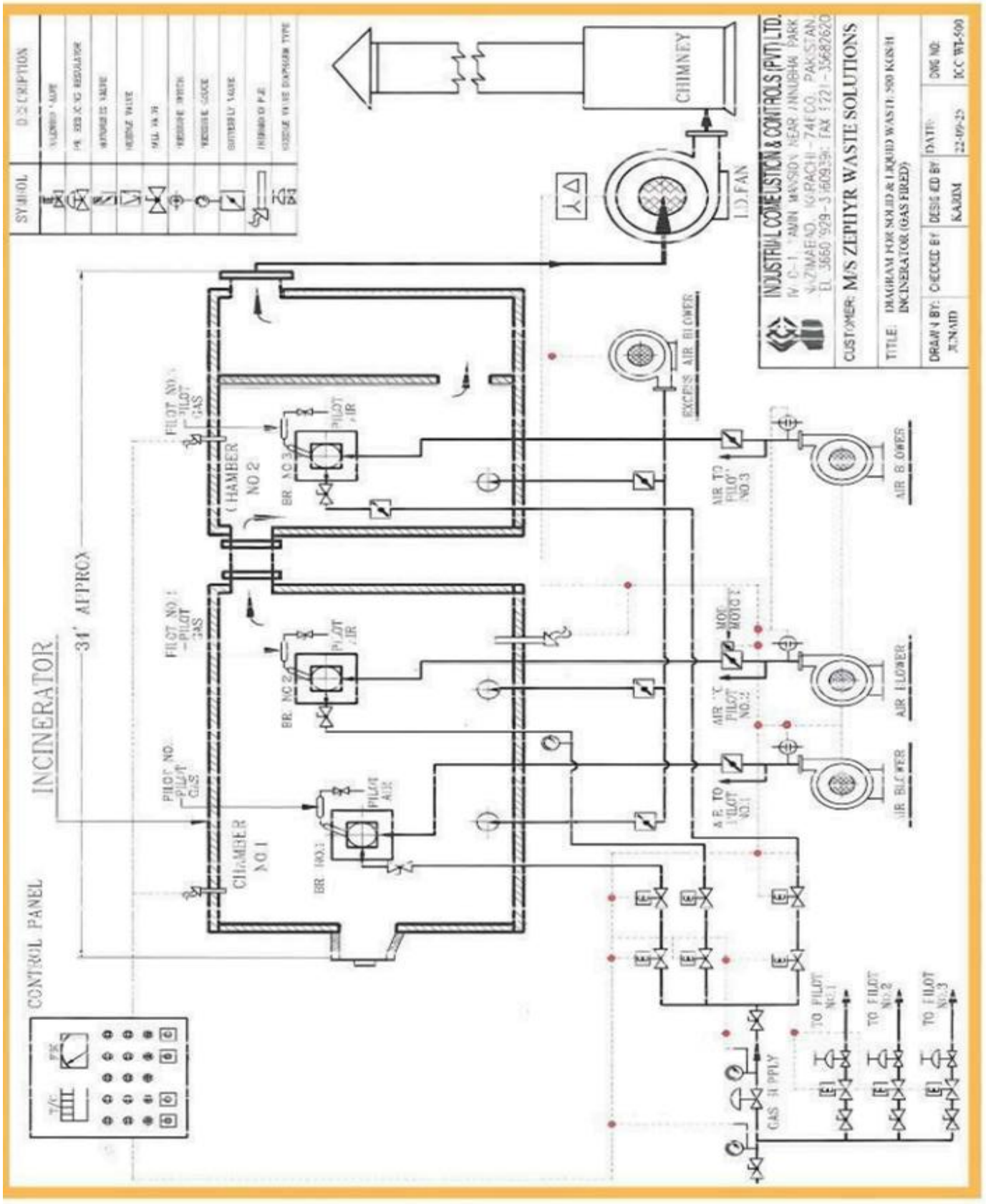


Figure 3.2: Incineration Process Flow Diagram

Figure 3.3: Incineration Design Layout



3.3.2 Incineration Process

3.3.2.1 Combustion Mechanism (Primary Chamber)

Purpose and Function

The primary combustion chamber is the first and most critical stage in the waste destruction process. Its main purpose is to thermally decompose and oxidize solid waste under controlled conditions. The waste is exposed to high temperatures using natural gas burners that ignite and maintain combustion.

Design and Operation

- **Burner System:**

  Pilot Burner: Operates automatically (Auto On/Off) to initiate the ignition sequence safely.

  Nozzle Mix Burner**:** Also, automatic; provides a homogeneous air-fuel mixture, ensuring uniform flame and steady combustion.

- **Temperature Control:**

  The automatic temperature controller maintains chamber temperature between 800°C and 1200°C. The controller modulates the burner firing rate (Hi/Lo mode) to avoid overheating and fuel wastage.

- **Air Supply:**

  Combustion air is supplied by two primary combustion blowers (each 5 kW).Air volume is adjusted automatically to maintain an optimal stoichiometric ratio for complete oxidation of organic materials.

- **Combustion Process:**

  Waste is loaded into the refractory-lined chamber. On ignition, the organic fraction is converted to CO_2, H_2O, and heat, while non-combustible materials remain as ash. Partial oxidation produces hot gases containing CO, hydrocarbons, and other volatiles, which flow into the secondary chamber for further treatment.

- **Construction:**

  The refractory lining is rated at 1200°C, ensuring thermal stability and protection against corrosion and mechanical stress.

- **Safety Features**

  Automatic Safety Burner Control prevents gas supply if ignition fails. Flame detection sensors continuously monitor burner operation. High-temperature cut-off automatically stops burners if chamber temperature exceeds the safe limit.

3.3.2.2 Post-Combustion Mechanism (Secondary Chamber)

Purpose and Function

The secondary combustion chamber ensures complete oxidation of the gases, smoke, and volatile organic compounds (VOCs) produced in the primary chamber. This stage eliminates toxic gases, odor, and visible smoke, ensuring compliance with environmental standards.

Design and Operation

- **Temperature Range:**

  The secondary chamber operates between 1200°C and 1600°C, sufficient to destroy dioxins, furans, and other hazardous organics.

- **Burner System:**

  Equipped with Auto On/Off pilot and nozzle mix burners, controlled automatically through a separate temperature controller. The burner system ensures complete oxidation of carbon monoxide and unburned hydrocarbons from the primary stage.

- **Air Supply and Flow:**

  A dedicated secondary/excess air blower (10 kW) supplies preheated air to support complete oxidation. The Induced Draft (I.D.) blower (50 kW) draws flue gases through the chamber, maintaining consistent gas velocity and residence time.

- **Residence Time:**

  The flue gases remain in the chamber for at least 2 seconds at ≥1200°C-1600°C, which ensures full decomposition of harmful pollutants.

- **Refractory Lining:**

  The refractory material is rated for 1600°C, capable of withstanding sustained high temperatures. The outer cladding temperature is maintained below 50°C, protecting operators and surrounding equipment.

- **Combustion Reactions:**

  - $CO \rightarrow CO_2$
  - Hydrocarbons $\rightarrow CO_2 + H_2O$
  - NOx and SOx formation minimized by proper air-fuel ratio control.

- **Emission Path**

After complete oxidation, the clean flue gases pass through the stack (chimney) — a 30-foot-tall mild steel structure (3 & 4 mm thick) — which safely disperses gases into the

atmosphere above ground level, minimizing local pollution impact.

3.3.2.3 Process Control Mechanisms

Automation and Control System

The entire incineration process is managed through an automatic control panel, ensuring stable operation, efficient fuel use, and maximum safety.

Table 3.2: Automation and Control System

Control Element	Function
Temperature Controllers (Auto)	Continuously monitor and regulate chamber temperatures. Adjusts burner intensity (Hi/Lo) automatically.
Burner Safety Control Unit	Shuts off gas supply in case of flame failure or abnormal operating conditions.
Flame Sensors	Detect and verify pilot and main burner flames, ensuring safe ignition.
Pressure and Air Flow Sensors	Ensure that correct air pressure is maintained in each chamber and that gas/air mixture remains stable.
Blower Interlocks	Prevent burner operation unless blowers are running and airflow is sufficient.
Emergency Shutdown System	Activates in case of over-temperature, draft loss, or power failure. Immediately cuts fuel and shuts all burners.
Power Requirements	220 VAC & 380 VAC, 3 Phase; Maximum 70 kW electric consumption.

3.4 Project Components

Main project components include:

- Waste storage and loading area
- Incinerator Plant
    - Primary Combustion Chamber
    - Post Combustion Chamber (Secondary Chamber)
    - Combustion System
    - Chimney
    - Flue Gas Wet Scrubber (Emission Control)
    - Electrical Control Panel
- Incinerated waste collection and storage

3.4.1 Waste Storage Area

Waste to be treated will be stored in demarcated areas with adequate lining. The waste will then be picked up with a trolley and moved to the incinerator.

3.4.2 Waste loading

Waste will be loaded in the primary chamber by the operator, ensuring that the loaded material is not positioned so as to occlude the fumes duct and not too close to the mouth of the burner. The operator will receive training before starting to handle and operate the incinerator.

3.4.3 Preparatory/ Installation Activities

Since the plot is ready and hence it does not involve any major construction work. Few modifications in the plot will be carried out to fulfil the requirements, such as the designation of the storage area, ensuring ventilation, etc. Installation activity will be limited and may include:

- Dedicating and preparing a of waste storage area
- Dedicating and preparing a of gas cylinders storage area
- Construction of a lined ash pit
- Masonry work for incinerator plant installation
- Installation of pre-fabricated Incinerator plant and its ancillary facilities and Mechanical and electrical works

3.5 Waste Management

3.5.1 Solid waste/liquid waste

The waste generated during the incineration process will include bottom ash and minute wastewater from the scrubber. The fly ash is mostly formed by the inorganic constituents of the waste and takes the form of particulates carried by the flue gas. The bottom ash will be collected and disposed of in a concrete-lined waste pit. The quantity of wastewater generated will be minimal, as it will be used and reused in a closed-loop system. If there is a need to dispose of any wastewater, it will be neutralized after checking its pH levels.

International practices for management of bottom ash:

Currently, hazardous waste incineration ashes are mostly dumped, or disposed of, in landfills or ash lagoons. There is however also substantial, but geographically variable, utilization of such ashes, mostly in construction, including civil engineering (e.g., in roads, embankments). Wider utilization of such ashes is also being researched. Hazardous-waste landfill is designed to ensure that there will be no groundwater pollution. Under some circumstances, the ash can be classified as nonhazardous after a comprehensive test procedure.

3.5.2 Gaseous Emissions

The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere. Incineration under effective and controlled process produces carbon dioxide, water vapor and ash as major by-products. The incinerator will use wet-scrubber technology to remove pollutants from exhaust gases.

Air dispersion modeling for the proposed project was conducted, which suggested 30 ft height of the stack as adequate for effective dispersion of flue gas.

Control of Dioxins and Furans

Dioxins and furans constitute a group of persistent pollutants that inexorably originate from thermal and combustion operations. Certain dioxin and furan isomers are well known for their toxicological features-they exert carcinogenic and mutagenic effects.

Good combustion practice coupled with end-of-pipe treatment using a scrubber and bag filter enables a significant reduction in emission of dioxin and furan compounds, even up to 99%. The proposed incinerator technology utilizes dual combustion chambers (primary and secondary) for an efficient burning process. 'Dual chamber' systems operate by destroying hazardous wastes in a primary chamber and then exposing the gases from the primary chamber for a second time in a secondary combustion chamber. These exposures lead to the decomposition of dioxin and furan compounds and prevent the toxic emissions from being

released into the atmosphere. The secondary chamber of the proposed incinerator will expose the incoming gases from the primary chamber to a temperature of >1200°C.

3.5.3 Wastewater

The water in the scrubber will be used in a closed-loop system. The only other potential wastewater source can be from the washing of storage areas used for waste storage. The wastewater from these pits will be screened, collected and disinfected before release into the local drain.

3.6 Work force

During the installation phase, 5 to 10 persons will be required for civil and technical work, provided by the installation company. During the operation phase, 3 sanitary workers, 1 supervisor and 1 incinerator operator will satisfy the requirement.

3.7 Utilities Requirements

3.7.1 Electricity

The electricity requirement will be fulfilled through the existing electricity supply. Approximate maximum requirement will be 70 kW. For a backup power supply, 1 generator (approx. 250 kVA) will be used as backup.

3.7.2 Water

There will be no major construction activity for the project; hence, water requirement during operation will be very limited, approximately 5-8 gallons per day. During the operation phase, water will be required for scrubber and waste pit washing. Being a closed-loop system, it doesn't need to change the water. Water requirement will be met through the existing water supply.

3.7.3 Fuel

Gas will be required as the primary burning fuel for the project. Gas requirement will be fulfilled through the existing Gas supply. In case of gas load shedding, gas cylinders will be used as backup following the NFPA 58 Requirements & Safety Rules for Cylinder Storage.

3.8 Installation Schedule

Installation will start after getting approval from the Pak EPA and shall be completed in a period of 06-07 weeks.

3.9 Project Alternatives

This section covers the project alternatives which were examined for the proposed project.

An analysis of the available alternatives is necessary to establish that the most suitable management and technology options will be adopted for the project, while minimizing environmental impacts. This evaluation explains the selection of the appropriate option that was required to ensure optimal results within a defined set of economic, environmental, health and safety constraints.

Alternatives analyzed in this regard include:

1. The "No Project Option"
2. Alternative Site Options
3. Alternative technology

3.9.1 No Project Option

No project option refers to continuation without this project. In such case, the region will continue to face serious public health risks due to inadequate treatment and disposal of infectious and pathological waste. Uncontrolled burning and improper dumping may lead to environmental degradation, including air pollution, toxic emissions (dioxins and furans), and groundwater contamination. The absence of a compliant facility would result in regulatory violations, limiting the area's capacity to manage increasing waste volumes. Furthermore, the lack of a commercial-scale solution could damage institutional credibility, discourage future investment, and lead to economic losses through higher long-term costs for remediation, legal actions, and public health impacts.

3.9.2 Project Location

Table 3.3: Site Alternative Analysis

Evaluation Criteria	Taxila Industrial Estate	Hattar Industrial Zone	Rawat Industrial Area	Any Hospital Premises
Zoning & Legal Compliance	✅ Industrial	✅ Industrial	✅ Industrial	⚠ Not industrial
Distance from Sensitive Receptors	✅ >500 m buffer	✅ >800 m	⚠ <300 m (urban proximity)	❌ Within hospital zone
Utility Availability	✅ Excellent	✅ Excellent	✅ Moderate	⚠ Variable
Access to Transport Routes	✅ Excellent	✅ Good	✅ Excellent	⚠ Limited access roads
Regulatory Feasibility	✅ Within Punjab EPA jurisdiction	⚠ Cross-border (KPK)	✅ Within Punjab EPA	⚠ Complex approval

Community Acceptance	✅ Moderate (industrial surroundings)	✅ Moderate	⚠ Likely objections	❌ High objection potential
Environmental Sensitivity	✅ Low	✅ Low	⚠ Medium	⚠ High
Overall Suitability	✅ Highly Suitable (Preferred)	⚠ Suitable (Regulatory limitation)	⚠ Marginal	❌ Not suitable

Site selection for the proposed incinerator considered environmental suitability, regulatory compliance, accessibility, and public safety. The chosen location — Punjab Small Industrial Estate, Taxila, District Rawalpindi — provides an industrially zoned setting that aligns with environmental and operational requirements for such facilities. Alternative site options were evaluated to ensure the most environmentally and economically viable location, using criteria such as distance from sensitive receptors, infrastructure availability, topography, utility access, land ownership, and community acceptance.

3.9.3 Technology Alternative

Incineration of wastes has been widely practised, but alternatives are also available, such as autoclaving, chemical treatment and microwaving, and may be preferable under certain circumstances. Options available for the treatment of hazardous hospital waste are discussed below.

1.) Incineration

Incineration comprises the process of burning waste in temperatures ranging from 1,800°F to 2,000°F (982°C to 1093°C). Incineration is a widely accepted and often preferred method of treatment, particularly on-site incineration, which provides the advantage of a quick, easy disposal method. However, due to emissions concerns, some countries have enacted moratoriums on incinerators to suspend permitting until further information on the safety of the option is available.

2.) Autoclaving

Also known as steam sterilization, autoclaving is the most commonly utilized alternative to incineration. In this method, wastes are sterilized or disinfected prior to disposal in a landfill. Bags of waste are placed in a chamber, and steam is introduced for a predefined period of time at a specified pressure and temperature. This assures the destruction of microorganisms. It is both less costly and carries no documented health impacts. Approximately 90% of regulated medical wastes are suitable for autoclaving, particularly microbiological wastes. Autoclaves are not suitable, however, for pathological, cytotoxic, or other toxic chemical wastes.

3.) Gas sterilization

In this process, medical waste is fed into an evacuated air-tight chamber and treated with a sterilizing agent (such as ethylene oxide or formaldehyde). The gas that comes into contact with the waste will kill harmful, infectious agents. However, US EPA does not recommend ethylene oxide for treating infectious wastes due to its toxicity.

4.) Chemical disinfection

This process involves the use of chemical agents for disinfection such as chlorine. Chemical disinfection processes are most appropriate for liquid wastes, although they can still be used to treat solid wastes. There are a number of factors that should be considered regarding the effective usage, including: the types and biology of microorganisms in the wastes, degree of contamination, type of disinfectant used as well as its concentration and quantity, contact time, and mixing requirements.

Another option is the grinding of medical waste before exposing it to a liquid chemical disinfectant. Grinding ensures sufficient exposure of the chemical agent to all parts of the waste and assists in easy disposal of any residues. The resulting liquids are placed into the sewer system, while solid residues are disposed in landfills.

5.) Microwave

In microwave technology treatment, waste is first shredded, and then mixed with water and internally heated to neutralize all present biological contaminants. Computerized controls are employed to ensure the minimum parameters for disinfection and proper equipment function. As with autoclaving, approximately 90% of medical wastes can be treated with this process. The shredding process results in a volume reduction, and energy use is reportedly lower than that of an incinerator.

6.) Irradiation

This method involves sterilizing waste by exposing it to a cobalt source. Cobalt gives out gamma radiations that destroy all microbes in waste. The high cost of cobalt and high operating costs, however, have discouraged commercial ventures from using the technology for the treatment and management of medical waste. There have also been some questions raised about the actual process of radiating the material and achieving adequate disinfection. As with autoclaving and microwave methods, it is not recommended for pathological wastes.

7.) Thermal inactivation

This process involves heating waste to temperatures at which infectious agents are killed. It is used for treating large volumes of liquid clinical wastes. A chamber is preheated to an intense, specified temperature and held for a specified time, then released.

Incineration is the method of choice preferred for variety of waste including hazardous non-hazardous, healthcare, domestic and industrial due high waste reduction efficiency and safer disposal of infectious waste. Incineration technology focuses on complete burning of waste and pollution control and treatment. Keeping in view the waste management issues especially the mixing of hazardous and non-hazardous waste and absence of specifically constructed landfill site; incineration is suitable and most prefer option for disposal of hospital waste. Major impact of incineration is air emissions, to cater this issue various technologies have been developed which showed satisfactory results. A comparison of different technological options for hospital waste treatment and their feasibility/applicability is given in the table below.

Table 3.4: Different options for Hospital waste treatment

Incineration	Autoclave	Gas sterilization	Chemical disinfection	Microwave	Irradiation	Thermal inactivation
Quick and easy (On-site incineration)	Less costly and carries no documented health impacts.	Not recommended due to the toxicity of ethylene oxide.	Most appropriate for liquid wastes, although it can still be used to treat solid wastes.	Around 90% of medical wastes can be treated with this process.	High operating costs	Used for treating large volumes of liquid clinical wastes.
Emissions concerns.	Approximately 90% of regulated medical wastes are suitable for autoclaving		The number of factors needs to be considered while opting to use this method.	energy use is reportedly lower than that of an incinerator.	not recommended for pathological wastes.	100% waste treatment is difficult to achieve.
Incineration waste management issue.	not suitable for pathological, cytotoxic, or other toxic chemical wastes.			Complete treatment of waste is not achieved.		

Of the above methods, two common methods include incineration and autoclaving. Incineration is often preferred over autoclaving since 100% disinfection is difficult to achieve with an autoclave.

[2] e.g. procedures provided under USA's Resource Conservation and Recovery Act (RCRA) regulations.

Chapter 4

DESCRIPTION OF ENVIRONMENT

4.1 General

This section provides a detailed environmental and social baseline profile of the project area where the proposed project will be undertaken. The information presented in this section covers:

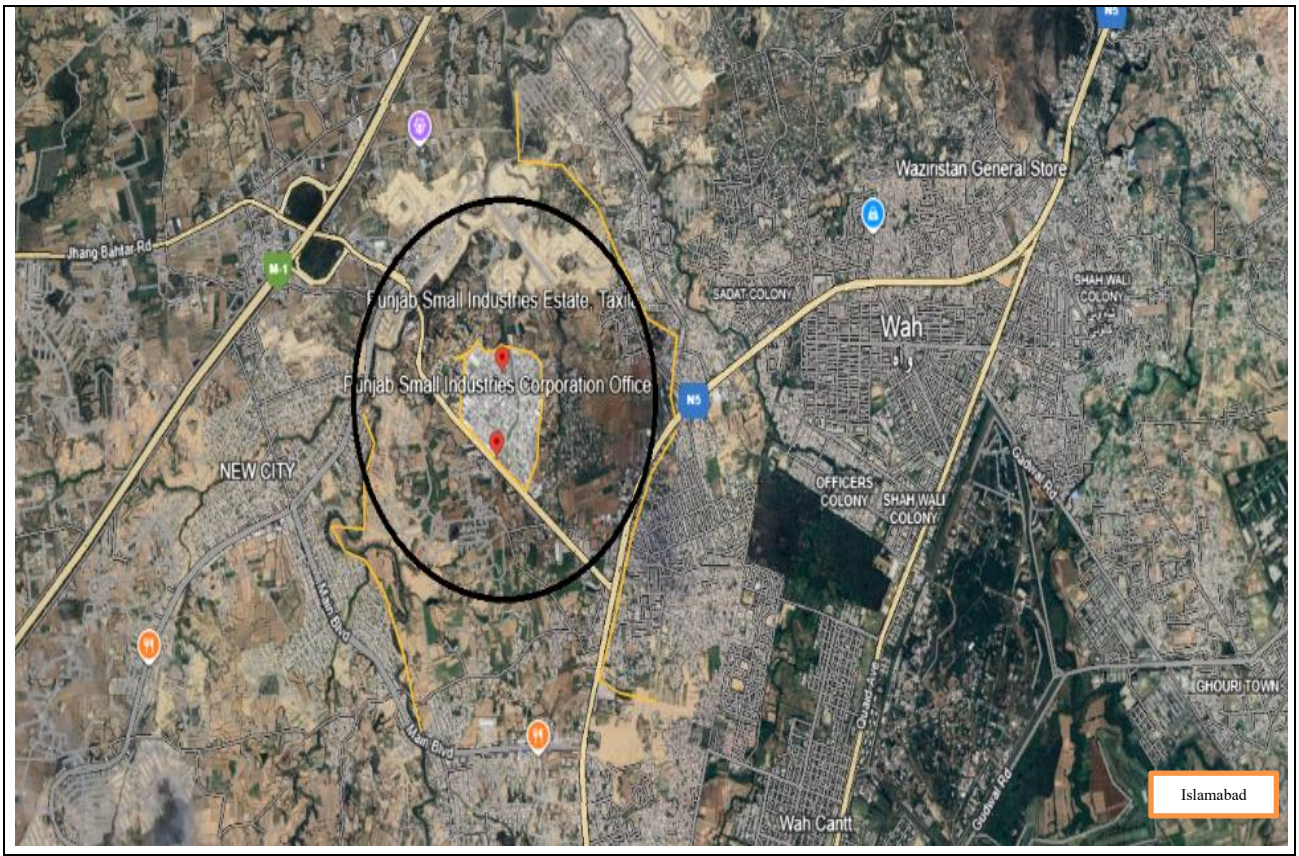
1. Physical Environment
2. Ecological Environment
3. Socioeconomic Environment

Information for the above areas has been collected from both primary and secondary sources. Secondary data includes maps prepared by the Geological Survey of Pakistan, the Soil Survey of Pakistan, published literature, Census Reports, etc. Primary data was collected through field surveys, onsite environmental monitoring and discussions with the locals.

The baseline information of the project area is required for the identification and assessment of potential social and environmental impacts associated with the implementation of the project. On the basis of baseline information, the project interventions would be addressed and mitigation measures proposed. The baseline information also helps to indicate the specific issues to be monitored during project execution as well as during the operational phase.

4.2 The Study Area

The project site and its vicinity within a 250 m radius are taken as the microenvironment for the EIA. Figure 4.1 shows the project location in the microenvironment.



N E S W	TERRE-VERDE ENVIRONMENTAL SOLUTIONS (SMC-PVT LTD)	Prepared by: Chaudhary Asif Approved by: Dr. Ilmas
	Date: 23/09/2025	Client: Zypher Waste Solutions Pvt Ltd

Figure 4.1: Project Location and Surroundings

4.3 Physical Environment

Detailed description of the physical resources is covered under the subjects of geology, soil condition, climate, surface and ground water resources, and seismology. The information is sourced from primary and secondary sources.

4.3.1 Geology and Soil Conditions

Taxila is situated on the Pothohar Plateau, which is part of the northern Punjab region of Pakistan. The elevation in the Taxila valley ranges from approximately 1,700 to 1,800 feet (around 520 to 550 meters) above sea level. The geological landscape of the area is influenced primarily by the Murree Formation, which consists of various sedimentary rocks including sandstones, siltstones, and shales. In particular, the Margalla Hill Limestone can be found near the base of the hills. A significant tectonic feature, the Main Boundary Thrust (MBT), plays a crucial role in the area's geological structure, where limestone from Margalla

is thrust over the sandstone of the Murree Formation, especially near Nicholson's Monument. Consequently, the underlying geology comprises sedimentary layers such as sandstones, shales, and limestones, alongside potential residual or alluvial materials in the lower-lying sectors of the region.

- The structural features of Taxila reveal its susceptibility to tectonic processes, indicated by the presence of thrust faulting such as the MBT, which points to geological stress in the area. Additionally, alluvial cover is prominent in the lowland and valley areas, particularly near drains and streambeds.
- In terms of soil conditions, the broader Pothohar region, including Taxila, predominantly features residual soils formed through the weathering of underlying sedimentary rocks, as well as alluvial soils found in valley bottoms and near watercourses. In the sub-montane areas of the Pothohar Plateau, the soils typically comprise silty loams, sandy loams, and residual silty eroded loess, with a high calcium carbonate content being common. Organic matter content in these soils tends to be low, especially in drier and more eroded locations. The surface soils in this region are generally calcareous, which significantly influences their buffering capacity, nutrient availability, and chemical reactivity. pH values for soils in the Pothohar area are slightly alkaline, often ranging from approximately 7.4 to 8.0. The electrical conductivity (EC) of these surface soils remains relatively low, typically between 0.2 to 0.4 dS/m, except in areas that are saline or have irrigated drainage.
- Physical properties and soil mechanics in the Taxila area are crucial for understanding stability. Several studies, including slope stability assessments near Qalandarabad, have revealed soil compositional varieties such as silty clayey sand, silty sand, and silty sand with gravel, which often exhibit low plasticity. The cohesion values of these soils are generally low, ranging from 1.39 to 5.48 kPa, while the internal friction angles are moderate, falling between 15.5° and 19.4°. As a result, the soil can be categorized as weak to moderately strong for construction purposes, depending on depth, with rock or bedrock potentially encountered at shallow to moderate depths due to the local geological conditions.
- Erosion and landscape stability are pressing concerns in the Pothohar region, particularly due to its semi-arid climate characterized by high temperatures in summer and monsoonal rains. This environmental condition makes surface soils quite susceptible to erosion and gullying, especially on slopes where vegetation is sparse. Furthermore, residual soils resting on weathered bedrock may exhibit fractures or tension cracks, particularly on slopes with unfavorable drainage conditions.

4.3.2 Topography

The proposed site for the incinerator is located within the Taxila Valley of the Pothohar Plateau in District Rawalpindi, Punjab, at an elevation of 520–540 meters above mean sea level. The terrain

features gentle undulations and low interfluves, shaped by erosion and deposition processes, transitioning from rocky uplands to flatter plains. The Punjab Small Industrial Estate, where the incinerator will be sited, is on relatively level ground that has been pre-developed for industrial use, with slopes ranging from 0.5% to 3%, facilitating good drainage.

Surface slopes are gentle (1° to 5°) and direct runoff towards minor seasonal streams and drainage channels, with no major watercourses crossing the estate. During the monsoon season, intense rains can cause temporary waterlogging, necessitating effective grading and stormwater management to prevent issues near foundations. The area exhibits geomorphological features of a structurally controlled depression bordered by low ridges, providing stable ground for construction.

Key implications for project design include the suitability of the well-drained terrain for industrial development, maintaining natural drainage, implementing surface protection to reduce erosion, and addressing stormwater and foundation drainage effectively to mitigate risks such as erosion or waterlogging.

4.3.3 Existing Land Use

Within the broader 3 km buffer, the land use remains predominantly industrial and semi-urban, gradually transitioning into agricultural land and rural settlements toward the outskirts of Taxila town.

- Nearest residential clusters: scattered houses and small hamlets exist approximately 500–800 m west and southwest of the industrial estate boundary.
- Nearest educational institution: likely local school or training center in Taxila town (~1.5 km).
- Nearest healthcare facilities: Taxila Civil Hospital (~3 km southeast) and Wah Cantt hospitals (~6 km).
- No schools, mosques, or dense housing are located within 300 m of the proposed plot, meeting siting safety criteria for industrial operations.

This land-use configuration provides a buffer zone between the project and the nearest residential receptors, reducing potential nuisance or air-quality impacts

Seismicity

The proposed site lies within the northern part of the Pothohar Plateau, which forms part of the active Himalayan foreland tectonic zone of northern Pakistan. This region is structurally complex and seismically active due to ongoing collision between the Indian and Eurasian tectonic plates. Taxila is situated near the Main Boundary Thrust (MBT) — a major regional fault system marking the boundary between the Himalayan foothills and the Pothohar Plateau. The MBT extends from Hazara–Kashmir through Margalla Hills towards Kalabagh, and passes north of Taxila, making the area one of moderate to high seismic potential within Punjab.

Seismicity details of the Area	
Parameter	**Value / Description**
Seismic Zone (BCP 2007 / NBCP 2021)	Zone 2B – Moderate to High Hazard
Peak Ground Acceleration (PGA)	0.16–0.24 g
Seismic Intensity (MMI)	VII–VIII (Very Strong)
Dominant Fault	Main Boundary Thrust (MBT) – ~10 km north
Soil Type (Preliminary)	Silty sand / sandy silt with local alluvium
Liquefaction Potential	Low to Moderate (site-specific verification required)
Landslide / Fault Rupture Risk	Low (no active fault mapped within site)
Structural Design Code	Building Code of Pakistan – Seismic Provisions (Zone 2B)
Recommended Structural Measures	Ductile design, anchoring, flexible gas lines, seismic bracing

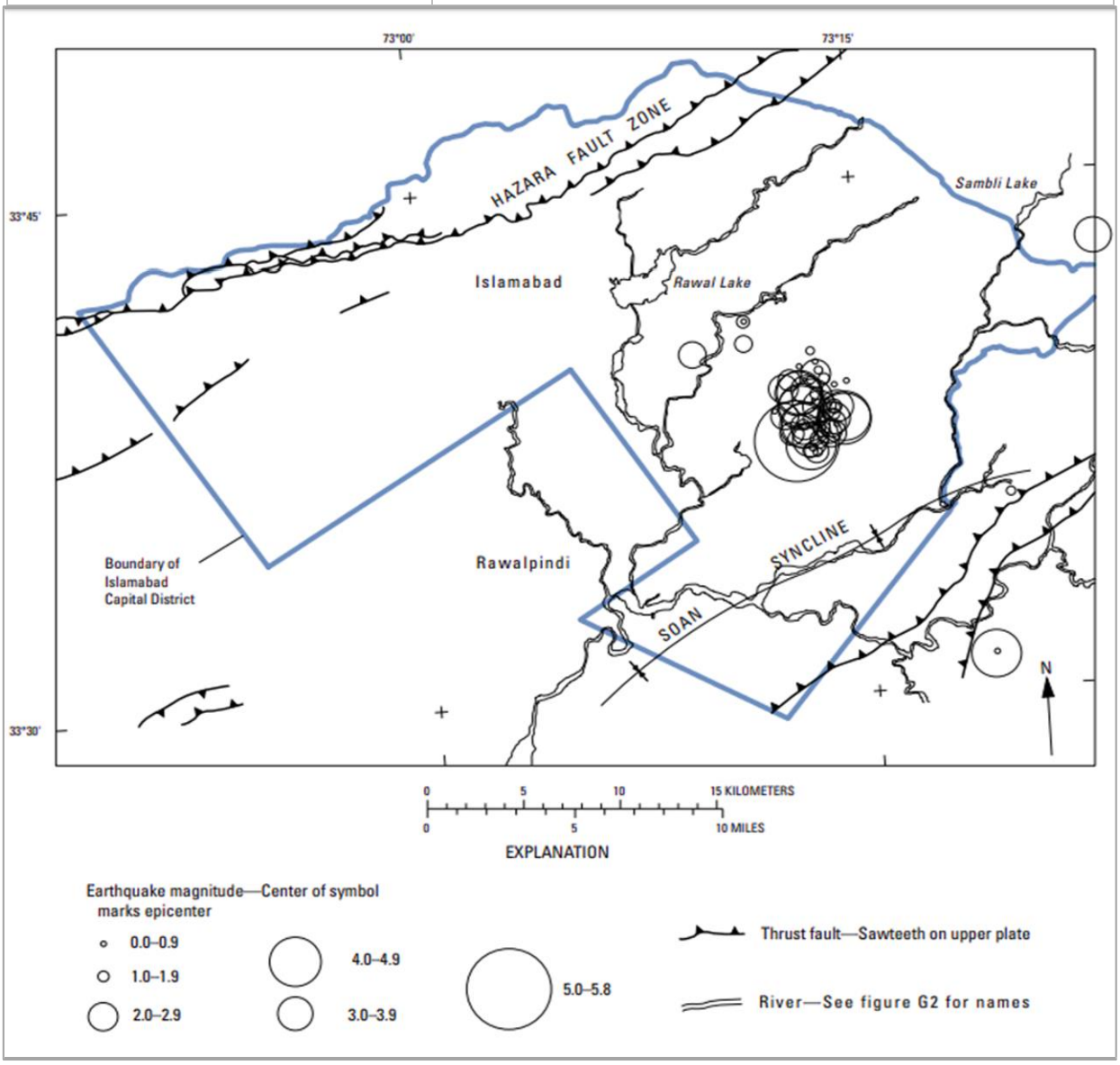


Figure 4.2: Potentially active faults in the Islamabad-Rawalpindi study area. Centres of circles are epicentres, and radii of circles are proportional to magnitude (Source: Geological Survey of Pakistan)

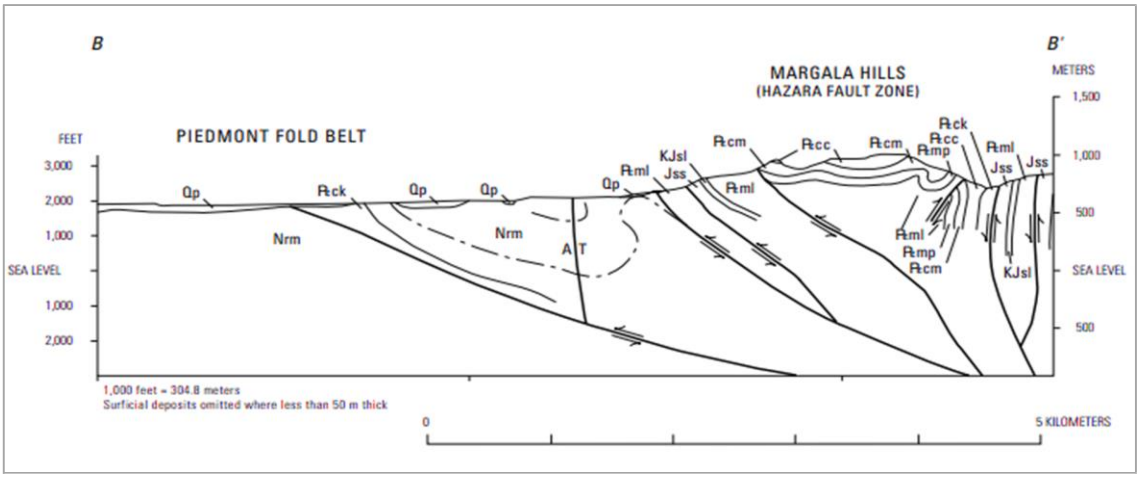


Figure 4.9: Geologic cross section in the Islamabad-Rawalpindi study area (modified from Williams and others, 1999).

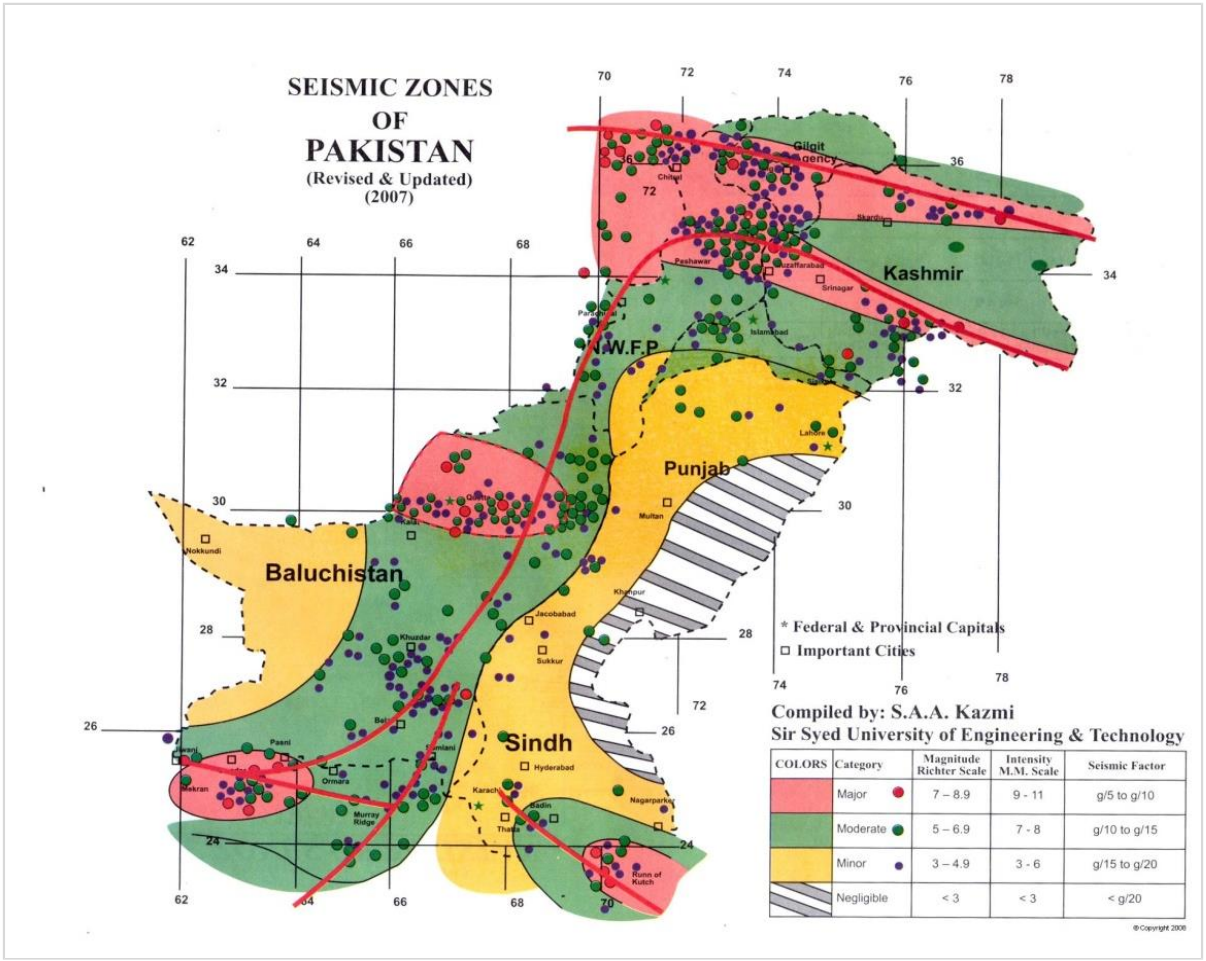


Figure 4.10: Seismic zoning map of Pakistan (Source: National Centre of Excellence in Geology)

Seismic Hazard

The Islamabad-Rawalpindi area lies in a tectonically active zone, where faulting, folding, and earthquakes have been frequent in the recent geologic past. Quaternary deposits are tectonically deformed throughout the map area. In A.D. 25, the Buddhist monasteries at Taxila, 25 km west-northwest of Islamabad, were destroyed by an earthquake estimated at Modified Mercalli intensity IX (Adhami and others, 1980). More recently, a Richter magnitude 7.6 earthquake on 8th October, 2008, 65 miles north-northeast of Islamabad caused severe damage including collapse of Margalla Tower. Subsequently, the re-zoning of seismically active areas was carried out.

According to Building Codes for Pakistan, the project area falls in Zone 2B, which corresponds to peak ground acceleration of 0.16 to 0.24g. Studies by National Engineering Services of Pakistan (NESPAK) indicated that a realistic seismic factor for building design should probably be higher than that indicated on the seismic zoning map of Pakistan (Adhami and others, 1980, p. 133). According to NESPAK, recommended design for 0.125-g (gravitational acceleration) horizontal acceleration for ordinary structures, and for 0.2 g without collapse for important structures (Adhami and others, 1980, p. 137). NESPAK (Adhami and others, 1980, p. 131) estimated that each year there is a 50 percent chance of a Richter magnitude 4 earthquake, an 8.33 percent chance of magnitude 5, a 1.67 percent chance of magnitude 6, a 0.26 percent chance of magnitude 7, and a 0.11 percent chance of magnitude 7.5 (recurrence intervals of 2, 12, 66, 380, and 912 years, respectively).

By adhering to modern seismic design standards, ensuring foundation stability, and integrating emergency response preparedness, the project can safely operate under the seismic conditions characteristic of northern Punjab.

4.3.4 Hydrology

Surface water

Around the project site, there is no surface water body. No perennial water bodies or irrigation canals exist within 2 km of the site. Any surface water within the vicinity (roadside drains or seasonal nullahs) may carry urban or industrial runoff containing suspended solids. The Northern Pothohar Plateau, which forms part of the Soan–Haro River catchment system, is a network of seasonal streams and drainage channels that eventually join the Indus River. The Taxila Valley, where the Punjab Small Industrial Estate is situated, is an intermontane basin bounded by low limestone and sandstone ridges of the Margalla Hills to the north and undulating uplands of Pothohar to the south. This basin receives runoff from surrounding hill slopes and minor streams (nullahs) during the monsoon season.

The regional drainage pattern is dendritic, typical of erosion-controlled sedimentary terrain, with flows generally directed southward and southeastward toward the Soan River basin. The Haro

River, located roughly 8–10 km north of Taxila, drains part of the northern valley and eventually joins the Indus River near Ghazi.

Groundwater

The regional aquifer system beneath Taxila is characterized by alluvial and weathered sedimentary formations, primarily consisting of sandstone, siltstone, and shale from the Murree Formation. Groundwater is found primarily in shallow unconfined aquifers that are recharged mainly through rainfall infiltration and percolation within the alluvial deposits. The depth of the water table typically varies from 5 to 15 meters below ground level, influenced by seasonal rainfall and proximity to drains or wells. Borehole data suggest moderate yields from these aquifers, making them suitable for domestic and light industrial use. Recharge occurs through direct rainfall, seepage from unlined drains, and return flow from nearby irrigation, while discharge primarily happens through pumping from bore wells and natural outflow towards lower southeastern elevations. Groundwater quality is generally fresh to slightly mineralized, with Total Dissolved Solids (TDS) levels ranging from 400 to 900 mg/L, and it tends to be slightly alkaline due to the calcareous nature of the underlying formations. Seasonal fluctuations in groundwater levels of 1–3 meters are common between the pre- and post-monsoon periods.

4.3.5 Climate

Climatic conditions are influenced by both monsoon winds from the Indian Ocean and continental air masses from the north and west, resulting in strong seasonal variations in temperature and precipitation. The nearest long-term meteorological data station is the Pakistan Meteorological Department (PMD) station at Islamabad (approximately 30 km east), which closely represents the conditions in Taxila.

According to the Köppen–Geiger Climate Classification, the region falls under the BSh–Cwa transition zone, meaning a semi-arid to subtropical humid climate with monsoon influence. The monsoon period (July–September) brings the majority of annual rainfall, while the dry season (October–June) is dominated by low humidity and large diurnal temperature ranges.

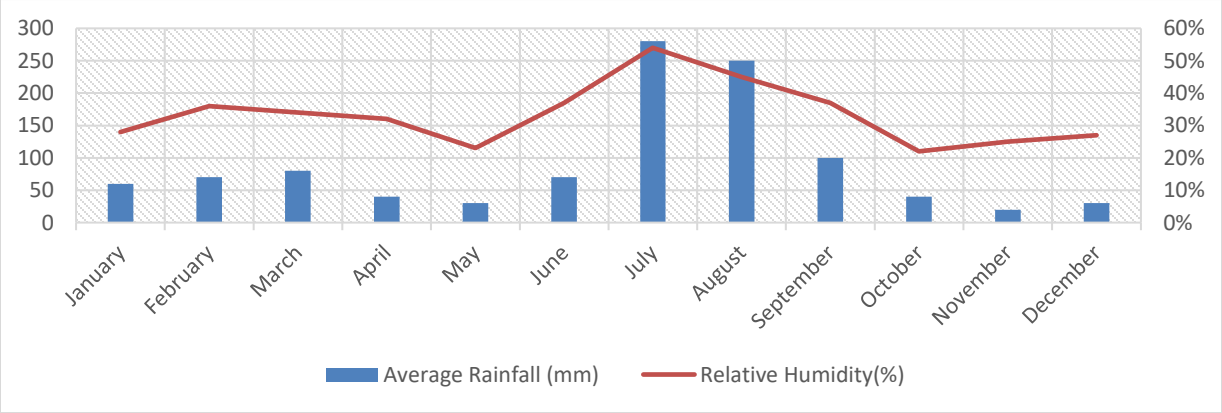


Table-4.5: Average monthly rainfall and relative humidity

- Average annual rainfall: 900 – 1,000 mm
- Monsoon rainfall (July–September): accounts for ~65–70% of annual total.
- Winter rainfall: occasional western disturbances bring 100–150 mm (December–March).
- Peak rainfall intensity: typically, in July–August, when short-duration storms can exceed 80–100 mm/hour, causing localized flash flooding in unlined drains and low-lying areas.

The mean relative humidity in summer is 60 - 80% while the mean relative humidity during winter is 70 - 90%. The average rain fall in the Islamabad city is 1,150 mm (approx.) last five years. Table-4.5 shows the average monthly relative humidity for the region.

4.3.6 Wind Speed and Wind Direction

Prevailing winds in the region exhibit distinct seasonal patterns, with summer winds blowing from the southwest to southeast, bringing moist monsoon air, while winter winds originate from the north and northwest, characterized by a dry continental flow. The average wind speed ranges from 7 km/h, and calm conditions are more commonly observed during winter mornings, which can lead to potential temperature inversions. Winter inversions require adequate stack height (≥30 m or per dispersion modelling) to minimize local ground-level pollutant concentrations.

The low wind velocity of an average 7 km/hr. and the mostly westerly direction in Islamabad suggest that the emissions from the point sources, including vehicular traffic and industries, would be adequately diluted and dispersed in the atmospheric air. Thus, the impact of emissions from industries or vehicular traffic would not be significant on the ambient air quality of locations near or at far-off distances from the Project Area. Ground-level pollutant concentrations will also be mitigated with 30ft high stack.

Wind Rose Summary (Islamabad/Taxila Region)		
Season	**Predominant Direction**	**Frequency of Calm Conditions**
Winter (Dec–Feb)	N – NW	25–30%
Summer (May–Aug)	SW – SE	10–15%
Monsoon (Jul–Sep)	S – E	5–10%
Annual average	SW	~20%

4.3.7 Ambient Air Quality and Noise (Annexure 7)

The prime objective of the baseline air quality study was to establish the existing ambient air quality of the project area. Ambient Air Monitoring was conducted by Green Crescents Pvt Ltd in project area. Green Crescents Pvt Ltd is Pak EPA and EPD certified laboratory.

Two locations i.e., outwards of the industrial estate and project location plot. The ambient air quality was monitored for the priority pollutants such as carbon monoxide (CO), Sulphur dioxide (SO_2), ozone (O_3), nitrogen oxide (NO), nitrogen dioxide (NO_2), suspended particular matter and particulate matter (PM_{10} and $PM_{2.5}$) and lead along with many others.

Results showed that all the parameters are within NEQS limits(figure 4.7). Lab Report is annexed.

Plot area

Figure 4.6 (a-e): Project site monitoring activities

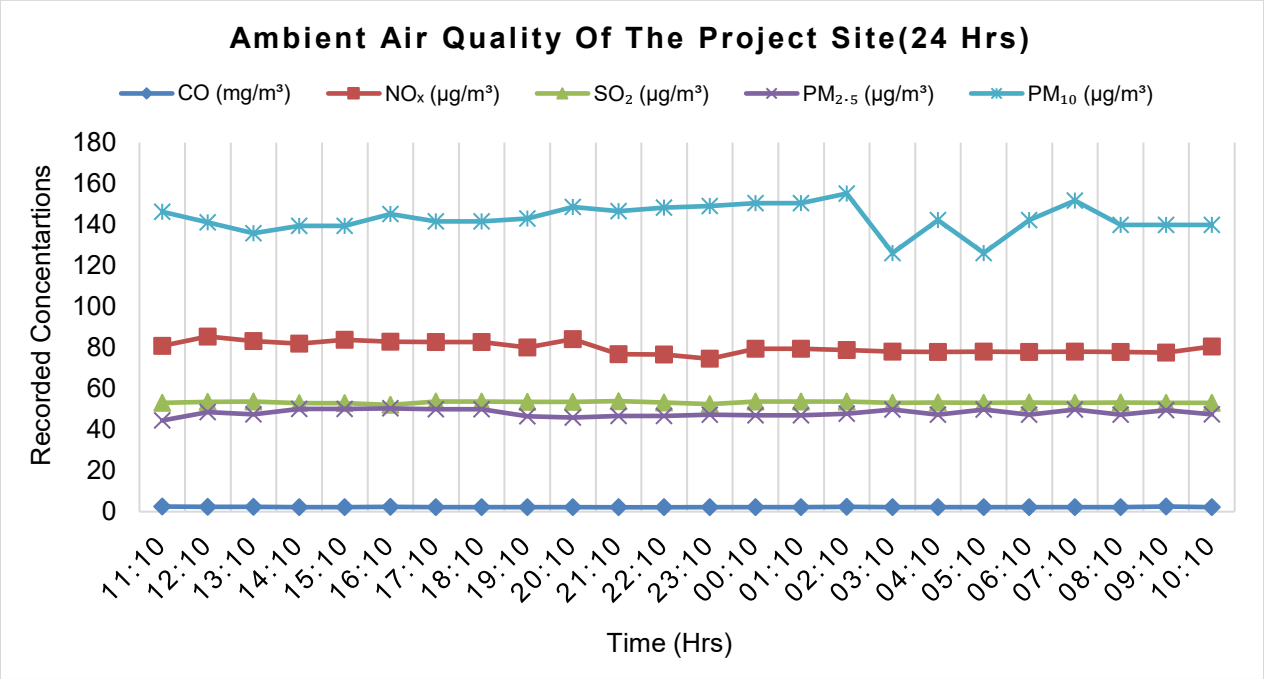
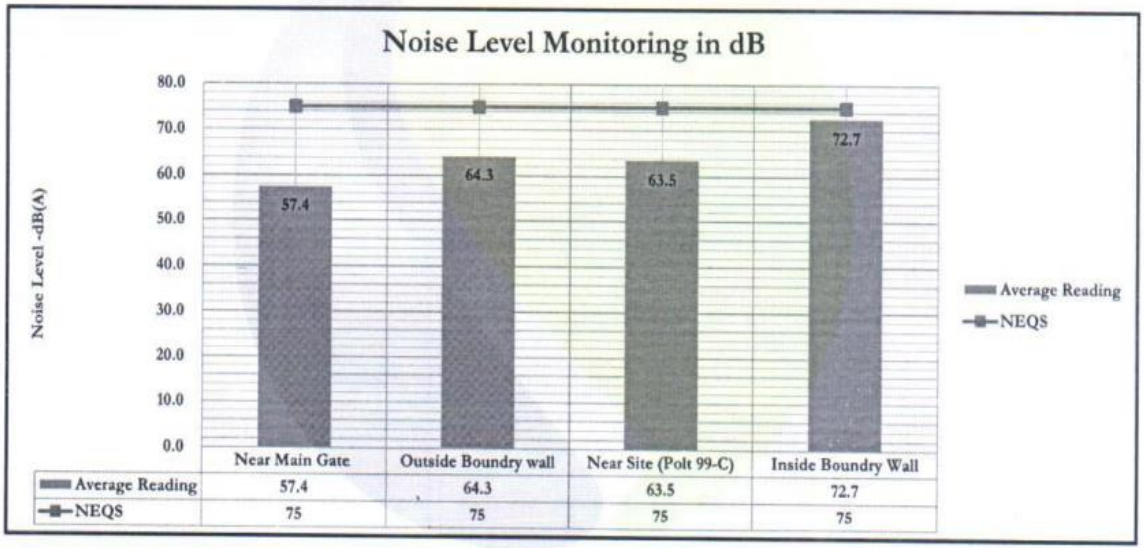


Figure 4.7: Ambient Air Quality of the Project Site (24 Hrs)

4.3.8 Noise Monitoring (Annexure 7)

Noise Monitoring was conducted by Green Crescent Laboratory at the project site and the surrounding area. Results showed that Noise levels are within NEQS limits. Lab Report is annexed.

Monitoring Point Details & Monitoring Results							
Sr.No	Points	Unit	Reading 01	Reading 02	Reading 03	Average Reading	Limits as per NEQS
1	Near Main Gate	dB(A)	53.7	57.4	61.2	57.4	75
2	Outside Boundry wall		61.4	63.7	67.8	64.3	
3	Near Site (Polt 99-C)		59.4	64.8	66.2	63.5	
4	Inside Boundry Wall		69.4	72.6	76.1	72.7	



4.1.1 Groundwater quality and water supply

The municipal water supply is the main source of water in the project area. The residential areas, as well as commercial buildings, generally receive water supply from Khanpur Dam. To compensate for water shortage, water demand is also met through the installation of bore water. Plot 101C also has 1 bore well. Water quality has been checked, and the results are annexed.

4.1.2 Wastewater Drainage System

The wastewater disposal system in the industrial estate comprises a network of sewers that collect and discharge the sewage into the main municipal sewerage lines.

4.1.3 Solid Waste Management

Solid waste management in the project area is done through RWMC, which collects waste from different areas through a designated transportation system.

4.2 Biological Environment

In this section, the baseline environmental conditions pertaining to biological environment have been described on the basis of primary and the secondary data. A reconnaissance of the project area was carried out followed by desktop study regarding the ecology of project area.

Flora

The project site itself — within the Punjab Small Industrial Estate, Taxila — is largely devoid of natural vegetation, as the land has been graded, leveled, and partially compacted for industrial use. Only ruderal and weedy species (those adapted to disturbed soils) occur sporadically along road shoulders and vacant plots.

Typical plant species observed or expected in and around the site include:

Category	Common Species	Remarks
Trees	*Acacia nilotica* (Kikar), *Dalbergia sissoo* (Shisham), *Morus alba* (Mulberry), *Eucalyptus camaldulensis* (Safaida), *Zizyphus nummularia* (Ber)	Planted along roads and boundary walls for shade and windbreak.
Shrubs	*Calotropis procera* (Aak), *Dodonaea viscosa* (Sanatha), *Capparis decidua* (Kareer), *Lantana camara* (ornamental shrub)	Common on disturbed lands and open plots.
Grasses and Herbs	*Cynodon dactylon* (Dub grass), *Imperata cylindrica*, *Desmostachya bipinnata*, *Parthenium hysterophorus* (weed), *Chenopodium album*	Sparse, seasonal growth depending on rainfall.
Agricultural crops nearby	*Wheat*, *Maize*, *Vegetables*	Grown in peri-urban fields within 1–2 km radius of estate.

No rare, endemic, or threatened plant species have been recorded from this locality in literature or field reconnaissance.

The vegetation is secondary and anthropogenic, maintained through plantation and volunteer regrowth rather than natural succession.

Fauna

Due to extensive human presence and industrial development, wildlife diversity in the project area is limited. The existing habitat supports only common and disturbance-tolerant species of mammals, birds, reptiles, and invertebrates. No endangered or protected wildlife species (as per IUCN Red List or Punjab Wildlife Act 2007) are known to inhabit the immediate project footprint. The nearest protected area the Margalla Hills National Park lies more than 25 km northeast of the project site and will not be affected.

Typical fauna likely to occur within and around the project site:

Group	Common Species	Status / Habitat
Mammals	*Herpestes edwardsii* (Indian mongoose), *Funambulus pennantii* (Five-striped palm squirrel), *Canis aureus* (Golden jackal), *Rattus rattus* (House rat), *Lepus nigricollis* (Indian hare)	Widespread and common; occur in open fields and built-up edges.
Birds	*Passer domesticus* (House sparrow), *Acridotheres tristis* (Common myna), *Corvus splendens* (House crow), *Milvus migrans* (Black kite), *Streptopelia decaocto* (Eurasian dove), *Bubulcus ibis* (Cattle egret), *Pavo cristatus* (Indian peafowl occasionally seen near fields)	Abundant; some seasonal visitors.
Reptiles	*Calotes versicolor* (Garden lizard), *Varanus bengalensis* (Monitor lizard), *Eryx johnii* (Sand boa), *Naja naja* (Cobra – rare sighting)	Occasional, mainly in uncultivated or rocky areas.
Amphibians	*Bufo stomaticus* (Indus Valley toad), *Hoplobatrachus tigerinus* (Bullfrog)	Found near drains or temporary rainwater ponds.
Insects and Arthropods	Ants, beetles, dragonflies, butterflies, bees	Typical of disturbed grassland ecosystems.

4.3 Socio-Economic Baseline

The socio-economic baseline provides an overview of the social and economic conditions of the project area based on primary and secondary data sources. This overview helps in understanding the socio-economic importance of the project area and contributes towards identification of any social risks that the project proponents must be aware of during the project design phase.

The Punjab Small Industrial Estate in Taxila lies within Tehsil Taxila in Rawalpindi District, a region characterized by both industrial activity and surrounding semi-urban/rural communities. According to the 2023 Census, Taxila Tehsil has approximately 739,244 inhabitants, of which about 537,633 are urban and 201,611 rural. This reflects a moderately dense population which contributes to both labour supply and demands for services in the project area. (citypopulation.de)

Economically, the district of Rawalpindi—which includes Taxila—has a sizeable industrial

base alongside agriculture and service sectors. As of 2019-20, agriculture and allied livestock account for about 8.4% of economic activity in the district, while manufacturing contributes roughly 5.3%, with construction, wholesale/retail trade, hotels/restaurants, transport, and social services making up larger shares. This industrial diversity is evident in Taxila, where heavy engineering units (such as Heavy Industries Taxila), defense and manufacturing units, and smaller workshops and SMEs are common. (District Profile of Rawalpindi, Scribd, Apr-2022)

Education and literacy rates are higher in Taxila compared to many more rural parts of Punjab, in part due to its proximity to universities, colleges and specialized institutions. An example of local initiatives includes the enrollment of several thousand women in adult literacy programs in Taxila and Wah Cantonment through centers managed by NCHD. (Pakistan Press Foundation) Likewise, the Heavy Industries Taxila Education Welfare Trust (HITEWT) has been active in trying to provide quality education to dependents of industrial workers and the community surrounding.

Health infrastructure in the area shows both capacity and gaps. The Tehsil Headquarters Hospital (THQ) Taxila, a 40-bed government hospital, serves a large catchment including Taxila, Wah Cantonment and surrounding villages, handling over **150,000** patient visits annually. Despite this heavy burden, the hospital is reported to suffer from shortages of doctors in key specialisations, inadequate infrastructure, and limited budgets for medicines and critical services. For instance, it has been reported that the hospital's budget for medicines is small relative to the patient load, requiring patients to procure medicines from outside(Healthy Writes/Dawn).

Access to **basic utilities** is relatively good within the Industrial Estate; most industrial and semi-urban residential areas have electricity, road access, piped water (though quality and reliability may vary) and natural gas in more developed parts. However, public health services at the Primary Health Unit / rural health centre level are uneven. Recent reports observe that many Basic Health Units (BHUs) in the Rawalpindi District (including in Taxila) fail to meet the required health-indicator standards set by the Punjab Healthcare Commission, indicating gaps in primary healthcare access in more peri-urban/rural zones. (Tribune)

Social welfare and income levels vary. While many industrial employees and those with service sector jobs have stable incomes, there is a significant portion of the population in surrounding areas who rely on informal work, agriculture, small trade, or subcontracting. Poverty remains an issue: historical surveys have shown that a considerable number of households in Rawalpindi live below the poverty line, particularly in peri-urban or rural settlements. Although up-to-date local household income data for the immediate project

footprint is limited, these broader patterns suggest that impacts (both positive and negative) of a large industrial-scale project (like commercial medical waste incinerator) will have meaningful socioeconomic implications for both employment and health outcomes.

Cultural and heritage aspects also shape local socioeconomic context: Taxila is globally recognized for its archaeological and historical importance, being home to ancient Gandharan sites and the Taxila Museum. Tourism related to this heritage offers indirect income opportunities, and environmental quality is of concern for both residents and authorities to maintain the town's image and attract visitors. Taxila is a UNESCO World Heritage site, containing remains of an ancient Buddhist city from the 5th Century B.C. to the 2nd Century A.D. Besides these large structures, smaller 13 buildings of cultural and religious significance exist in large numbers.

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Chapter 5

STAKEHOLDER CONSULTATION

This section provides the details of the consultation process carried out for the EIA study of the project. The consultation process with the stakeholders constitutes part of the environmental and social soundness assessment process requiring information disclosure and sharing. For this purpose, consultation meetings were held followed by a series of meetings at the grassroot level.

5.1 Objectives

The objectives of consultation is to:

- Share information with the Stakeholders about the project being established at PSIC, Taxila.
- Inform the stakeholders of the project objectives and scope and identify issues likely to emerge during project execution.
- Request the stakeholders to share information/feedback on physical, biological and socioeconomic environment that must be taken into consideration during the different stages of the Project, and measures to be adopted to minimize the severity of impact;
- Assess the level of awareness of stakeholders on the environment and the proposed project, and
- Identify environmental opportunities and constraints in the project area and obtain suggestions from the stakeholders on same.

5.2 Consultation Framework

The consultation being a continuous process needs to be maintained throughout the project. The consultation framework designed for the pre-construction, construction and subsequent phases of the project is elaborated in the Table 5.1:

Table 5.1: Consultation Framework

Project Phase	Proposed Tool	Stakeholders Consulted/to be Consulted	Responsibility
Pre-installation	Formal and informal meetings, focus group discussions	Institutional stakeholders, the general public, and neighboring industries	TVES, ZWS
Installation phase	i. Liaison with the relevant stakeholders	Institutional stakeholders	ZWS

	(e.g. EPA)		
	ii. Grievance Redress iii. Consultations with organizations during environmental compliance & Impacts monitoring	Institutional stakeholders	
Operation	Contact with relevant organizations	Institutional stakeholders	ZWS

5.3 Consultation Process

The stakeholders were briefed about the objectives of the project and the need for the project. The process of EIA was introduced to them. Feedback from the stakeholders was noted and incorporated into the EIA. During consultation, the stakeholders and residents were informed that:

- The proposed site is owned by ZWS, the proponent of the project.
- The proposed process of incineration.
- The Project will involve the following activities:
  - ✓ Installation of a waste incinerator at Small Industrial Estate, Taxila.
  - ✓ Minor construction works involving the construction of a storage area etc.
  - ✓ Installation and commissioning work of the incinerator plant.
  - ✓ Operation of incinerator.

Scoping meetings were conducted with institutional stakeholders while conducting the present EIA, including the following:

- Punjab-EPA
- Estate Management Office
- District Health Officer
- NCPC
- International Islamic University Islamabad (Environment Department)
- Allama Iqbal Open University, Dept. of Env.Sciences, Islamabad

5.4 Formal Consultation Meetings with Institutional Stakeholders

The Institutional stakeholders contacted during the consultation meetings gave useful feedback to the project. The formal consultation meetings with different officials yielded the following observations/ suggestions:

- The location of the incinerator at NIRM is not suitable as there are communities in close vicinity to the site. It should be located away from population.
- Considering that there are multiple incinerators installed at healthcare facilities within 10km radius of NIRM, NIRM should consider integrated waste management approach by using the incinerator facilities available at PIMS and other nearby major healthcare facilities. Alternatively, the incinerator should be made available to other small healthcare facilities for was disposal.
- Dedicated personnel should be deputed to operate and handle the incinerator.
- Attention should be paid to emergency scenarios and safety of operators.
- The healthcare professionals should be consulted before finagling the design of incinerator.
- The data on gaseous emissions should be made available and evaluated during the EIA for impact on project area's air quality.
- Stack height should be adequate and not less than 70 feet.
- Air dispersion modelling should be carried out for the project and recommendation of the study be incorporated into project design including stack height.
- Standard practices for ash disposal should be adopted by NIRM.
- Regular monitoring for scrubber efficiency should be ensured.
- Install firefighting equipment like fire extinguishers. The incinerator installed should be modern to ensure minimal particulate matter is released to the atmosphere.
- Advanced air pollution control systems (filters, scrubbers) must be installed.
- Continuous monitoring of emissions will be ensured.
- A green buffer zone must be developed around the facility.
- Public must be periodically informed about environmental monitoring results.

5.5 Consultation with Primary Stakeholders

Primary stakeholders for the project included:

- Neighboring Residents
- Schools/ Colleges
- Shop owners
- Management office

The local residents did not raise any significant concerns regarding the proposed project. Feedback obtained from the primary stakeholders during consultation is given below. The stakeholders consulted provided both positive and negative views, as well as suggestions for the proponent to consider during the construction/installation and operation phases of the incineration station. Their views are discussed below:

Positive Issues Feedback

- The project is positive for the improvement of standards for disposing of the waste. it will help manage hazardous waste in the area and improve in building environmental conditions, and should therefore be undertaken.
- The majority of respondents showed a positive attitude towards the project location. They stated that the project would bring further development in the area.
- The incinerator may provide a proper waste disposal solution for hazardous medical waste.
- It can reduce open dumping and improve environmental hygiene.
- Job opportunities may increase for residents.

Negative Feedback

- Air pollution may occur during the operation phase.
- Health risks to nearby communities due to particulate matter and dioxins.
- Fear of unpleasant odours and noise pollution.
- Concerns regarding the management of ash and residue waste.
- Need for regular monitoring and compliance with environmental standards (EPA Punjab).
- Increased water and electricity demand
- Accidents and hazards during excavation, construction and Operation Phase

Suggestions by respondents

- The Proponent should ensure proper environmental management practices are put in place.
- Noise pollution should be controlled.

Conclusion

Primary stakeholders were surveyed to assess community awareness and perceptions regarding the installation of an incinerator at the Punjab Small Industrial Estate, Jhang Bahtar Road, Wah Cantt, Taxila. The results, illustrated in the graph, show that a significant majority (80%) of participants were literate, while only 20% were illiterate. This indicates that most respondents had sufficient understanding of environmental and health-related implications associated with waste management technologies. Furthermore, 80% of respondents expressed a positive attitude toward the installation of the incinerator, appreciating its potential benefits in reducing solid waste and improving local sanitation. In contrast, 20% of participants showed negative responses, citing possible concerns such as air pollution and improper maintenance. Overall, the survey reveals a strong level of community support for the project, particularly among educated participants who recognize its environmental significance.

Table 5.2: Details of Primary Stakeholder Consulted			
Respodent name	**Age**	**Education**	**Occupation**
Mudassir Ahmad	32	secondary	Manager Marbal industry
Mobeen	29	Graduate	Chemical and seeds Businessman
Frhan Iqbal	34	secondary	flour mill Manager
Shehzad	27	Graduate	Teacher
Areeba GUL	26	Graduate	Teacher
Rukhsana	35	Graduate	Teacher
M.SHOAIB	32	secondary	Industry worker
waqar Ahmad	38	postgraduate	Pharma QC deptt
Ishtaq Ahmad	39	Graduate	GM
Junaid	34	Graduate	School Administrator
AZAN Ali	27	secondary	STORE MANAGER
Hamza Ali	28	Graduate	local residence
Fazin	29	Graduate	Business man
M.hamza	34	Graduate	Teacher
M.Iqbal	49	primary	Manager Marbal industry
MOIN	26	Graduate	Solar services
Shehryar	27	secondary	Manager Marbal industry
Mujtba	27	Graduate	Teacher
Laiba	28	Graduate	Teacher
Zuhaib	26	secondary	shopkeeper
Alishba shakeel	24	Graduate	pharmacist
ShoaIB Abassi	24	Graduate	student
Mussarrat hussain	30	Graduate	Agri business shop
sabar Muhammad	36	secondary	local residence
ShaKEEL KHAN	29	secondary	shopkeeper
Fatima	27	Graduate	sst teacher
ALI Hamza	32	Graduate	Admin head teachers
Raja shawal	31	Graduate	sports teacher
Barirra kamran	30	Graduate	Teacher
Alishba shakeel	23	Graduate	Pharmacist
Liaqat Ali	25	Graduate	Student
Kamran Akhtar	30	Secondary	Businessman
Ali Hassan	32	secondary	Medical Store
Ayaz	42	secondary	Pharmacy Owner
Abd Ur Rehman	55	primary	Hotel Manager
M. Nadeem	33	Graduate	Teacher
Tahir Hamza	35	Graduate	Store manager

Zoya Khalid	30	Graduate	Teacher
Furqan Qureshi	35	Graduate	Businessman
Farhad Ali	28	Graduate	Businessman
Atif Ali	33	Graduate	IT Office
Zafran Omar	30	Graduate	Businessman
M. Sajid	38	secondary	local residence
Rida	31	Graduate	Teacher
M. Hassam	27	secondary	Medical Store
Raheem Khan	30	secondary	shopkeeper
M. Awais Anjum	30	postgraduate	G.M Plant
Muhammad Raheel	32	Graduate	Chemical Engineer
Ali Imran	43	primary	Store Keeper
M. Afan	27	secondary	local residence
Murad	28	Graduate	Teacher
Rashid	33	Graduate	Teacher
Ibrar	30	Graduate	shopkeeper
Imran	38	secondary	pharmacist
M. Rafiq	31	Graduate	student
Jhangir	27	secondary	Agri business shop
Munir	30	secondary	local residence
Fakhr	30	postgraduate	shopkeeper
Badshah	32	Graduate	sst teacher
Nasir dad Baloch	43	primary	Shopkeeper
Yawar dad baloch	27	secondary	Shopkeeper
Hussnain	28	Graduate	Shopkeeper
Liaqat Mehmood	33	Graduate	Hawker
Osama ali	30	Graduate	Local Resident
Qeemat Khan	38	secondary	Local resident
Shahron	31	Graduate	Local resident
Awais	27	secondary	Local resident
Mrs Salama	30	secondary	Local Resident
Mumtaz	30	postgraduate	Local resident

Medical Store

TSS Faculty

Veterinary Medicine Store

New Haq Bahoo Floor and General Mill

Business Man

Milk and Cheese Industry Staff

Marble Factory Manager

SEPAL School Faculty

Chemicals and Pesticides Store

Estate Management office

Meeting with officials of EPA

Chapter 6

SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS & THEIR MITIGATION MEASURES

This section of the EIA report presents an evaluation of the screening process and identifies the existence, if any, of significant environmental impacts during different phases of the proposed project and provides necessary mitigation measures that may have to be adopted in order to reduce or otherwise compensate for the negative impacts.

The review/screening provides the assessment of impacts of different activities before the start of installation and operation, as well as installation of machinery and the resulting emission of gases, and solid waste generation during operation of the "Incinerator Plant".

Impact assessment was conducted in detail, covering each single project activity while simultaneously focusing on the nature and extent of activities proposed during the different stages of the project. Nature and strength of the impacts described below depend on the duration and frequency of activities and operations which will be carried out during the course of the project.

The assessment of impacts and risk assessment was followed by identification and suggestion of suitable and workable mitigation and control measures to reduce the severity of the impact. The mitigation measures proposed here will be adopted by the Proponent to reduce, minimize and compensate for the negative impact as far as possible.

No Construction is needed for this project as already it's a ready unit in the industrial estate. The phases of the project covered in the impact assessment include:

- Installation phase
- Operational phase

6.1 Impact Assessment Methodology

The methodology adopted for carrying out the impact assessment of the proposed Project included a combination of tools to encompass each project component while also ensuring that the assessment has been carried out in an effective way covering all areas. The environmental aspects of the project were identified in relation to the present land use, damage to vegetation, air pollution due to fugitive dust emission, hydrology of the area and other issues.

The entire assessment process was designed in a way so as to provide a complete assessment of the impacts on the ambient environment. The methodology included the identification of risks and hazards associated with the project activities by:

- Review of Applicable Guidelines and use of Checklist matrix;
- Analysis of information obtained from site surveys and stakeholder consultation;
- Professional Judgment to assess the intensity and significance of potential impacts and obtain expert opinion during environmental and social impact analysis;
- Defining mitigation measures to reduce impacts to as low as practicable;
- Predicting any residual impacts, including all long-term and short-term, direct and indirect, and beneficial and adverse impacts;

National Environmental Quality Standards (NEQS) were referred for determining the permissible levels of environmental parameters during project operation and classification of the site with respect to its pollution status. Guidelines were also reviewed in order to determine compliance conditions for the proponent in terms of ecology (fauna, flora, habitats and natural ecosystems), historical and archaeological sites. Impact assessment strategy at different stages of the project are summarised as per Fig. 6.1 below:

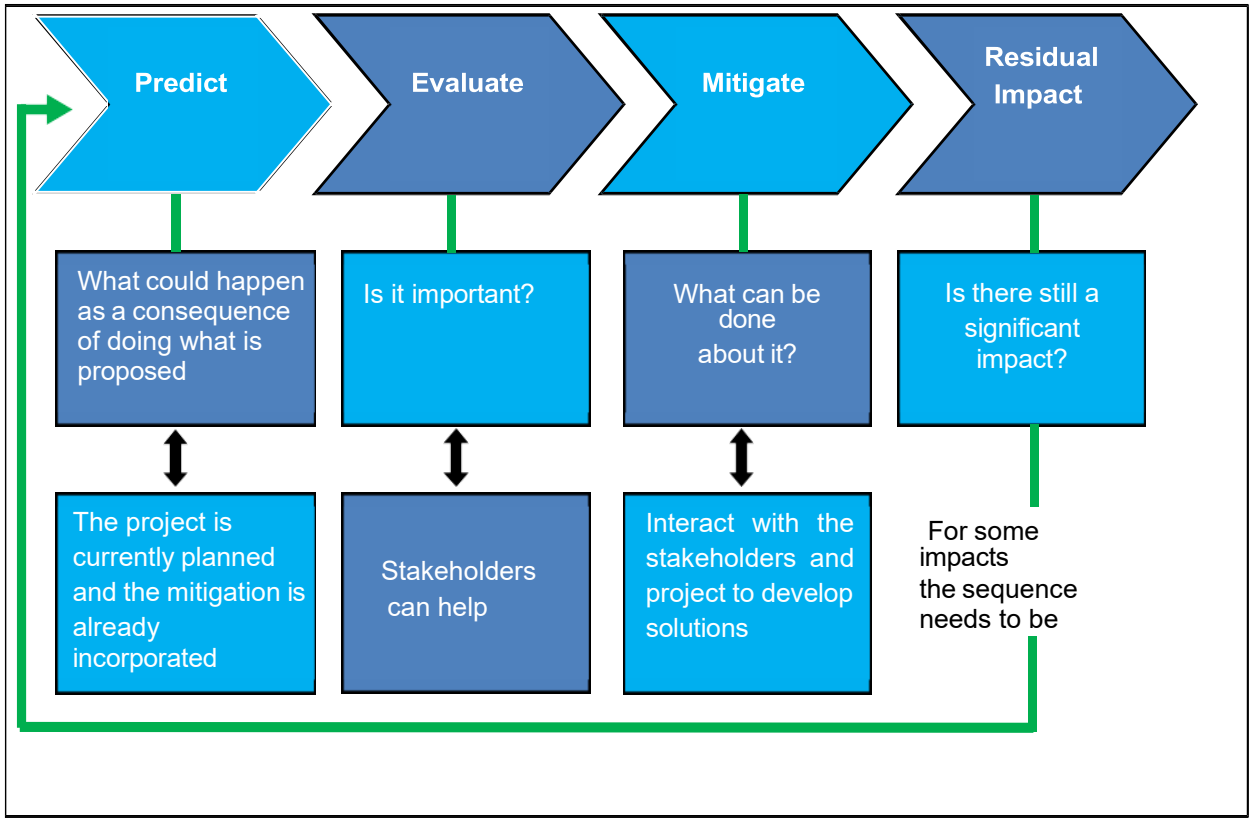

Figure 6.1: Impact Assessment Strategy

6.2 Screening of Potential Environmental Impacts Using Checklist Matrix

The following Checklist provides the screening of potential environmental impacts of the proposed project.

Table 6.1: Checklist provides the screening of potential environmental impact

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting **Is the project area…**			
Densely populated?		X	No dense population in the radius of around 3km
Have land use change issue?		X	The incinerator will be installed in already ready plot, hence, no construction and change in land use.
Adjacent to or within any environmentally sensitive areas?			
Cultural heritage site		X	No heritage site is found close to project site.
Protected area		X	No protected area is found within or immediate environs the project site.
Estuarine		X	Not Applicable
Buffer zone of the protected area		X	Not Applicable
Special area for protecting biodiversity		X	No such area is located close to site.
B. Potential environmental impacts **Will the project cause…**			
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	X		The incineration plant will reduce the waste quantity and ensure safe disposal of biomedical and infectious waste. Hence causing a positive impact on solid waste disposal system.
Deterioration of the environmental conditions surrounding of project site during construction.		X	The project will use existing infrastructure and involve no construction work.

Degradation of land and ecosystems (e.g. loss of forests)?		X	Not envisaged. Temporary disturbance may last till the completion of construction work.
Dislocation or involuntary resettlement of people.		X	Not expected.
Degradation of cultural property, and loss of cultural heritage and tourism revenues?		X	Not envisaged. No such sites are found within the proximity of the site.
Water resource problems (e.g. depletion / degradation of available water supply, deterioration for surface and ground water quality, and pollution of receiving waters)?		X	There is no major water requirement during construction or operation phase. During operation water will only be required for wet scrubber, which is a closed loop system and for waste pit washing on need base.
Air pollution due to dust and gaseous emissions?		X	Air quality of the area will not be degraded, ensuring implementation of following; • air pollution controls as per design • stack height as per air dispersion modeling • mitigations provided for air pollution control
Social conflicts between construction workers from other areas and local workers?		X	Not anticipated. workforce required for construction will be limited. There will be no interaction of local community and workers.
Road blocking and temporary flooding due to land excavation during rainy season?		X	Not envisaged.
Noise from construction activities?		X	Not envisaged. No construction involved
Traffic disturbances due to construction material transport and wastes?		X	Construction material and incinerator plant transportation to the site will be managed through the use of access roads and the adoption of good management practices.

6.3 Screening of Potential Impact during Pre-Construction Phase

6.3.1 Facility Siting and Layout

- Land acquisition: No land acquisition involved. The project is located within the existing constructed facility of PSIC.
- There are no ecologically sensitive areas, archaeological, historical or cultural heritage sites at or near the project site.
- Land use: No change in land use. The site is already being used by another industry. The proposed incinerator will replace the existing ready industrial unit.
- Only limited construction and renovation would be needed to replace the existing industry to establish the prerequisites for incinerator operations.
- Utility connections are already available at the site.
- Sewage /drainage systems are already available at site
- Waste collection/storage area is adjacent to the Incinerator plant.
- Flue gas stack with adequate height as suggested by air dispersion modelling (10m) will be installed to ensure effective dispersion of flue gas and achieving mining or no impact on surrounding area.

6.3.2 Structural Stability

The vertical structures, flue gas stack in this case, are vulnerable to seismic shocks and wind damages if the structure does not comply with recommended seismic codes and engineering standards. Similarly, material not complying with standards are also prone to damage.

Mitigation Measures

- In view of the seismic zoning for the region, the project components will be designed with respect to seismic zone 3 requirements.
- Standard engineering material and practices for the stack will be followed.

6.3.3 Safe Design

National standards for equipment design and operation where they exist should be implemented and be the subject of inspection by the Management. Wherever possible, the design of equipment within facility should be to industry good accepted practice and incorporate learning from relevant incidents.

The manufacturer company has ISO-9001:2015 and has experience in the manufacturing of high-quality plants. The proposed incinerator plant has been designed as per European Machinery regulations. (manufacturer's certification of conformity is annexed in this report). The design of the proposed incinerator will also ensure compliance with National environmental exhaust emission standards (i.e., NEQS).

6.4 Screening of Potential Impact during Construction Phase

The proposed project site is located within the existing boundary of PSIC and was being used by another industry. The proposed incinerator plant will replace the existing space and will be installed within the same room. The proposed site does not require any major construction and site development work. However limited construction and renovation of the existing structure will be required to install the incinerator plant. The construction and installation activity may include;

- Construction of ash storage pits
- Repair or replacement of roof fabrications, window and door (if required)
- Limited masonry work for Incinerator plant installation and storage rooms/
- Installation of pre-fabricated Incinerator plant and its ancillary facilities and Mechanical and electrical works
- Restoration

Considering the above discussion, it is envisaged that the limited construction/renovation activity will have minimal impacts that will be short term, localized to project site only and non-significant.

6.4.1 Creation of Employment Opportunities

Being limited activity, employment opportunities for 5-10 workers will be created for short time. However, the impact will be positive.

6.4.2 Provision of Market for Supply of Construction Materials

The project will require supply of some quantities of construction material, most of which will be sourced locally. This provides market for suppliers such as brick works, hardware shops and individuals with such materials. It is also a positive aspect of the project in terms of local economic activity.

6.4.3 Soil Erosion

The proposed project will only require renovation of existing structure, no land clearance will be involved, hence soil erosion is not envisaged.

6.4.4 Land Contamination

The proposed project will only require renovation of existing structure however, land contamination may occur due to spillage of paints and improper storage and disposal of waste generated during renovation and incinerator installation activities.

Mitigation Measures

- Paints and any other chemicals, fuels used will be stored provided with secondary containments.
- Care must be taken during renovation and paint activity.
- Waste will be collected and stored at designated waste area.
- The site will be cleared of any debris after completion of work.

6.4.5 Construction Waste

As described earlier there will be no major construction activity. The waste generated during renovation and installation of Incinerator will be very limited however it may comprise any damaged structure like roof fabrications or door which need to be replaced, demolition waste (if any), electrical and metallic waste and packaging waste of equipment.

Mitigation Measures

- Project management will ensure that no waste will be thrown in surrounding area or sewage drain.
- The waste will be segregated, collected and stored at designated temporary waste storage area.
- Recyclable waste will be used at project site if possible after repairing.
- If reuse is not possible recyclable waste will be handed over to recycling contractor.
- Non-recyclable waste will be handed over to municipal waste collection authority or disposed off through waste contractor.
- The construction material will be kept in a cover place, especially during the precipitation season.

6.4.6 Air Quality

No or minimal impact on air quality is anticipated during renovation and installation activity. Air emission sources during construction phase may include dust from construction material and dust vehicular exhaust during transportation of material and incineration plant however, vehicular trips will be very limited.

Mitigation Measure

- Safe driving speed will be advised to drivers as well as monitored.
- Vehicles used for transportation will have the fitness certificate.
- Construction material will be kept covered to avoid any dust emissions.
- Good housekeeping practices will also reduce dust emissions.

6.4.7 Wastewater Generation

No substantial wastewater generation is anticipated. A limited quantity of non-hazardous wastewater may be generated from renovation activity. Workers will use the existing washroom facility for sanitation purposes.

6.4.8 Noise

Noise is also one of the aspects which may cause hearing impacts on workers associated with construction and traffic activities. It is anticipated as like the construction will be of very short period therefore, the impacts associated with the noise are localized and of no significance.

Mitigation Measures

The following measures are adopted to keep the noise within the limits as prescribed in NEQS:

- Nighttime activities will be avoided.
- During vehicular movement use of horns will be prohibited.
- Machinery used will be kept in good condition to reduce noise generation.

6.4.9 Occupational Health & Safety Issues

Construction and installation activity will be very limited during the proposed project, having minimal impact on Occupational health and safety of workers. Keeping in view the scope of work it is understood that the impacts will be non-significant however, considering the importance of human life, mitigation measures have been provided in detail to avoid any incident. Over-exertion, ergonomic injuries and illnesses, such as repetitive motion, overexertion, and manual handling, are among the most common causes of injuries in construction sites.

Mitigation Measures

Recommendations for their prevention and control include:

- Awareness regarding lifting and materials handling will be provided to workers.
- Work site layout will be planned to minimize the need for manual transfer of heavy loads.
- Tools will be selected and work stations would be designed to reduce force requirements and holding times, which promote improved postures, including, where applicable, user adjustable work stations.
- Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes.

Risk	Potential hazards	Mitigation Measures
Slip and fall	Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.	Recommended methods for the prevention of slips and falls from, or on, the same elevation include: • Good house-keeping practices, such as the sorting and placing loose construction materials in established areas away from foot paths, would be implemented. • Excessive waste debris and liquid spills will be cleaned up regularly. • Electrical cords and ropes will be located in common areas and marked corridors. • Slip retardant footwear will be used
Work at Height	Falls from elevation associated with working with ladders and scaffolding are among the most common cause of fatal or permanent	Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at

	disabling injury at construction site. But there are many more activities where people are required to work at height. Examples include roof work, working at the edge of elevated structures, or on top of vehicles or trailers etc. If fall hazards exist, a fall protection plan will be in place which includes one or more of the following aspects, depending on the nature of the fall hazard	heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface. Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces.
Struck by Objects	Construction activities of the project may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.	Techniques for the prevention and control of these hazards include: Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap. Temporary fall protection measures in scaffolds and out edges of elevated work surfaces would be used, such as hand rails and toe boards to prevent materials from

		being dislodged. Appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be worn.
Moving Machinery	Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise.	Techniques for the prevention and control of these impacts include: The location of vehicle traffic, machine operation, walking areas will be planned and segregated. The visibility of personnel will be ensured through the use of high visibility vests when working in or walking through heavy equipment operating areas. Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations
Other Site Hazards	Construction of site may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms.	Will be mitigated by using appropriate PPEs, staff training, and adopting proper management practices.

6.5 Impact Associated with the Operational Phase of the Incinerator Plant

The operation of the project is expected to produce the following impacts, which should be taken into consideration:

6.5.1 Air Emissions and Ambient Air Quality (Major Impacts)

The major source of air pollution from the proposed project is emissions of the incinerator, which will be operated to treat infectious waste. Pollutants potentially emitted from waste incinerators include;

- Various organic compounds (e.g. dioxins and furans, chlorobenzenes, chloroethylene and polycyclic aromatic hydrocarbons [PAHs]), which are generally present in hospital waste or can be generated during combustion and post-combustion processes;
- Hydrogen chloride (HCl) and fluorides, and potentially other halogen-hydrides (e.g. bromine and iodine);
- Heavy metals including Mercury, Lead, Cadmium
- Typical combustion products such as sulfur oxides (SO_X), nitrogen oxides (NOX), volatile organic compounds (including non-methane, VOCs), particulate matter and methane (CH_4) and carbon monoxide (CO).

1. Dioxins & Furans

The most dangerous chemical known to man is the dioxins. Dioxin have carcinogenic properties. Long-term, low-level exposure of humans to dioxins and furans can lead to the impairment of the immune system, impairment of the development of the nervous system and endocrine system, birth defects, altered liver functions, breast cancer, and reproductive functions. Dioxins have also been linked with lowered sperm counts, behavioural problems and increased incidence of diabetes. Even when not present in the waste stream, dioxins form during the burning of plastics and paper. Furans are similar to dioxins and are suspected carcinogens. These chemicals form when temperatures are not consistent, when waste is not completely incinerated, and during by-pass events when air pollution control equipment fails. Items common to medical waste that may create dioxins and furans are plastic blood bags and fluid (IV) bags, bleached paper products, including facial tissue and paper towels. Dioxins formed during incineration are released into the air and travel long distances, contaminating fields, crops, livestock and dairy products.

2. Hydrogen Chloride

Hydrogen chloride is a colourless gas with a pungent odour. Heavier than air, it accumulates in low-lying areas. Hydrogen chloride is irritating and corrosive to any tissue it contacts. Brief

exposure to low levels causes throat irritation; exposure to higher levels can result in rapid breathing, narrowing of the bronchioles, blue coloring of the skin, accumulation of fluid in the lungs, and even death. Some people may develop an inflammatory reaction to hydrogen chloride, called reactive airways dysfunction syndrome, a type of asthma caused by irritating or corrosive substances.

3. Mercury

Mercury can affect the brain functioning, causing mental retardation and seizures. Mercury causes kidney damage, digestive problems, and may result in irritability, tremors, changes in vision or hearing, and memory problems. Children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and it can also pass to a nursing infant through breast milk.

4. Lead

Lead is highly toxic and can enter the human body through uptake of contaminated food, water and air. Health effects include anemia, elevated blood pressure, kidney damage, miscarriage, disruption of nervous systems, brain damage, and declined fertility of men through sperm damage. Lead is particularly harmful to children, and exposure can result in diminished learning abilities and behavioral disruptions such as aggression and hyperactivity.

5. Cadmium

Cadmium is a toxic metal and causes cancer. Chronic exposure can cause lung cancer and kidney damage. Cadmium also is believed to cause pulmonary emphysema and bone disease. Cadmium may also cause anemia.

6. Particulate matter

Fine particle pollutants are microscopic solid or liquid droplets that pass into the lungs and cause serious health problems. Studies link particulate pollution exposure to a variety of respiratory problems, including irritation of the airways, decreased lung function, aggravated asthma and chronic bronchitis. People with heart or lung diseases, children and older adults are the most likely to be affected by particulate pollution.

The technologies used in proposed project includes; complete burning of waste in primary chamber, destruction of hazardous chemicals (including dioxin and furans) in exhaust gases by providing higher temperature and suitable retention time (>2 seconds) in secondary chamber, and end of pipe treatment i.e., wet scrubber. Wet scrubber is part of the project installation.

Incinerator Environmental Monitoring (Annexure 6)

The concentration at ground level mainly depends upon the strength of the emission source and the micrometeorology of the area.

The manufacturer of the plant has conducted an evaluation of emissions in the atmosphere for the model incinerator with wet scrubbers at its factory. The analysis was carried out considering the height of chimney as 30ft from the ground.

The evaluation report (annex 6) showed that emissions comply with NEQS, showing compliance with NEQS limits.

Table 6.2: Emissions from proposed model incinerator while operational

S. No	Parameter	Unit	Result	NEQS
8.	Particulate Matter	mg/Nm^3	70.1	300
9.	Carbon monoxide (CO)		420	800
10.	Oxides of Nitrogen (NO_x)		126	400
11.	Sulphur dioxide (SO_x)		120	1700
12.	Hydrogen Chloride (HCl)		2.1	400
13.	Carbon Dioxide (CO_2)		10.2	--
14.	Smoke	Rignlemann scale	1.3	2

The results indicate that the concentrations of CO, NO_2, SO_2 and PM are well within NEQS limits of each pollutant.

Table 6.3: Emissions from proposed model incinerator outside the plant (1km from plant)

Measuring Parameter	Units	Testing Method	SEQS Limits	Results
Carbon Monoxide	CO (mg/m^3)	ASTM D3162 – 12	10	ND
Sulphur Dioxide	SO_2 (µg/m^3)	ASTM D-2914	120	ND
Particulate Matter (10)	PM_1 (µg/m^3)	RFPS-0706-162	150	75.5
Particulate Matter (2.5)	$PM_{2.5}$ (µg/m^3)	RFPS-0316-232	35	32.1
Solid Particulate Matter	SPM (µg/m^3)	RFPS-0706-162	500	112.1
Ozone	O_3 (µg/m^3)	ASTM D-5156	130	ND
Nitrogen Oxide	NO (µg/m^3)	ASTM D-3824	40	1.72
Nitrogen Dioxide	NO_2 (µg/m^3)	ASTM D-3824	80	9.02
Volatile Organic Carbon	VOC (µg/m^3)	ASTM D-3687	—	ND
Lead	Lead (µg/m^3)	AAS Method	1.5	ND

Therefore, the adverse impact of air emissions released from the stack (with given designed parameters) from the proposed project to the ambient air within a domain of 3 km radius is predicted as insignificant, as it complies with NEQS limits for ambient air for both emission scenarios.

Mitigation measures

Although the proposed technology sounds safe and would not pose any air quality hazard or damage, precautionary and management decisions have to be taken to ensure this scenario in the long run.

- Waste segregation and/or presorting to avoid incineration of wastes that contain metals and metalloids that may volatilize during combustion and be difficult to control through air emission technology (e.g., mercury and arsenic);
- Removal of the following items from waste destined for incineration: halogenated plastics (e.g. PVC), pressurized gas containers, large amounts of active chemical waste, silver salts and photographic/radiographic waste, waste with high heavy metal content (e.g. broken thermometers, batteries), and sealed ampoules or ampoules containing heavy metals;
- Follow applicable national requirements and internationally recognized standards for incinerator design and operating conditions
- Introduce wastes into the incinerator only after the optimum temperature is reached in the final combustion chamber.
- Minimize the uncontrolled ingress of air into the combustion chamber via waste loading or other routes;
- Optimize furnace geometry, combustion air injection, and, if used, NOx control devices using flow modelling;
- The pollution control equipment would be regularly checked and maintained to ensure their efficiency.
- Use flue gas treatment system for control of acid gases, particulate matter, and other air pollutants;
- Minimize formation of dioxins and furans by ensuring that particulate control systems do not operate in the 200 to 400 degrees Celsius temperature range; identifying and controlling incoming waste composition; using primary (combustion-related) controls; using designs and operation conditions that limit the formation of dioxins, furans, and their precursors; and using flue gas controls.
- The flue gases from the primary chamber would be combusted completely in the secondary chamber, which is further heated up to 1600 ˚C by firing additional auxiliary fuel or high-calorific-value liquid incinerable waste. The secondary chamber and the ducting would be designed in such a way as to have a minimum of 2 seconds residence time to ensure complete combustion. The refractory in the secondary chamber will be capable of withstanding around 1600 ˚C.
- Stack height would be kept high enough to disperse the gas effectively.

Other Mitigations for Air Emission Control

- Regular maintenance of the incinerator will be carried out.
- Staff operating the refractory-lined dual-chamber type incinerator would be required to wear proper PPEs.
- Staff operating the incinerator should be trained to operate the facility in accordance with the SOPs and EIA study requirements.
- In the incinerator, materials to be burnt would be limited to those proposed in the incineration manual;
- Incinerator operations guide (including bypass operations) should be developed and maintained.
- All the records of waste processing should be kept and maintained daily

6.5.2 Noise Level

During the incinerator operations, noise will mainly be coming from moving parts such as blowers, pumps, etc. and will mainly be confined to the incinerator room.

Mitigation Measures

The following steps will be taken during the operational phase to reduce the noise level impact.

- All equipment will be managed and maintained regularly.
- Steps will be taken to reduce the noise at the source level.
- Provision of insulating caps and aids at the exit of the noise source on the machinery.
- Provision of earmuffs to the workers and enforcement to their use by the workers will be ensured.

6.5.3 Soil Contamination

During the operational phase, accidental spillage of hazardous waste at the facility can contaminate the soil. To mitigate that risk, it will be ensured that hazardous materials will be placed in proper and designated areas to minimize the possibility of spillage.

The other activities during the operation phase, which may have the following potential impacts:

- During transfer from one container to another or during lifting of waste;
- During maintenance of the facility;
- Improper handling of waste, including its handling and transfer (due to lack of good housekeeping)

Mitigation Measures

- All spills will be cleaned and removed from the site and will be restored to their original conditions;
- Oils, lubricants, chemicals, and other listed hazardous materials should be placed safely at designated spots and away from any potential source of fire;
- Ash from incineration operations will be disposed of in waste pits.

6.5.4 Wastewater

The water used in the scrubber is a closed-loop system. The only possible wastewater source could be wastewater from pit washing. The wastewater from pit washing will be screened, collected and disinfected before release into the local drain.

Mitigation Measures

- Waste water discharged to the local drain must comply with NEQS limits.

- Regular monitoring of wastewater to ensure compliance with NEQS.

6.5.5 Transporting, Storage and Handling of Biomedical Wastes

Handling and transportation of the hazardous waste can cause soil and water contamination, bad aesthetics, odor, health and safety impacts and mixing of hazardous and non-hazardous waste if not properly handled.

It should be ensured that the hazardous waste is packaged in a manner suitable for safe handling, storage and transportation at the generation and collection points. Labelling on packaging is readily visible, and the material used for packaging shall withstand physical and climatic conditions.

As part of project, waste collection bins and waste transport trolleys will be provided for waste collection.

Mitigation Measures

- Generator of the hazardous waste shall ensure that wastes are packaged in a manner suitable for safe handling, storage and transportation.
- Labeling on packaging is readily visible and material used for packaging shall withstand physical and climatic conditions. Generator shall ensure that information regarding characteristics of wastes particularly in terms of being corrosive, reactive, ignitable or toxic is provided on the label.

Category	Control Measure
Operational	Dedicated vehicles, scheduled collection, manifest tracking
Engineering	Leak-proof, washable body; internal disinfection system; GPS tracking
Administrative	SOPs, route planning, emergency response plans
PPE and Hygiene	Gloves, masks, boots, overalls, vaccinations
Monitoring	Logs, audits, EPA reporting, GPS-based monitoring

- Upon collection from waste generation site or on receiving of the waste at facility the labeling and packing of waste shall be inspected and inventory of waste received and incinerated must be maintained.
- Transportation of infectious and pathological waste from healthcare facilities to the proposed incinerator at Punjab Small Industrial Estate, Taxila, will strictly follow:
  - ✓ Hospital Waste Management Rules, 2005 (Schedule II, III, and IV)
  - ✓ Pakistan Environmental Protection Act (PEPA), 1997
  - ✓ Punjab Hospital Waste Management Guidelines (2014)
- The transport system is designed to minimize risk of exposure, prevent spills or leakage, and ensure traceability of each waste consignment from generation to final disposal.
- The transport bins shall be designed suitably to handle and transport the hazardous

wastes of various characteristics.

- Transporting the wastes in closed containers at all times delivering the wastes at designated points.
- Drivers and waste handlers will receive certified training on biomedical waste handling (as per Rule 18, HWMR 2005).
- All staff will be equipped with Nitrile gloves, face masks, protective overalls, safety boots, and goggles.
- Each vehicle will carry: Emergency contact list, SOP manual, and spill management guide.
- Regular medical check-ups and vaccinations (Hepatitis B, Tetanus) for all waste-handling staff.
- Solid waste storage facilities will be properly lined with impervious material.
- Waste pits will be used for the disposal of ash.

6.5.6 Odor Management

The most common odour-causing compounds from incinerators are volatile organic acids and methyl mercaptan. These compounds are detectable at very low concentrations. The waste combustion process itself is not generally prone to frequent odor problems. Other sources for odor are waste storage area and waste transportation vehicles.

Mitigation Measures

- Waste combustion facility will be designed to draw air from the waste receiving and storage areas to be used to provide oxygen to the combustion process. This should create a negative air pressure in these waste handling areas and prevent the escape of odor causing pollutants to outside surrounding areas. If odors are being emitted, the air pressure should be able to be controlled by closing unused openings to the outside.
- Any leakages should be checked and fixed.
- Proper treatment of flue gas through scrubber shall be ensure.
- Suitable masks should be provided to the workers.
- Good housekeeping shall be ensured.

6.5.7 Impacts due to Waste Disposal

The waste generated during the project operation phase will include bottom ash and sludge from the scrubber.

Incinerator ash, which is often contaminated with heavy metals like lead and cadmium (if they have not removed substantially from the charged waste) as well as toxic compounds like dioxins, are usually disposed in landfill sites. However, these landfills require careful management since the pollutants can leach out posing a more immediate threat to ground

water and surface water bodies if the landfill sites are not properly designed and managed. Ash residues from the gas cleaning filters of incinerators are classified as hazardous waste and should be disposed of in special landfills. Filter ash contains very high concentrations of heavy metals and chlorinated organic compounds, which can cause cancer and other health problems.

Mitigation Measures

- Implement stringent waste selection procedures so that only wastes that can be effectively managed are accepted;
- All wastes should be stored separately.
- The bottom ash and sludge will be collected and stored at the designated area of the site and finally disposed of in a concrete-lined Pit.
- Finding and collaborating on sustainable, eco-friendly solutions to reuse ash in different ways.

6.5.8 Fire Hazard

Fire is a major hazard due to its potential to severely harm the people in the vicinity and affect the environment. Fires can cause loss of life and property. Risk of fire during operation of the proposed incinerator is low however following measures shall be adopted to prevent and control the any emergency.

Mitigation Measures

- All waste shall be stored separately.
- There should be clear and visible labeling on ignitable wastes (if any).
- Fire Extinguishing cylinders shall be provided at project location and surrounding areas.
- Firefighting equipment such as fire extinguishers will be maintained at strategic locations within the premises.
- Regular inspection and servicing of the extinguishers will be undertaken by a reputable service provider and record of such inspections should be maintained.
- Firefighting training and drills should be conducted on regular basis.
- Proper grounding to avoid static electricity build up and lightning hazards (including formal procedures for the use and maintenance of grounding connections)

6.5.9 Occupational Health and Safety

The workers and incinerator operator can be exposed to hazardous wastes, heat, noise levels and emissions from the project operations. The most significant occupational health and safety impacts typically associated with workers at industrial waste management facilities occur during the operational phase and include:

- Accidents and injuries
- Chemical exposure

Mitigation Measures

- The Health and Safety Management Plan should be implemented, and workers' training related to health and safety and waste management should be provided regularly.
- Hazardous materials management plan should be incorporated into and be consistent with facility operations.
- Health and safety risks associated with onsite processes would be addressed in procedures developed to guide the safe handling of materials and waste.
- Provide workers with appropriate protective clothing, gloves, respiratory face masks and slip-resistant shoes for waste transport workers and hard-soled safety shoes for all workers to avoid puncture wounds to the feet. For workers near loud equipment, include noise protection. For workers near heavy mobile equipment, buckets, cranes, and at the discharge location for collection trucks, include the provision of hard hats.
- Control and characterize incoming waste.
- Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work.

6.5.10 Gas Cylinder Explosion Risk

The proposed incinerator at Punjab Small Industrial Estate, Taxila, will utilize natural gas or LPG cylinders as a backup fuel source. While this ensures operational reliability, it introduces potential hazards such as gas leakage, fire, or explosion. Therefore, strict safety and engineering controls will be implemented in line with NFPA 58 (Liquefied Petroleum Gas Code), Pakistan Gas (Safety) Rules, 1991, and the Building Code of Pakistan (Fire Safety Provisions, 2016). The objective is to eliminate ignition sources, prevent leakage, and ensure a safe response in the event of an emergency.

Gas cylinders will be stored in a dedicated, fenced, and well-ventilated outdoor enclosure located at a safe distance from operational units. The storage area will be at least 15 meters away from the incinerator combustion chamber or any open flame, 10 meters away from electrical panels or buildings, and 25 meters from the site boundary. Cylinders will be placed on a non-combustible concrete base under a protective canopy to prevent exposure to direct sunlight and rain. The cage will be constructed of steel mesh or angle iron, ensuring free airflow from at least three sides. Each cylinder will be kept upright, securely chained, and clearly labeled with "FLAMMABLE GAS – NO SMOKING" signage in both English and Urdu.

Mitigation Measures

The mitigation of gas cylinder explosion risk will rely on a three-tiered control strategy:

- *Engineering controls:* proper siting, gas detection, pressure regulation, and fire protection systems;
- *Administrative measures:* SOPs, training, signage, and regular inspections;
- *Emergency preparedness:* alarms, firefighting equipment, and coordination with local emergency services.
- Engineering controls will form the first line of defense against explosion risks. Each cylinder will be fitted with a certified pressure relief valve, and gas manifolds will include secondary regulators and pressure gauges to control flow. The storage area will be equipped with fixed gas detectors to monitor leaks, while portable detectors will be used during inspections. Gas pipelines will be made of approved seamless steel with flame arrestors installed at burner inlets. Manual and automatic shut-off valves will be positioned at key points along the gas line, and all electrical fittings in the vicinity will be of explosion-proof (Ex-rated) type. To mitigate lightning-related risks, the gas storage system and incinerator structure will be properly grounded and protected by lightning arrestors.
- Operationally, gas cylinders will be handled only by trained and authorized personnel. The inventory will be minimized to maintain a maximum of three days' supply on site. Cylinders will be visually inspected daily for dents, corrosion, or leakage using soap solution tests, and defective units will be immediately returned to the supplier. No refilling or repair activities will be carried out within the premises. Preventive maintenance will be scheduled for all burners, valves, and regulators to ensure continuous safety.
- The facility will be equipped with a comprehensive fire protection system, including Dry Chemical Powder (DCP) and CO_2 extinguishers within 10 meters of the storage area, and a hydrant point or hose reel within 30 meters. An automatic fire detection and alarm system will monitor the storage area and trigger shut-off valves in case of elevated temperature or gas concentration. A thermal sensor-linked solenoid valve will automatically isolate the gas supply in case of fire. Fire and evacuation drills will be conducted quarterly under the supervision of the Environmental Health and Safety (EHS) Officer.
- Personnel safety will be ensured through proper training and personal protective equipment (PPE). All workers will receive certified training in gas cylinder handling, leak detection, and emergency response procedures. They will wear flame-resistant coveralls, safety gloves, antistatic footwear, goggles, and helmets during handling and inspection activities. Health surveillance, including vaccination against Hepatitis B and Tetanus, will be mandatory for all operations staff.
- An Emergency Response Plan (ERP) will be developed and implemented. In the event of a gas leak or fire, the main isolation valve will be closed immediately, the alarm activated, and all non-essential personnel evacuated. Small fires will be controlled using DCP extinguishers, while cylinders exposed to heat will be cooled with water spray from a safe distance. For large leaks or fires, emergency services such as Rescue 1122 and the Civil Defence Department

will be informed immediately. The affected area will be cordoned off, and all ignition sources eliminated. After any incident, the system will undergo full inspection and root-cause analysis before restarting operations.

- Routine monitoring and inspections will ensure sustained safety performance. Cylinder inspections will be carried out daily, leak tests weekly, pressure regulator checks monthly, and emergency drills quarterly. All inspection results will be documented in a Hazard and Safety Logbook. Third-party inspection of cylinders and pressure equipment will be conducted annually by a certified supplier.

Chapter 7

ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

7.1 Introduction

This section of the EIA report details the Environmental Management Plan (EMP) for the subjected activities of the proposed project.

Environmental Management plays a vital role in the development of the project to ensure that all the phases of the proposed project are being carried out in environmentally sustainable way. The Environmental Impact Assessment for the proposed project has identified potential impacts that are likely to arise during different phases (siting, construction/installation and operation phases) of the project and mitigation measures, management and monitoring practices, physical controls are recommended to control and minimized the adverse impacts in acceptable limits.

7.2 Objectives of EMP

The EMP is meant to provide an overall approach for managing and monitoring environment-related issues and to describe the institutional framework for implementing the EMP. The EMP aims to achieve the following objectives:

- Outlining measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels.
- The actions needed to implement these measures such as defining 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 stakeholders.
- Defining the requirements for communication, documentation, training & management and implementation of the mitigation measures.
- Actions required assessing the effectiveness of the mitigation measures employed such as guide through the monitoring mechanism and identifying related parameters that will be required for confirming the effective implementation of the mitigation measures.

The previous section has identified the environmental impacts of different activities during the construction and operation stages of the proposed project and mitigation measures to reduce the severity of the impacts. For successful environmental practices, an essential requirement of the PEPA 1997 is to develop an Environmental Management Plan (EMP) to guide through the procedures to the management and employees of the organization for continual improvement.

7.3 Scope of EMP

The EMP consists of the following components:

- Legislation and Guidelines
- Organizational Structure and Responsibilities
- Mitigation Plan/matrix
- Environmental Monitoring Plan
- Emergency Response and Contingency Plan
- Communication and Documentation
- Change Management Plan

7.4 Legislations and Guidelines

The EIA has discussed national and international legislation and guidelines that are relevant to the project. ZWS will ensure that the key project management officials and staff and all its assigned and associated consultants and contractors are aware of these legislations and guidelines prior to the start of the project activities.

7.5 Roles and Responsibilities

The project will have the following key players:

- Zypher Waste Solutions Pvt Ltd as proponent and overall owner and executer of EMP
- Contractors/personals as executors of EMP during construction/installation/operation

These organizations will have the following roles and responsibilities during the project activities.

Project Proponent Roles

As the project proponent, Zypher Waste Solutions Pvt Ltd will be responsible for ensuring the implementation of the EMP. HSE Manager will be responsible for the overall environmental performance during the proposed project. He/she will be responsible for ensuring the implementation of the EMP by Zypher Waste Solutions Pvt Ltd and project contractors. HSE Advisor/consultant will be appointed and be made responsible for the implementation of the EMP and liaison with the project contractor and stakeholders at the site regarding environmental issues during the construction and installation phase.

Project Contractor Roles

During the installation/ construction phase, the main responsibility of environmental performance will reside with that contractor. During operation phase, responsibility for environmental performance will be supervised by the committee constituted by Zypher Waste Solutions Pvt Ltd for hospital waste management. Zypher Waste Solutions Pvt Ltd has constituted the committee to undertake the responsibility of overseeing the waste management operations and recommending a course of action for further improvement. The committee is in line with Hospital Waste Management rules 2005 and comprises a total of 04 members.

7.5.1 Top Management of Project

Environmental management plan (EMP) will be regulated by the Project's top management; therefore, will play an important role. Some of the key role & responsibilities are given below.

- To cooperate and consult with relevant environmental agency in order to perform in better

way.

- To evaluate the progress of development and implementation of this management plan.
- To approve any change in decision making with the consultation of respective managers, if appropriate.
- The review the environmental performance and suggest and approve changes for better implementation.

7.5.2 Manager HSE

WMO is the key person for ensuring sound waste management practices of overalla operations. He is responsible to ensure that:

- Waste collection, storage and disposal is done as per recommended procedures and HWM rules
- All contracted healthcare facilities' responsible personal are fully aware of their duties and responsibilities under the Waste Management Plan
- Sanitary staff and sweepers are not involved in waste segregation and they only handle waste bags and containers in the correct manner
- Emergency procedures are available at all times, and all staff members are aware of the action to be taken by them
- Any incident regarding hospital waste management is investigated, recorded and reviewed.
- Quantities of waste generated by each client are recorded regularly.
- To ensure that the EMP has been communicated to the staff, contractors and EHS officers are considered and placed in the EMP accordingly.
- To identify issues and where possible propose solutions for inclusion in the management plan review process.
- To undertake and implement good construction practices in coordination with EHS officer during construction.
- To improve coordination and exchange of information between top management, employees, contractors, etc.
- To monitor the progress of development and implementation of this management plan.

Other key players for the implementation of EMP for the project are given below with their proposed roles and responsibilities.

7.5.3 Project Manager

The role of Project Manager is very important. The success of an EMP will mainly depend upon the effective management of the EMP by this person.

7.5.4 EHS Officer/supervisor

The role of EHS officer will be vital during the construction phase. He will be the key advisor

on environmental issues to the c manager of the project.

- To develop EMS and monitor its implementation during construction and operation.
- To integrate, as far as possible, the aims and objectives of different users within an agreed plan.
- To maintain a balanced, holistic approach to the solution of concerned issues in accordance with compliance to the legislative requirements.
- To provide professional guidance on questions relating to environmental management and issues raised by contractors/relevant personnel.
- To discuss and review the project progress with the project manager.

7.5.5 Construction Contractor

The role and responsibilities of the contractor will consist of the following basic points:

- To carry out installation/ construction activities in an environmentally sound manner.
- To coordinate with the EHS officer to resolve issues, if any arise.
- To manage and implement environmental management practices and construction work as per the recommendations of EMP.
- To manage the construction/installation crew and reduce the environmental impacts.

7.6 Maintenance of the EMP

EMP needs to be revised on periodic basis to maintain up-to-date environmental management requirements with the changing physical and regulatory constraints. Therefore, outlining and defining the responsibilities of personnel and activities under the project's operation execution, implementation, mining, operation & monitoring and decommissioning phase are integral part of maintenance of the EMP. Dissemination of reviewed and revised EMP need to be notified to all stakeholders particularly, relevant government and municipal agencies so that their modified role is also redefined and re-established in the overall environmental management process.

7.7 Health, Safety and Environment Management System

Health, Safety and Environment Management System is essential and integral component of the environmental management system for the safe and secure working environment assuring sustained development, dependent on health associated performance of human resources. EHS issues and aspects are outlined in EMP with mitigation measures based on principles of best management practices. EHS management system undertakes carrying out a complete assessment, evaluating, monitoring, identifying and control measures (mitigation) of all potential hazards and risks arising during the construction, and operation phases of the proposed project. It needs to ensure that the Health and Safety Plan (HSP) along with the

Health and Safety Rules is established, documented and enforced. The plan also outlines roles, responsibilities and expected outcomes of proper implementation with respect to the environment, health and safety management of various phases of the project. These measures should be implemented to ensure that no significant adverse, health and safety impacts occur due to proposed activities associated with the project.

7.8 Activities Requiring Environmental Management

The following phases in the Project will need to be environmentally managed:

a. Installation / minor renovation and
b. Operations

Minor civil construction will be done in order to renovate the room. The side walls will be raised to cater for the height of the incinerator, whilst the roof will be fabricated.

Environmental Performance Monitoring will be an essential component of the Project and will be governed through the Environmental Monitoring Plan. Site restoration work will include the removal of construction materials and equipment.

7.9 Regulatory Requirements

7.9.1 Approvals, Authorizations and Permits

The proponent will, besides obtaining NOC from EPA, need to obtain other clearance/approval from the government and other agencies before commencing installation and operation. Furthermore, issuance of NOC will require the project to plan for undertaking continuous monitoring through an Independent, approved environmental Monitoring lab.

The approval from the EPA shall not absolve the proponent of the obligation to obtain any other approval or consent that may be required under any law in force.

Contractual Provisions: The requirements of environmental impact assessment with respect to mitigation measures shall be incorporated in the construction and operations plans and procedures. This will make it mandatory for the contractor to follow procedures and comply with environmental regulations.

7.9.2 Compliance Monitoring

The management of the project shall monitor compliance by implementing the Environmental Monitoring Plan. The compliance will be reported in the form of periodic reporting and the report to be submitted to the EPA.

7.10 Mitigation Plan

It lists down the impacts and their mitigation measures and also highlights the responsible personnel for the said actions. A mitigation plan is basically a mitigation matrix which is given as Table 7.1 and 7.2 for the installation/construction and operation phase, respectively. All these impacts and mitigations have already been given in previous section of this report. The proponent and construction contractor will be required to adhere to these mitigation measures throughout the project.

7.11 Training

This is another major step for the implementation of EMP. All the employees will be require to be trained appropriately to work on EMP effectively. Employee training can guide workers to minimize waste generation, conserve resources such as water etc. The EHS Manager will determine the training requirements in consultation with the contractor.

Training Needs Assessment: In addition to the regular safety and subject-specific trainings, special/additional trainings will be provided during the project activity. The criteria to assess the need of training will be based on the following:

- When a specified percentage of staff is newly inducted in the project
- When any non-compliance is repeatedly reported refresher training will be provided regarding that issue.
- When any incident/accident of minor or major nature occurs. Arrival of new contractor/sub- sub-contractor.
- Start of any new process/activity.

7.12 Monitoring and Review

Monitoring of all the activities will be required to analyze the impacts of construction and operation on the environment and detailed Monitoring plan is given in Table 7.3 and 7.4. Project Manager will coordinate with contractor to monitor environmental parameters during the construction phase.

During operations, the ZWS-deputed EHS officer will follow the monitoring plan as mentioned in the EIA. He will keep record of all environmental non-compliances and report them along with the corrective actions in meetings with the top management.

7.13 Meetings

Meetings are an important source of information exchange and will be held periodically

during the project to discuss any hang-up in the project. Environmental monitoring and performance will also be taken up in such meetings to evaluate the extent the EMP requirements are being met. The following meetings will take place during the project in addition to other meetings:

- Project initiation meetings (once for each of the contractors).
- Fortnightly meetings

The purpose of the project progress meetings will be to discuss the progress of EMP and ensure full understanding and commitment from concerned parties for its implementation. Meetings will be held periodically during the construction phase. The purpose of the meetings will be to discuss the progress of construction, any non-compliance observed, and any EHS / social issues identified at the project site. The remedial measures will also be discussed and agreed upon during these meetings. The meetings will be recorded in the form of a report prepared by the EHS Officer.

7.14 Change Management

The present EIA has been carried out on the basis of the project information available at this stage. This is however possible that the changes are made in some components of the project, during the design and construction phases. In order to address the environmental and social implications of these changes, a simple framework has been devised. The change management system recognizes three orders of changes:

First Order: A first order change is one that leads to a significant departure from the project described or the impacts assessed in the EIA and consequently require a reassessment of the environmental impacts associated with the change. Example of first order change includes change in location of proposed project. Action required in this case will be that the environmental impacts of the proposed change will be reassessed by ZWS and sent to the EPA for approval.

Second Order: A second order change does not result in the change in project description or impacts that are significantly different from those detailed in the EIA. Example of second order changes includes extension in the project area. Action required for such changes will be that ZWS will reassess the impact of the activity on the environment & specify additional mitigation measures if required and report the changes to Punjab EPA.

Third Order: A third order change is one that does not result in impacts above those already assessed in the EIA, rather these may be made site to minimize the impact of an activity such as:

- Increase in project workforce;
- Change in layout plan.

Table 7.1 Mitigation Matrix for Proposed Incinerator Project (Construction Phase)			
S. No.	**Affected Areas**	**Possible Mitigation Measures**	**Responsibility**
1.	Land Contamination	• Paints and any other chemicals, fuels used will be stored in areas with secondary containments. • Care must be taken during renovation and paint activity. • Waste will be collected and stored at designated waste area. • The site will be cleared of any debris after completion of work.	Contractor
2.	Construction Waste	• Waste will be collected and stored onsite. Project management will ensure that no waste will be thrown in surrounding area or sewage drain. • The waste will be segregated, collected and stored at designated temporary waste storage area. • Recyclable waste will be used at project site if possible after repairing. • If reuse is not possible recyclable waste will be handed over to recycling contractor. • Non-recyclable waste will be handed over to municipal waste collection authority or disposed off through waste contractor. • The construction material will be kept in a cover place, especially during the precipitation season.	Contractor
3.	Air Quality	• Construction material will be kept covered to avoid any dust emissions. • Good housekeeping practices will also reduce dust emission.	Contractor
4.	Wastewater Generation	• Wastewater will not be disposed of directly into the drainage. • Construction wastewater will be retained for settling and will be used for sprinkling or watering the nearby plants or grass.	Contractor

5.	Noise	• Night time activities will be avoided. If unavoidable, following will be practiced: ○ During vehicular movement use of horns will be prohibited. ○ Machinery used will be kept in good condition to reduce noise generation. ○ Speed limits will be observed. ○ Noise producing construction equipment will not be used at night time.	Contractor
6.	Occupational Health & Safety Issues	• Awareness regarding lifting and materials handling will be provided to workers. • Work site layout will be planned to minimize the need for manual transfer of heavy loads. • Good house-keeping practices, such as the sorting and placing loose construction materials in established areas away from foot paths, would be implemented.	Contractor

Table 7.2 Mitigation Matrix for Proposed Incinerator Project (Operation Phase)			
S. No.	**Affected Areas**	**Possible Mitigation Measures**	**Responsibility**
1.	Air Emissions and Ambient Air Quality	• Waste segregation and/or presorting to avoid incineration of wastes that contain metals and metalloids that may volatilize during combustion and be difficult to control through air emission technology (e.g., mercury and arsenic). • Removal of the following items from waste destined for incineration: halogenated plastics (e.g. PVC), pressurized gas containers, large amounts of active chemical waste, silver salts and photographic / radiographic waste, waste with high heavy metal content (e.g. broken thermometers, batteries), and sealed ampoules or ampoules containing heavy metals. • Introduce wastes into the incinerator only after the optimum temperature is reached in the final combustion chamber. • Minimize the uncontrolled ingress of air into the combustion chamber via waste loading or other routes. • Flue gas treatment system will be used for control of acid gases, particulate matter, and other air pollutants. • **Dioxin and Furan control:** • Minimize formation of dioxins and furans: o using designs and operation conditions that limit the formation of dioxins, furans, and their precursors e.g. by ensuring that particulate control systems do not operate in the 200 to 400 degrees Celsius temperature range. The flue gases from the primary chamber would be combusted completely in the secondary chamber which is further heated up to more than 1100	Proponent

		˚C by firing additional auxiliary fuel or high calorific value liquid incinerate-able waste. The refractory in secondary chamber will be capable of withstanding around 1400 ˚C. o The secondary chamber has a minimum residence time of 2 seconds in order to ensure complete combustion. o identifying and controlling incoming waste composition; o using primary (combustion-related) controls; and o using flue gas controls • Stack height will be adequate enough to disperse the gas effectively and should be as per suggestions of Air Dispersion modeling. • Regular maintenance of the incinerator will be carried out as manufacturer's recommendations. • In the incinerator; materials to be burnt would be limited to those proposed in the incineration manual	

2.	Noise	Provision of earmuffs to the workers and enforcement to its use by the workers will be ensured. • All equipment will be managed and maintained regularly. • Steps will be taken to reduce the noise at the source level. • Provision of insulating caps and aids at the exit of noise source on the machinery.	Proponent
3.	Soil Contamination	• All spills will be cleaned and removed from the site and will be restored back to its original conditions. • Oils, lubricants, chemicals, and other listed hazardous materials should be placed safely at designated spots and away from any potential source of fire. • Secondary containment will be provided in all areas where there is possibility of soil contamination. • Ash from incineration operations will be disposed in pits with concrete lining.	Proponent
4.	Waste Water	• Water from wet scrubber will run in closed loop manner, so there will be minimum process effluent only from pit washing.	Proponent

5.	Transporting, Storage and Handling of Biomedical Wastes	• Storage area will have adequate capacity for incoming waste. • Flammable, Ignitable, Reactive and Non-Compatible waste will be stored separately in the designated areas. • Storage area will be provided with flame proof fittings, automatic smoke & heat detection system, adequate firefighting systems etc. • Loading and unloading of Hazardous Wastes in storage sheds will only be done under the supervision of the well trained and experienced staff. • Containment measures such as proper slopes. • Storage area will proper shed to prevent waste from storm water. • Labeling on packaging is readily visible and material used for packaging shall withstand physical and climatic conditions. • The transport bins shall be designed suitably to handle and transport the hazardous wastes of various characteristics. • Transporting the wastes in closed containers at all times delivering the wastes at designated points. • Solid waste storage facilities will be properly lined with impervious material.	Proponent
6.	Spillage /Leakage Control	• The storage areas will be inspected daily for detecting any signs of leaks or deterioration if any. • Leaking or deteriorated containers will be removed and ensured that such contents are transferred to a sound container. • Adequate number of spill kits with compatible sorbent material in adequate quantity will be provided.	
7.	Incineration Waste	• The bottom ash and sludge will be collected and disposed in concrete lined pit.	Proponent

	(Bottom Ash and	• The pit will be located as near to the incinerator as possible to avoid contamination due to ash/sludge	

	Sludge)	leakage during transit to the pit.	
8.	Fire Hazard	• All waste shall be stored separately in designated areas. • There should be clear and visible labeling on ignitable wastes (if any). • Firefighting equipment such as fire extinguishers will be maintained at strategic locations within the premises. • Regular inspection and servicing of the extinguishers will be undertaken by a reputable service provider and record of such inspections will be maintained. • Firefighting training and drills will be conducted on regular basis. • Proper grounding to avoid static electricity build up and lightning hazards (including formal procedures for the use and maintenance of grounding connections).	Proponent
9.	Occupational Health and Safety	• For emergency scenarios, first-aid kit, spill control equipment and fire extinguisher will be placed in handy positions. • Core team including incinerator operators and waste handling workers will be trained on regular basis regarding safety practices in waste management. • Workers coming in contact with waste or those handling /operating incinerator will have appropriate protective clothing, gloves, face masks and slip-resistant shoes for waste transport workers and hard- soled safety shoes for all workers to avoid puncture wounds to the feet. • For workers near loud equipment, noise protection will be provided. • Adequate personnel facilities will be provided including washing areas and areas to change clothes before and after work.	Proponent

7.15 Environmental Monitoring Program

Monitoring of activities during the construction and operation phase will be necessary to assess the impacts of these activities on the environment. Monitoring is necessary to:

- To check compliance of the contractors with the EMP by monitoring activities of the project on a daily basis (compliance monitoring).
- To monitor impacts of the operation in which there has been a level of uncertainty in prediction such as impacts of air pollution and noise etc. and to recommend mitigation measures if the impacts are assessed to be in excess of or different from those assessed in the EIA (Effects monitoring).
- To achieve these objectives, the following monitoring programme will be implemented.

Compliance Monitoring

Compliance monitoring will be carried out to ensure compliance with the requirements of the EIA and to document and report all non-compliances. The mitigation management matrix provided in the EMP will be used as a management and monitoring tool. The proponent will make regular checks on the contractor's works; keep records of all non-compliances observed during the execution of the project activities; and the details of all remedial actions taken to mitigate the project impacts.

Effects Monitoring

The effects monitoring requirements have been detailed in Table 7.2. An independent monitoring consultant (IMC) will be responsible to carry out the required effects monitoring during the construction and operation phase.

Table 7.3 Environmental Monitoring Plan (Construction Phase)

Environmental Concern	Parameters to be Monitored	Monitoring Location	Frequency	Responsibility
Dust Pollution (particulate matter) during construction	Visible dust	Construction site	Daily during the construction period	- Contractor - TVES
Noise level	Continuous Noise level Leq dB(A) monitoring	Construction site as well as the generators, equipment and the	Once during the project	- Contractor - TVES

		vehicles.		
Soil contamination	Visual inspections and photographic evidences	Construction site and its surrounding area	Daily	- Contractor - TVES
Wastewater	BOD, COD, DO, TSS, TDS, pH, NO_3, SO_4, Oil & Grease) and others as per NEQS	Waste discharge points	Monthly	- Contractor - TVES
Solid Waste Management	Record and logging of daily generated waste. Hazardous and non-hazardous waste quantity	Construction site	Daily	- Contractor - TVES
Occupational Health and Safety	EHS compliance	Construction site	Daily	- Contractor - TVES

Table 7.4: Environmental Monitoring Plan (Operational Phase)				
Environmental Concern	**Parameters to be Monitored**	**Monitoring Location**	**Frequency**	**Responsibility**
Exhaust emissions	HCL, HF, Mercury, Lead, Dioxin and Furans CO, NOx, SOx, PM	Incinerator Stack	Quarterly	- Proponent
Waste water	As per NEQS for wastewater	Waste discharge point	Quarterly	- Proponent
Noise level	Noise level Leq dB(A) monitoring	Project Site	Quarterly	- Proponent
Soil Resource	Visual inspection	Project Site	Quarterly	- Proponent
Waste Management	- Records of waste received and waste incinerated - Ash storage and Disposal	Waste disposal site	Quarterly	- Proponent
Community	Community grievances or complaints, categorized by type.	Grievance register maintained at project site	On-going	- Proponent

7.16 Emergency Response Plan

An emergency may be defined as a sudden event causing or has the potential to cause serious human injury and/or environmental degradation of large magnitude. The best "cure'' for an emergency is, of course, "prevention". Any emergency starts as a small incident that may become a major accident if not controlled in time.

For the proposed incinerator, the following potential emergency scenarios may be encountered:

1. Fire
2. Earthquake
3. Equipment malfunction

1. Fire

In event of fire, the fire response team will be called upon to handle the emergency. The team will undertake the following:

- Deployment of required manpower and equipment.

- Organizing required logistical support so that there are no bottlenecks hampering the rescue/fire control work.
- Isolate all sources of ignition and environmental hazard.
- Evacuation of people who are in immediate or imminent danger.
- Surveillance and monitoring operations.
- Retrieval and disposal of earth/debris and resources affected by the hazard at appropriate site.

2. Earthquake

The foundation base for the incinerator will be have adequate load bearing capacity to withstand an moderate to strong earthquake such that the equipment can withstand moderate to strong seismic shocks.

3. Equipment malfunction

Regular maintenance and tuning of equipment as per manufacturer's manual will help avoid any event of equipment malfunction. Nevertheless, in case of any equipment related failure, the incinerator will be turned off. After troubleshooting and necessary checks, the equipment will be restarted.

Chapter 8

CONCLUSION

The Environmental Impact Assessment (EIA) of the proposed project has been carried out in compliance with the mandatory requirement of Section 12 of Pakistan Environmental Protection Act, 1997. The requirement of an EIA study for proposed incinerator is justified in view of the nature of project category under Schedule II of EIA/IEE Regulations 2000, Category G: Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste).

The EIA study for proposed Incinerator Plant has identified potential impacts that are likely to arise during construction and operational phases of the project. Potential environmental impacts are associated with air quality, solid waste, wastewater, soil quality, terrestrial biodiversity and health and safety. The project is expected to bring a positive change in the socioeconomic setup of the area through the creation of Jobs and providing a suitable waste disposal option for the hazardous/ medical waste.

The proposed incinerator technology is sourced from Karachi and employs dual chamber combustion equipped with pollution control system comprising Integrated Flue-Gas Wet Scrubber System. The incinerator will be able to achieve 95-98% reduction in waste volume. The waste feeding will be done manually to the primary chamber.

Potential Project impacts have been identified related to the plant installation/minor construction and operation phases. Impact predictions are based on the consultants' previous experiences on similar projects; professional judgment; data collected in the field; discussions with local communities, relevant government officials and relevant technical specialists. Many of the mitigation measures are related to good design practices, others with good construction and housekeeping practices.

This Environmental Impact Assessment (EIA) evaluates the potential environmental and social impacts of the proposed project. Field surveys were carried out to collect primary data on the environmental and social setup of the project area, including environmental monitoring to determine baseline concentration of environmental parameters. Stakeholder consultations were also carried out to obtain feedback from the stakeholders regarding project implementation.

Overall assessment of the environmental aspects and screening of potential impacts of the proposed activities pertaining to the installation of the proposed incinerator finds that:

- Proposed project intervention is needed, considering the need of an incinerator for the final disposal of medical/hazardous waste in the region in an environmentally friendly way.
- The incinerator will also cater to future waste management requirements in view of national hazardous waste management policies.
- The scope of civil construction is small and involves mainly the necessary renovation of site to meet the installation requirements for the incinerator. The impacts from associated construction works will be small scale and temporary in nature. Air emissions and noise from construction works will be localized and tranPSICnt. Dust emissions will require adequate controls in the form of good construction practices including dust suppression methods.
- Design of the incinerator gives due consideration to the gaseous emissions. The dual chamber technology coupled with Integrated Flue-Gas Wet Scrubber System will ensure that gaseous emissions from stack meet the local regulatory limits i.e. NEQS. Monitoring studies conducted for the incinerator showed that ground level concentrations of stack emissions will be within NEQS limits in a radius of 3km. Production of dioxin and furan will also be controlled using a secondary chamber, whereby incoming gases from the primary chamber will be exposed to temperatures above 1100 degrees Celsius to enable destruction of dioxin and furans.
- Process effluent is not anticipated since the water will be circulated in closed loop.
- The induced impact of the operation of the incinerator on the microenvironment will be monitored through the environmental management plan and environmental monitoring plan, and mitigated, if necessary, by the adoption of suitable measures at the site.
- Ecology of the microenvironment will be protected as all activities will be confined within the facility premises.
- Mitigation measures identified for different stages of the project will be monitored for environmental compliance.
- There are no issues on land acquisition, loss of land, or loss of business; no involuntary resettlement will be required.

The proponent is committed to ensure the potential impacts from project operations are mitigated using good industry practices and monitoring of EMP compliance. Mitigation measures proposed for the operation phase include adoption of standard procedures for incinerator operations and maintenance of incinerator operations as per equipment manual/SOP.

To ensure effective implementation of EMP environmental monitoring plan has also been developed for each phase of the project focusing on monitoring of air quality, stack emissions, waste water, and ash disposal.

In summary, based on the findings of this assessment, there is no reason why the facility proposed for the site should not be authorized, contingent on the mitigations and monitoring for potential environmental and socio-economic impacts as outlined in the EIA and EMP being implemented.

Annexure list

Annexure 1	Proponent Company Profile
Annexure 2	ZWS- Registrations & Certifications
Annexure 3	TORs of EIA Report
Annexure 4	Incinerator Manufacturer Details
Annexure 5	Incinerator Detailed Quotation & Design
Annexure 6	Incinerator Monitoring reports
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Annexure 8	ZWS- Environmental Approvals from Other Provinces Waste Management and Disposal/Incineration
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