Environmental Impact Assessment of Provision of Incinerators (Procurement, Installation, Commissioning & Operations) in Different Hospitals

MARCH 2019
REVISED REPORT
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Executive Summary

Title of the Project
This report presents the findings of "Environmental Impact Assessment (EIA) of Provision of the Incinerators (Procurement, Installation, Commissioning & Operations) in different hospitals of Sindh. The EIA study aims at the identification of the possible environmental and social impacts of the proposed project on its immediate surroundings on both short and long-term basis, suggesting mitigation measures and identifying the responsible agencies to implement those measures.

Location of the Provision of the Incinerators Project
The project aims to install eight incinerators at eight selected hospitals of Sindh. The credentials are listed as follows:

i. Jinnah Postgraduate Medical Centre (JPMC), Karachi is located on Rafiqi H J Road via main Shahrah e Faisal Road in north and Korangi Road on the right. The coordinates of the location are 24°51’01.7”N and 67°02’53.4”E.

ii. National Institute of Child Health (NICHI), Karachi is located near JPMC Karachi on Rafiqi H J Rd, Karachi Cantonment, Sindh, Pakistan. The coordinates of the location are 24°51’12.833”N and 67°02’53.30.38”E.

iii. Dr Ruth Pfau Civil Hospital Karachi is located on Mission Road connected via Main MA Jinnah Road in the south and Princess Road in the north. The coordinates of the location are 24°51’36.76” N and 67°0’36.80” E.

iv. Sindh Government Lyari General Hospital Karachi is located on Tannery Road which is connected via main Lyari Expressway. The coordinates of the project site of installation of the incinerator at Sindh Government Lyari General Hospital are 24°52’17.77” N and 66°59’34.41” E.

v. People Medical College Hospital Shaheed Benazirabad is located at Civil Hospital Road via Shaheed Bhutto Road and Court Road. The coordinates of the project site are 26°14’40.92” N and 68°24’15.97” E.

vi. Liaquat University Hospital Jamshoro is located on Hospital Road via main Bhurgari Road in east and Pathan colony Road in the west. The coordinates of the site of installation of the incinerator at Liaquat University Hospital Jamshoro are 25°25’56.23” N and 68°16’19.57” E.

vii. Ghulam Muhammad Mahar Medical College Hospital Sukkur is located on main Sukkur- Faisalabad highway. The coordinates of the site of the installation of the new incinerator are 27°42’6.01” N and 68°52’34.82” E.

viii. Chandka Medical College Hospital Larkana is located on University Road via Shah Nawaz Bhutto Road. The coordinates of the location are 27°33’18.42” N and 68°12’33.20” E.

Name of Proponent
Health Department, Government of Sindh, is the proponent of the project for provision of the incinerator (procurement, installation, commissioning and operations) in different hospitals of Sindh. The Health Department intends to achieve a hepatitis free province whereby their aim is to curtail every possible source of infectious hospital waste which can cause the spread of Hepatitis C in Sindh.
Organization Preparing the EIA Report

M/s Project Procurement International, an Environmental and Management Consultancy Firm, in Islamabad has prepared Environmental Impact Assessment of the provision of incinerators in different hospitals of Sindh.

Outline of the Project

The Government of Sindh is making strenuous efforts for a better and effective Health Care system. Sindh is Pakistan's third largest province by area, after Punjab and Balochistan. It has an estimated population of 47.89 million as of 2017.

The objective of the project is to install eight Incinerators at eight hospitals located in five districts of the Sindh Province, for the promotion of cleaner practices and complete combustion of hazardous and infectious hospital wastes. The project will help to overcome the infectious hospital waste management and disposal problems under the health programs in Sindh province.

Health Department, Government of Sindh along with all the selected hospitals strive to implement the policy on Health Care in the province and have effectively joined hands to combat the spread of infectious diseases. All the eight hospitals in five districts of the Sindh province have declared their mission to improve education and health care in the province by imparting quality education and care, followed by the promotion of research and generation of knowledge and skill development by providing quality healthcare to all.

A piece of land has been allotted at each hospital for installation of a new state of the art incinerator so as to meet Sindh Hospital Waste Management Rules, 2014.

The project consists of procurement, installation, commissioning and operation of eight 100 kg/hr incinerators (MP 500, Addfield Environmental Systems Limited, UK). There will be an incineration room, yellow room, one supervisor room, furniture, washroom, cold storage room, Ashpit and boundary wall of 6 ft. with steel gate.

The total estimated cost of the project is Rs. 218.171 million and the construction period to install the incinerator will be four months. The construction will begin simultaneously at respective hospitals.

Environmental Baseline Conditions

In order to assess and evaluate the impacts and related mitigation measures, in the project area, existing conditions of physical, biological and the socio-economic environment were studied as under:

Physical Environment

The physical environment including the topography, climate followed by geology and soil of all the respective proposed project sites at each hospital are discussed in detail in chapter 5 of the report.

Air Quality: The ambient air quality monitoring was conducted for 24 hours at all the 8 project sites of Sindh. The parameters monitored were: SO$_2$, NO, NO$_2$, CO, O$_3$, Pb, SPM, PM$_{2.5}$ and PM$_{10}$. The concentrations of all these parameters meet the SEQS limits.

Generally, elevation in the concentration of NO was seen, but overall the average concentrations were under SEQS limits. The concentration of CO, SO$_2$, and O$_3$ were mostly
below detection limit except at JPMC, Karachi and Sindh Government Lyari General Hospital Karachi.

The 24 hour averages of SPM, PM$_{2.5}$ and PM$_{10}$ were below SEQS. However, they were quite noticeable because of dust and particulate matter present in the air due to heavy traffic and commercial activities nearby.

**Noise and Vibration:** Ambient noise levels were also continuously recorded at all the 8 project sites of Sindh for 24h. The sound pressure levels (dB) were frequency weighted on A-curve (dB (A)) and time weighted (dB (A) Leq) on an hourly basis.

Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison, i.e. 65 dB (A) for daytime and 55 dB (A) for night time.

The noise level exceeds the SEQ values at all the project sites, especially for day time. This elevated noise levels can be associated with heavy traffic flowing in rush hours on the adjacent roads and commercial activities near the hospital. The observed elevations were not too high from the SEQS but exceeded by small values. However, measures should be taken to reduce noise levels near the hospital areas.

**Ecological Environment**

**Flora:** Since all the project sites are located in the urbanized heart of the respective cities, the floral species are fewer in number and mostly anthropogenic. However, in some cases, scattered vegetation which includes different trees species of medium height was observed in the project area and its surroundings.

**Fauna:** A limited number of mammals, birds and reptiles were recorded from the project sites of the selected hospitals during the field visit for the EIA study. The vertebrate fauna was documented. However, none of the species found was regarded as key species or species of interest. All species of birds, mammals and reptiles whose number was recorded are not protected under the Sindh Wildlife Protection Ordinance.

**Protected Areas/National Sanctuaries**

In Pakistan, there are several areas of land devoted to the preservation of biodiversity through the dedication of national parks and wildlife sanctuaries. There are no protected areas near any of the proposed incinerator project sites.

**Socio-Economic and Cultural Environment**

The project site of all the eight selected hospitals, where incinerators will be installed has been surveyed, and socioeconomic and cultural environment has been delineated. For JPMC and NICH, Naval Officers Residential Estate III and Railway Colony were surveyed whereas Panjguri Mohalla and Rangiwara were surveyed for Sindh Government Lyari General Hospital Karachi. On the other hand, Bhimpura and Narayan Pura were studied for Dr Ruth Pfau Civil Hospital, Karachi.

Similarly, for Liaquat University Medical Hospital, Jamshoro Doctor’s colony was surveyed. For Chandka Medical College Hospital, Larkana Wakeel colony and Doctor’s Colony were studied, and responses were generated. On the other hand, for Ghulam Muhammad Mahar Medical College Hospital, Nao Gaz Pir Colony and Thermal Colony were surveyed and for contemplation of socio-economic environment in Peoples Medical college hospital response from Old Doctor’s Colony was gathered and compiled.
The socio-economic survey involved all possible members of the community, hospital staff members, municipal committee members, followed by doctors and staff of the adjoining public and private hospitals and clinics located in the near vicinity of the selected hospitals.

**Public Consultation**

Public Consultation for the project, “Provision of Incinerators (Procurement, Installation, Commissioning & Operations) in Different Hospitals of Sindh”, was held with the adjoining communities and stakeholders for all the selected hospitals. Generally, the communities were not aware of the need of the incinerator, but they were informed about it during the consultation process, and the negative and positive impacts were communicated to them.

The details of the provision of incinerator project were conveyed to the local communities and all the adjoining stakeholders, whereby they were briefed about the project site construction which would involve an incineration room, yellow room, one supervisor room, furniture, washroom, cold storage room, Ashpit and boundary wall of 6 ft with steel gate.

Similarly, valuable feedback obtained from the communities was reported and was used to identify concerns and issues that have been subsequently mentioned and addressed in the EIA report.

**Major Impacts and Recommended Mitigation Measures**

**Physical Environment**

**Impacts:** The installation of incinerators involve the construction of incineration room, yellow room, one supervisor room, furniture, washroom, cold storage room, Ashpit and boundary wall of 6 ft with steel gate. It requires less space and involves minimal construction activities. There would be minimal soil erosion and slope stability issues associated with the present project.

While burning of any substance leads to emissions which could be released into the air, and the emissions contain particulates, Sulfur oxides (SO₃), Nitrogen oxides (NOₓ), Volatile Organic Compounds (VOCs) dioxins/furans and acidic gases. The particulates generated as a result of the burning process of infectious waste also contain heavy metals which could cause severe health and environmental impacts. Primary attention needs to be focused on gaseous emissions of particulate less than 10 microns in size. Dioxins, furans, sulfur oxides and nitrogen oxides are also associated with immediate health and environmental concerns.

These emissions can deteriorate the ambient air quality in the immediate vicinity of the project site. The quality of water may degrade in the area. Because of preparation of construction material on site, leachate may be produced and percolated through the soil. It may then reach the water table and contaminate the water that may be consumed by the local people. Special attention is required for the disposal of incinerated waste in the form of ashes. It has the potential to cause soil pollution around the waste dumping site.

**Mitigations:** The construction of required facilities would be carried out in a contained and enclosed the designated area to avoid dust and noise pollution.

Fly ash and other incineration residuals will not be disposed on land but rather be disposed of in an ash pit or landfills.

Wastewater will be discharged adequately into the existing sewerage system during the construction phase. Waste oils will be collected in drums and sold to the recycling contractor.
The recyclable waste from the project sites (such as cardboard, drums, broken/used parts, etc.) will be sold to recycling contractors, or where appropriate to reuse/recover it. The infectious waste will be kept separate and handled according to the nature of the waste. While storing, infectious waste will be marked.

Modern pollution control equipment is designed to remove air emissions in order to meet environmental standards. If adequately operated the best air pollution control equipment can potentially remove up to 99% of dioxins and furans, more than 99% of heavy metals, 99% of PM, more than 99% of hydrogen chloride, more than 90% of sulfur dioxide and up to 65% of nitrogen oxides.

Gaseous and particulate air emissions can be controlled with different emissions control technologies available for incinerators like fabric filters also known as bag houses, electrostatic precipitators, electrostatic gravel bed filters and scrubbers (wet and dry both). These control methods are very helpful in metals and organic contaminants that could also attach to fine particulates.

**Ecological Environment**

**Impacts:** The preparation and construction activities may necessitate removal of the natural vegetation and minimal loss of plant cover and productivity. It is pointed out that during the construction phase existing vegetative cover would not be disturbed at any point; however, the establishment of new plantations would also be initiated once the project construction phase is completed.

In addition, the wildlife may be disturbed by noise, illumination, dust and soot generated during construction. However, the selected project sites are small and inhibit no wildlife, while smoke, chemicals, dust particles and noise produced by heavy machinery during the construction period are a scaring factor for biota, rodents and insects who would lose their abode.

**Mitigations:** All the selected hospitals will maintain existing plantation cover and aesthetic beauty of the selected site areas.

Endeavours will be made to enhance the environment, through a plantation of trees.

All preventive measures will be adopted to control the spill-over of chemicals and other effluents on the ground to protect soil fauna and ensure microbial activity in accordance with SEQS.

Extraordinary measures will be adopted to minimize impacts on birds, such as avoiding noise-generating activities.

The measures to restore natural vegetation losses in the project sites will benefit the area’s fauna as well.

After completion of the project, the proponent will rehabilitate the land by planting trees and ornamental flowers on the disturbed and undisturbed areas.

**Socio-Economic Environment**

**Impacts:** The state of the art incinerators will be installed adjacent to the existing incinerators in all hospitals, except for Chandka Medical College Hospital where the incinerator is being installed in Sheikh Zaid Block. The project will not have any impact on demographic patterns, social and cultural values. The socio-economic impacts of setting up of the incinerator are anticipated as majorly positive.
The incinerator site is located within the hospital premises and may pose some safety hazards to the hospital staff, patients and local population to a varying degree.

The proposed project aims at handling infectious hospital waste. There will be temporary waste storages and liquid tank storages; the facilities could lead to significant health and environmental impacts if not controlled and appropriately supervised. The surrounding water bodies may get contaminated if the residual liquid waste would be poorly managed and ultimately cause adverse health and environmental impacts. The workers who are in direct contact with the waste could be affected if the personal safety measures are not ensured.

There are no reported sites of the archaeological or historical significant site at or near all the selected project sites.

However, in case an artefact of such significance is found during the construction activities, the Archeology Department, Government of Pakistan will be duly informed.

Mitigations: The local communities, hospital staff members and patients will be educated regarding the safety hazards at the selected project sites.

Infectious hospital waste will be incinerated on a daily basis if not, the infectious waste should not be stored for more than 24 hours.

The infectious waste storage facilities will be appropriately marked, and unauthorized personals will not be allowed there.

While dealing with the storage facilities, workers will wear personal protective equipment like a gas mask, gloves, safety shoes etc.

Environmental Management Plan and Proposed Monitoring

The purpose of the Environmental Mitigation Plan (EMP) is to minimize the potential environmental impacts due to the provision of the incinerator (procurement, installation, commissioning and operations) in different hospitals of Sindh. The EMP reflects the commitment of installation of incinerators project at the selected hospitals to safeguard the environment as well as the surrounding population.

The EMP provides a delivery mechanism to address the adverse environmental impacts, to enhance the project’s benefits and to introduce standards of best practices to be adopted for all phases of the project.

The contractor will prepare a Quarterly Environmental Monitoring Report of project activities carried out during the construction phase of the project. These reports will be submitted to the Environmental Protection Agency, Government of Sindh for their review and consideration.

Conclusion and Recommendations

On the basis of the overall impact assessment, more specifically, nature and magnitude of the residual environmental impacts identified during the present EIA, it is concluded that provision of the incinerator (procurement, installation, commissioning & operations) in different hospitals of Sindh is likely to cause environmental impacts during its constructional and operational phase. However, these impacts can be mitigated provided that the proposed project activities are carried out as mentioned in the report, and the mitigation measures included in this report are completely and effectively implemented.
The project will positively contribute to the reduction of infectious diseases spreading among the community, given a platform for proper disposal of infectious waste.

There are no remaining issues that warrant further investigation. This EIA is considered adequate for the environmental and social justification of the project.
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<tr>
<td>BMW</td>
<td>Bio-Medical Waste</td>
</tr>
<tr>
<td>BS</td>
<td>British Standards</td>
</tr>
<tr>
<td>CMCH</td>
<td>Chandka Medical College Hospital Larkana</td>
</tr>
<tr>
<td>DHQ</td>
<td>Department Head Quarters</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>FHS</td>
<td>Friction Heating Treatment System</td>
</tr>
<tr>
<td>GMMCH</td>
<td>Ghulam Muhammad Mahar Medical College Sukkur</td>
</tr>
<tr>
<td>GPD</td>
<td>Gallons per Day</td>
</tr>
<tr>
<td>HCWM</td>
<td>Health Care Waste Management</td>
</tr>
<tr>
<td>HD</td>
<td>Health Department</td>
</tr>
<tr>
<td>HSE</td>
<td>Health, Safety and Environment</td>
</tr>
<tr>
<td>HWM</td>
<td>Hospital Waste Management</td>
</tr>
<tr>
<td>JPMC</td>
<td>Jinnah Postgraduate Medical Centre, Karachi</td>
</tr>
<tr>
<td>LUMHS, Hyderabad</td>
<td>Liaquat University Medical Health Science, Hyderabad</td>
</tr>
<tr>
<td>LUMHS, Jamshoro</td>
<td>Liaquat University Medical Health Science, Jamshoro</td>
</tr>
<tr>
<td>NCS</td>
<td>National Conservation Strategy</td>
</tr>
<tr>
<td>NEQS</td>
<td>National Environment Quality Standards</td>
</tr>
<tr>
<td>NICH</td>
<td>National Institute of Child Health</td>
</tr>
<tr>
<td>NOC</td>
<td>No Objection Certificate</td>
</tr>
<tr>
<td>PEPA</td>
<td>Pakistan Environmental Protection Act 1997</td>
</tr>
<tr>
<td>PEPC</td>
<td>Pakistan Environmental Protection Council</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>SEQS</td>
<td>Punjab Environment Quality Standards</td>
</tr>
<tr>
<td>SEQS</td>
<td>Sindh Environment Quality Standards</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>VMPL</td>
<td>Vertex Medical (Pvt) Ltd. Lahore</td>
</tr>
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</table>
### List of Units

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>Percent (age)</td>
</tr>
<tr>
<td>°C</td>
<td>Degree centigrade</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeter</td>
</tr>
<tr>
<td>dB (A)</td>
<td>Decibel</td>
</tr>
<tr>
<td>ft²</td>
<td>Square foot</td>
</tr>
<tr>
<td>ft³</td>
<td>Cubic foot</td>
</tr>
<tr>
<td>Km</td>
<td>Kilo meter</td>
</tr>
<tr>
<td>Km/h</td>
<td>Kilometer/hour</td>
</tr>
<tr>
<td>m</td>
<td>Meter</td>
</tr>
<tr>
<td>m²</td>
<td>Square meter</td>
</tr>
<tr>
<td>m³</td>
<td>Cubic meter</td>
</tr>
<tr>
<td>MT</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>Rft</td>
<td>Running Feet</td>
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1 Introduction

1.1 Project Background and Overview

Globally, 2.2% of the world’s population is suffering from hepatitis C virus (HCV)\(^1\). The disease is becoming a significant health problem in developing countries, including Pakistan that has the second highest prevalence rate of hepatitis C ranging from 4.5% to 8%\(^2\). Studies in Pakistan on small targeted groups including blood donors, health professionals, drug abusers and chronic liver disease patients indicate that the prevalence of hepatitis C is as high as 40%\(^3\).

Improper disposal of hospital wastes is one of the most common contributing factors associated with the spread of hepatitis C. Throughout the country, from a child to the older age group, hundreds of garbage collectors are affiliated with significant recycling businessmen and are providing unsterile syringes to them. In Karachi, a very young scavenger of waste products around 18 to 20 years of age sells 20 to 25 syringes per day to the health care waste dealers against money, and the same child gets needle stick injury around none to three times per week\(^4\). Thus, this horrifying environmental condition may be a reason behind the increasing cases of hepatitis C in Pakistan.

Infectious hospital waste management is a significant environmental, social and health problem, which requires particular attention by all concerned.

Hospital waste has been reported to be poorly handled and managed by the hospital staff and administration respectively. This leads to environmental and health consequences within hospitals as well as to the outside population\(^5\). It requires proper handling and treatment prior to its final disposal.

With an increase in the number of hospitals and their inherited biomedical waste, a bulk of it is dumped untreated. On a typical day, almost 75% of hospital beds are occupied by patients. The hospital waste includes both the non-risk (domestic) and risk waste (infectious, pathological, sharps, etc.). To cope up with this issue amicably, proper segregation and disposable of biomedical waste are vital.

In developing countries like Pakistan, awareness regarding hospital waste management in terms of its segregation, collection, storage, transportation and disposal is lacking. In Pakistan, every hospital must comply with their provincial hospital waste management rules. Likewise, Sindh Hospital Waste Management Rules 2014 is applicable to all hospitals in the Sindh province of Pakistan. It also must ensure its level of service and waste management system according to international standards\(^6\).


Studies from Pakistan show that around 1.35 kg of waste is produced every day for each hospital bed occupied.\(^7\) There were about 92,000 hospital beds in Pakistan in 2006. In total, approximately 0.8 million tons of hospital waste is produced every day.\(^8\)

The studies suggest that most hospitals and independently working physicians do not comply with healthcare waste management practices exposing themselves, other staff, and patients to acute injuries and infection.\(^9\) Hospital waste in Pakistan spreads diseases, and it also becomes the target of scavengers who collect used syringes which are recycled and re-sold in the market for personal financial reasons.\(^10\)

Health workers in lower tiers of health care in Pakistan suffer from acute injuries even worse than those in the hospitals, and about 54% of health workers had sustained at least one injury within 6 months at first level care facilities.

Considering the current relevant issues, the Health Department, Government of Sindh has taken some steps to control hepatitis and infections in Sindh by launching vertical programs like “HIV/AIDS Control Program”, “Hepatitis Free Sindh Program” among others. Under these programs, different activities have been carried out to give better healthcare to the people of Sindh.

To control the potential infection associated with the infectious waste of hospitals generated during needle pricking, scavenging hospital waste, re-use of syringes etc., the Sindh Health Department has decided to install eight incinerators in eight different hospitals of Sindh. Incineration is one of the final treatment options. Unregulated incineration leads to harmful effects on health.\(^11\) A typical hospital waste treatment facility seems to be the most promising option along with other technological options. Private sector involvement may benefit the system.\(^12\)

With the installation of incinerators, hospital waste would be discarded in an effective manner and hospitals would be made duty bound to dump their waste correctly. There is an urgent need for a new state of the art incinerators at the selected hospitals to control the pollution and contamination issues.

### 1.1 Nature, Size and Location of the Project

**Nature**: The project involves installation of eight 100 kg/hr incinerators at eight different hospitals of Sindh namely:

1. Jinnah Postgraduate Medical Center Karachi,
2. National Institute of Child Health Karachi,
3. Dr Ruth Pfau Civil Hospital Karachi,
4. Sindh Government Lyari General Hospital Karachi,
5. Liaquat University Hospital Jamshoro,

---


\(^11\) Hoenich NA, Pearce C. Medical waste production and disposal arising from renal replacement therapy. Adv Ren Replace Ther 2002; 9:57–62

vi. Ghulam Muhammad Mahar Medical College Hospital Sukkur,

vii. Chandka Medical College Hospital Larkana,

viii. Peoples Medical College Hospital Shaheed Benazirabad.

Size: The project consists of the installation, commissioning and operation of 100 kg/hr incinerators (Model No. MP 500, Addfield Environmental Systems Limited, UK).
### Table 1.1: Details of Provision of Incinerator at the selected hospitals in Sindh

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Hospital</th>
<th>Location</th>
<th>Address</th>
<th>Coordinates</th>
<th>Installation site area size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jinnah Postgraduate Medical Center</td>
<td>Karachi</td>
<td>Rafiqi Shaheed Road, Karachi</td>
<td>24° 51' 7.56&quot; N 67° 2' 45.24&quot; E</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>2</td>
<td>National Institute of Child Health</td>
<td>Karachi</td>
<td>Rafiqi S J Shaheed Road, near JPMC Karachi</td>
<td>24° 51' 12.833&quot; N 67° 2' 45.30.382&quot; E</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>3</td>
<td>Dr Ruth Pfau Civil Hospital</td>
<td>Karachi</td>
<td>Mission Road and is connected via main Muhammad Ali Jinnah Road, Karachi</td>
<td>24°51'36.76&quot; N, 67°0'36.80&quot; E</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>4</td>
<td>Sindh Government Lyari General Hospital</td>
<td>Karachi</td>
<td>Tannery Road and can be approached via Main Lyari Expressway Karachi</td>
<td>24°52'17.77&quot; N, 66°59'34.41&quot; E.</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>5</td>
<td>Liaquat University Hospital</td>
<td>Jamshoro</td>
<td>Hospital Road, connected via Bhurgari Road in east and Pathan Colony Road, Jamshoro.</td>
<td>25°25'56.23&quot; N, 68°16'19.57&quot; E.</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>6</td>
<td>Ghulam Muhammad Mehar Medical College Hospital</td>
<td>Sukkur</td>
<td>On main Sukkur-Faisalabad Highway, Sukkur</td>
<td>27.704673 N, 68.833283 E.</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>7</td>
<td>Chandka medical college hospital</td>
<td>Larkana</td>
<td>On Main University Road and can also be approached via Main Shah Nawaz Bhutto Road, Larkana city.</td>
<td>27.5520° N, 68.1978° E.</td>
<td>120.61 Sq. m</td>
</tr>
<tr>
<td>8</td>
<td>Peoples Medical College Hospital</td>
<td>Shaheed Benazirabad.</td>
<td>Hospital Road via Shaheed Shutto Road and Court Road Shaheed Benazirabad.</td>
<td>26°14'40.92° N, 68°24'15.97° E.</td>
<td>120.61 Sq. m</td>
</tr>
</tbody>
</table>
Figure 1.1: Key project location maps of selected hospitals in Sindh
1.2 The Proponent

The Health Department, Government of Sindh, is the proponent of the project (https://www.sindhhealth.gov.pk/). The Department of Health is responsible for public health in Sindh. It performs the following functions:

- Accreditation of the provincial Medical Schools/Medical Courses,
- Has responsibility for Government medical employment in Sindh,
- Make a decision regarding Sindh Health Force,
- Health Legislation to curb quackery,
- Regulation of Private Health Sector,
- Legislation of medico-legal and organ transplant, and
- Execute different Projects/Schemes with Donor coordination.

The Health Department currently has more than 14,000 Doctors, 2,000 Nurses and over 12,000 paramedics serving all over the province. The province has two medical universities; one each at Karachi and Jamshoro, and three medical colleges; one each in Sukkur, Nawabshah and Larkana, 12 Nursing School, 10 Midwifery Schools and 5 Public Health School for lady health visitors.

The huge network of hospitals and health facilities include 6 teaching hospitals, 5 specialized institutions for chest, dermatological and mental illness, 11 district headquarters hospitals, 27 major hospitals located in the major cities, 44 Taluka hospitals, 99 Rural Health Centers in small towns, 738 basic health units in Union Councils, 305 dispensaries in larger Union Councils, 36 MCH Centers, 12 maternity Homes and 39 centers for traditional medicine.

1.2.1 The Organization Structure of the Proponent

The Health Department, Government of Sindh, is headed by the Secretary. There are 2 Special Secretaries and 4 Additional Secretaries. Figure 1.2 shows the organizational structure of the Health Department, Government of Sindh.
Figure 1.2: Organizational Structure of the Health Department, Government of Sindh
1.3 Executing Agency

Health Department, Government of Sindh along with all the selected hospitals strive to implement the policy on Health Care in the province and have effectively joined hands to combat the spread of infectious diseases. All the chosen hospitals in five districts have declared their mission to:

- Improve education and healthcare in Pakistan by imparting quality education and care.
- Promotion of research and generation of knowledge and skill development.
- Provide quality healthcare to all irrespective of ability to pay.
- Explore avenues for resource generation.

The details of executing agencies for the selected hospital has been described as hereunder:

1.3.1 Jinnah Postgraduate Medical Centre (JPMC), Karachi:

JPMC Karachi is a 1,700-bed hospital, and around 3,000 outpatients come daily. It can now proudly claim to be the biggest and the best equipped public sector hospital in Pakistan, employing highly qualified staff in numerous specialities, ready to render quality health care services to the ailing. In the process, JPMC also imparts high-quality training to medical graduates, nurses and technicians, and undertakes meaningful research in clinical and basic medical sciences (http://www.jpmc.edu.pk/).

JPMC Karachi has almost 32 departments in its fold including Basic Medical Sciences Institute (BMSI), Department of Accident & Emergency, Department of Medicine, Medical Unit I, Medical Unit II, Medical Unit III, Medical Unit IV / Medical ICU, Department of Thoracic Medicine, Department of Radiotherapy/Oncology, Department of Dermatology, Department of Psychiatry, Department of Nephrology, Department of Dentistry and Oral / Maxillofacial Surgery and Department of Anesthesiology.

1.3.2 National Institute of Child Health (NICH), Karachi

NICH is a 500 bedded hospital which is currently under the administrative control of Health department Government of Sindh. It is the first children hospital of the country and presently one of the largest and the only children hospital of the province of Sindh (www.nich.edu.pk).

It provides tertiary care services for almost all types of paediatric diseases and is equipped with the latest diagnostic gadgets. The Paediatric Emergency department provides care for more than 1, 00,000 children each year. The department is open 24 hours a day, seven days a week. Children 14 and under who are acutely ill or injured can get specialized care in a reassuring, child-focused environment.

1.3.3 Dr Ruth Pfau Civil Hospital Karachi:

Dr Ruth K.M. Pfau Hospital is a 1,900-bed tertiary care public hospital that imparts both undergraduate and postgraduate teaching and training. It is one of the teaching hospitals affiliated with the Dow Medical College, now the Dow University of Health Sciences. It is arguably the largest teaching hospital of Pakistan, catering not only to all areas of the province of Sindh but also the neighbouring province of Balochistan.

The clinical departments of the hospital include Internal Medicine, Gynecology and Obstetrics, Anesthesiology, Pediatrics, Cardiac Surgery, Oncology, Radiology, General Surgery, Neuro Surgery and Laboratory. The Hospital is proving all the services and facilities in one premise.
The first state-of-the-art Burns unit has also been established in this hospital. The department of surgery comprises six general surgical units besides the specialities of neurosurgery, paediatric surgery, orthopaedic surgery, urology, vascular surgery, maxillo-facial surgery and plastic surgery.

The department of medicine comprises five general medicine units, 60 beds each. Other specialities include Cardiology, Psychiatry, Dermatology, Neurology and Nephrology. The Department of Paediatrics has three units with a DTU (Diarrhea Treatment Unit). The Department of Gynecology and Obstetrics is divided into three units, having facilities of the labour room and Operation Theatre.

The Emergency Department has several sections including an Operation Theatre and Surgical Intensive Care Unit, which are functional around the clock for use in case of mass disasters. All the units function independently.

1.3.4 Sindh Government Lyari General Hospital Karachi

Sindh Government Lyari General Hospital Karachi was established in 1970. It is a tertiary care hospital in Karachi. It is located at Rangiwara Karachi, Karachi City, Sindh. Some of the general departments of the hospital are 24-hour emergency service, Laboratory, Radiology, Ultrasound, OPD and Surgery. Anesthesiology, ICU, Dental Service, Dialysis, ENT, Orthopedic and Gynecology are the specialized services in the hospital.

Sindh Government Lyari General Hospital Karachi is 524-bed with a present average of 200 in-patients per day. Around 4,000 outpatients come daily.

1.3.5 People Medical College Hospital Shaheed Benazirabad:

The exclusive Medical College for Girls Shaheed Benazirabad came into existence in April 1974 and was named as Peoples Medical College. It is an 800-bed hospital with a present average of 300 in-patients per day. Around 3,000 outpatients come daily.

1.3.6 Liaquat University Hospital Jamshoro:

Liaquat University Hospital Jamshoro is a 1450-bed tertiary care hospital in Pakistan. It is one of the largest teaching hospitals affiliated with Liaquat University of Medical and Health Sciences, the first medical university of the public sector in Pakistan. The hospital serves Sindh and the neighbouring province of Balochistan.

It has various clinical departments including Pediatrics, Cardiology, Pulmonology, Dermatology, Family Medicine, Gastroenterology, Nuclear Medicine, Nephrology, Psychiatry, General Surgery, Trauma & Orthopaedics Surgery, Accident and Emergency, Plastic Surgery, Pediatric Surgery, Neurosurgery, Cardiothoracic Surgery, Vascular Surgery, Urology, Radiology and Gynae.

The hospital provides services to patients in Sindh as well as in the neighbouring province of Balochistan.

1.3.7 Ghulam Muhammad Mahar Medical College Hospital Sukkur

Ghulam Muhammad Mahar Medical College (GMMMC) Sukkur, is a constituent College of Shaheed Mohtarma Benazir Bhutto Medical University and is located in the centre of Sukkur city. It is the sixth public sector Medical College under the Health Department, Government of Sindh.

Ghulam Muhammad Mahar Medical College Hospital, Sukkur, is home to 500 students in the MBBS programs, with clinical rotations occurring at GMMMC Teaching Hospital and
Government Anwar Piracha Teaching Hospital. The school has a large and experienced faculty to support its mission of education, research, and clinical care. Faculty members hold appointments at basic sciences and clinical departments. There are 114 full-time faculty members consisting of Lecturers, Assistant Professors, Associate Professors and other senior professors at the medical college.

The new campus of Ghulam Muhammad Mahar Medical College Hospital Sukkur is established on 53.8 acres of land acquired at the Sukkur Bypass, connecting main national highway N-5 National Highway with N-65 National Highway bypassing the congested urban roads in the city of Sukkur. The new Complex will house buildings for, Medical College, Student Hostels, and Residential Quarters for faculty and supporting staff, and 1200 bedded Teaching Hospital. The foundation stone of the Complex was laid by the then Chief Minister of Sindh Arbab Ghulam Rahim on the 30th day of May 2005. A private consultancy firm has designed the Master Plan (the detailed drawing) of the Project and is currently supervising the execution work for the new complex which is in full swing.

1.3.8 Chandka Medical College Hospital Larkana

Chandka Medical College Hospital Larkana was inaugurated on 20th April 1973. It is a 1400-bed hospital, and around 3,000 outpatients come daily (http://www.cmc.edu.pk/).

Chandka Medical College Hospital Larkana is located in the province of Sindh with the mighty river Indus flowing in the east. Chandka medical college hospital, Larkana was inaugurated on 20th April 1973. It was the fourth Medical College of Sindh province at that time. This college provides facilities not only to Upper Sindh but a large adjoining area of Balochistan province.

Chandka was the old name of Larkana, that was derived from Chandio tribute which is the oldest tribe residing in these areas. The college was established in a building, which already existed as Government Polytechnic Institute and DC High School Larkana, which was converted to Chandka Medical College.

1.3.9 Installation, Commissioning, Operation Contractor

Health Department, Government of Sindh, has contracted the installation, commissioning and operation of eight units of 100 kg/hr incinerators at eight different hospitals to M/s Vertex Medical Pvt. Ltd., Lahore (VMPL) as a turnkey project (http://vertexmedical.com/).

The contract agreement signed between the Health Department, Government of Sindh and VMPL stipulate as follows:

- Warranty of the incinerators will be 3 years with parts and labour etc. from the date of commissioning,
- VMPL will produce an Environmental Impact Assessment (EIA) report before installation within the stipulated period,
- VMPL will get its approval from EPA as their requirement,
- VMPL will maintain, control and supervise the incineration process, segregation of waste, periodic monitoring of exhaust gasses by EPA or its approved body for proper functioning and implementation of the hospital disposal system for at least three years.
- VMPL will impart training to the hospital staff and conduct workshops so that after complete handing over the system, the hospital has sufficient technical expertise and skilled persons compete to handle the infectious hospital waste for its efficient disposal.
- VMPL will be responsible for treating and maintaining emission levels and get it monitored biannually by the SEPA or its approved body during the warranty period of three years.
VMPL will train two engineers of the Department for comprehensive repair and maintenance of the system.

VMPL will provide one set of complete repair and installation manual for the unit.

M/s VMPL, imports and distributes healthcare equipment, instruments and consumable/disposable items. VMPL provides “fast, accurate, timely and reliable” supply services to all major Hospitals and Medical Institutes of Pakistan both in public and private sectors. VMPL has developed branch offices in major cities of Pakistan to ensure speedy services to the customers.

1.3.10 Consultant Introduction

M/s Project Procurement International (PPI), an Environmental and Management Consultancy Firm, Islamabad has prepared Environmental Impact Assessment of installation of incinerators at in different hospitals of Sindh (www.projectpi.pk).

The list of names, qualification and roles of team members carrying out the EIA has been attached in Annexure-1.

PPI has also carried out the EIA study of installation of incinerators at thirteen District Headquarter Hospitals of Punjab. Moreover, PPI has also conducted Hospital waste generation survey in public and private hospitals in AJK.

PPI will conduct the following types of consultancy studies for its clients:

- Environmental and Social Impact Assessment Studies,
- Socio-economic Development Studies,
- Feasibility and Marketing Studies,
- Baseline Studies,
- Knowledge Attitude Practices (KAP) Surveys,
- Water, Sanitation and Hygiene (WASH) Surveys,
- Hospital/Solid Waste Management, Treatment and Disposal,
- Mid Term/End of Project Evaluations, and
- Environmental, Occupational Health & Safety Management System (EHSMS) Assessments and Audits.
1.3.11 Contact Persons

The authorized representatives are stated as follows:

<table>
<thead>
<tr>
<th>Proponent</th>
<th>Contractor</th>
<th>Environmental Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of the Additional Secretary Development, Health Department, Government of Sindh Barrack No. 94 Opp. Sindh Assembly Sindh Secretariat Karachi Email: <a href="mailto:healthdev94@gmail.com">healthdev94@gmail.com</a></td>
<td>Mr Ashar Shaikh, Project Coordinator, Vertex Medical Pvt Ltd, 110-Anum Blessings, Block 7/8, Plot-ZCC, KCHSU, Karachi Tel: +021 34325307 Cell: +92-03332228006 Email: <a href="mailto:ashar.shaikh@vertexmedical.com">ashar.shaikh@vertexmedical.com</a> Website: <a href="http://vertexmedical.com/">http://vertexmedical.com/</a></td>
<td>Saadat Ali, Environmental Engineer Project Procurement International 26, Second Floor, Silver City Plaza, G 11 Markaz, Islamabad Tel: +051 2363624 Cell: 0300 8540195 Email: <a href="mailto:projectpi@gmail.com">projectpi@gmail.com</a> Website: <a href="http://www.projectpi.pk">www.projectpi.pk</a></td>
</tr>
</tbody>
</table>

1.4 Environmental Impact Assessment

According to the Sindh Environmental Protection Act 2014, Section 12 (1):

“No proponent of a project shall commence construction or operation unless he has filed with the Provincial Agency an initial environmental examination or where the project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Provincial Agency approval in respect thereof”.

1.5 Purpose of Report

The Environmental Impact Assessment (EIA) is the assessment of the environmental consequences (positive and negative) of a plan, policy, program, or actual projects prior to the decision to move forward with the proposed action.

The EIA is the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development project prior to major decisions being taken and commitments made. Furthermore, the report will enable the Health department, the Government of Sindh to obtain environmental approval of Installation of the incinerators from the Environmental Protection Agency, Government of Sindh.

The purpose of the EIA is to ensure that the decision-maker consider the environmental impacts when deciding whether or not to proceed with a project.

1.6 Scope of EIA

The project requires the Environmental Impact Assessment to identify environmental impacts of the proposed project for the provision of incinerators (procurement, installation, commissioning & operations) in different hospitals of Sindh. The scope of EIA of Installation of Incinerators is as follows:

- The identification and assessment of all major and minor impacts during pre-construction, construction and operational phases;
- Identification of all significant impacts that may require detailed assessment;
- Propose mitigation measures to minimize, eliminate or to compensate for the potential adverse impacts that may arise during pre-construction, construction and operational phases of the project;
1.7 Approach and Methodology

1.7.1 Approach for EIA

The approach for conducting EIA of the provision of incinerators (procurement, installation, commissioning & operations) in different hospitals of Sindh project is to follow the requirement of Sindh Environmental Protection Act 2014 and Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000.

1.7.2 Kick off Meeting with the Proponent

Kick off meeting was held between the PPI team and Medical Superintendent of all eight hospitals along with the Project Coordinator, Vertex Medical and officials of the Health Department, the Government of Sindh.

During this meeting, the list of activities for the study relevant to the environmental impact assessment of the project was discussed.

1.7.3 Collection of Secondary Data

All available published and unpublished information pertaining to the background environment was obtained and reviewed. All data sources were carefully reviewed to collect the following information:

- **Physical Environment**: topography, geology, soils, surface and groundwater resources and climate;
- **Biological Environment**: habitat types, flora and fauna (particularly rare or endangered species), critical habitats, and vegetation communities within the area;
- **Socio-Economic Environment**: settlements, socio-economic conditions, infrastructure and land use; and
- **Heritage Aspects**: sites of cultural, archaeological or historical significance.

The list of secondary data consulted during the EIA study is provided in Annexure-3. The glossary of terms used in the EIA report has been provided in Annexure-4.
1.7.4 Collection of Primary Data and Field Visit

The PPI team visited the project site and adjoining areas for obtaining detailed knowledge of the environmental conditions of the area. During the field visits, the existing environmental conditions were studied.

The Rapid Social Appraisal method was applied to discover the facts, empirically verifiable observations or verifying the old facts, on the prevailing socio-economic and cultural conditions of the project area. Communities that were in the surrounding 0.5 km radius investigated during the field survey.

The ambient air quality and noise level monitoring at the project site was carried out. The survey team ensured that the mammals, birds and other species were observed without causing any potential disturbance. The sampling locations were randomly selected, ensuring that these locations are represented from each habitat type, and the maximum number of species is recorded.

1.7.5 Analysis of Alternatives

The EIA report gives the details of alternatives considered during the planning and design phases of the project.

1.7.6 Public Consultation

Public consultations were held with community living in the vicinity of all eight medical hospitals of Karachi, Hyderabad, Sukkur, Larkana and Benazirabad. Different aspects of the proposed project were highlighted to the community regarding their impacts on the physical, biological, and socio-economic environment of the project area and their concerns and suggestions were solicited.

The meetings were held with the Director Vertex Medical Lahore, Health Department, Environmental Consultants, Medical Superintendent (MS), waste management team, doctors, nurses and patients of all the project concerned, MS of private hospitals, Town Municipal Administration and their point of concern and suggestions regarding the project was solicited.

The information obtained from the community was used to identify concerns and issues that have been subsequently mentioned and addressed in the EIA report. The list of the people met during the public consultation is provided in Annexure-5.

1.7.7 Review of Legislative Requirements

The information on environmental policies, national and international laws as well as guidelines relevant to the project was reviewed, and a synopsis of all applicable laws has been narrated in the report.

1.7.8 Identification and Evaluation of Impacts

The identification of impacts is a key activity in the environmental assessment process, which is based on the professional judgment of our experienced team supported by national and international guidelines.

The potential impacts were identified with methodical consideration of likely or possible significant impacts on the environment for Installation of the incinerators project. The aim of this task was to assess the associated risks with these impacts.
Each impact identified has been evaluated against its significance in terms of severity and likelihood of its occurrence. The impact evaluation process prioritized each potential impact and screened out insignificant or inconsequential impacts.

The significance of the impacts has been assessed in terms of the effects on the natural ecosystem, level of public concern and conformity with legislative or statutory requirements. The assessment of the severity was to consider the nature, magnitude, extent and location, timing and duration and reversibility of the potential impact. The evaluation of the significant impacts has formed the basis for the development of the Environmental Management Plan.

1.7.9 Identification of Mitigation Measures

The objective of identification of mitigation measures is to identify practices, technologies or activities that would prevent or minimize all significant environmental impacts and propose physical and procedural controls to ensure that mitigation is effective.

On the basis of the impact evaluation performed, changes or improved practices have been suggested, where practical, in the planned activities, to prevent and control unacceptable adverse impacts resulting from normal or extreme events. Monitoring requirements and institutional arrangements for monitoring have been defined and suggested.

1.7.10 Development of Environmental Management Plan (EMP)

An Environmental Management Plan has been developed for effective implementation of the recommended mitigation measures of negative impacts during pre-construction, construction and operation phase. The Environmental Monitoring Plan has been developed to monitor the achievement of the Environmental Management Plan during the pre-construction, construction and operational phases of the project.

The EMP also lays down procedures to be followed during the operation of the project and identifies the roles and responsibilities of all concerned personnel, including reporting in the operational phase.

1.8 Organization of the EIA Report

This report has been structured in the following manner:

Chapter 1 (Introduction) provides an overall introduction to the project and impact assessment methodology.

Chapter 2 (Legal Framework) describes the regulatory framework of Pakistan on the environment and its implications for the project.

Chapter 3 (Project Description) provides the description of the proposed project, its layout plan and associated activities, raw material details and utility requirement.

Chapter 4 (Project Alternatives) details the potential alternatives that were considered during the design phase.

Chapter 5 (Existing Environment) provides a description of the micro-environment and macro-environment of the proposed project site. This chapter describes the physical, ecological and socio-economic resources of the project area and surroundings.

Chapter 6 (Public Consultation) describes details of discussions held with primary and secondary stakeholders.

Chapter 7 (Impact Assessment and Mitigation Measures) details the potential environmental and social impacts of the proposed project on the different features of the micro and macro-environment using the matrix method.
Chapter 8 (Environmental Management Plan) explains the mitigation measures proposed for the project in order to minimize the impacts to acceptable limits. It also describes the implementation of mitigation measures on ground and monitoring of environmental parameters against likely impacts.

Chapter 9 (Conclusion) summarizes the report and presents its conclusions.

The last Chapter is followed by Annexure that provides supporting information. Figure 1.3 shows a summary of methodologies and activities to conduct EIA.

**Figure 1.3: Summary of Methodologies and Activities to Conduct EIA**

- Development of a detailed understanding of the planned activities
- Obtaining of information on alternatives and best construction practices
- To form the basis of impact identification and evaluation
- To define normal conditions for various parameters keeping in view the current trend and expectations
- To understand and define the nature and degree of impacts
- To form the basis for developing a mitigation program
- To compile all the information in one document

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Meetings and discussions

Collection of baseline data and Review of secondary data

Public consultation with the community and stakeholders.

Analysis of data and identification of impacts

Evaluation of impacts and Preparation of Environmental Management Plan

Compilation and finalization of the report

Feedback from EPA Government of Sindh

**Submission and approval of final EIA report**
2 Legislative Institutional Framework

2.1 Introduction
Pakistan being a signatory of multilateral international treaties has a comprehensive set of environmental legislation covering multiple environmental issues facing Pakistan like pollution of freshwater bodies and coastal water, air pollution, deforestation, loss of biodiversity, lack of proper waste management and climate changes. The basic policy and legislative framework along with detailed rules, regulations and guidelines required for the implementation of the policies and enforcement of legislation for the protection of the environment and overall biodiversity are in place.

The compliance status of the installation of incinerators in different hospitals of Sindh was reviewed with reference to the legislation and existing legal framework on the environment in Pakistan and International level as described henceforth.

2.2 National Environmental Policy, 2005
The National Environment Policy (NEP) aims to protect, conserve and restore Pakistan’s environment in order to improve the quality of life of the citizens through sustainable development. In NEP, the further sectorial guidelines, Energy Efficiency and Renewable directly related to building energy code for newly constructed buildings were introduced.

The NEP provides an overreaching with a framework for addressing the environmental issues facing Pakistan, particular pollution of freshwater bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also provides directions for addressing the cross-sectored issues as well as the underline causes of Environmental degradation and meeting international obligations.

The NEP, while recognizing the goals and objectives of National Conservation Strategy, National Environmental Plan and other existing environment-related national policies, strategies and action plans provides broad guidelines to the Federal Government, Provincial Government, Federally Administered Territories and local Government for addressing environmental concerns and ensuring effective management of their environmental resources.

2.3 Laws and Regulations
Pakistan has a number of rules and regulations regarding the conservation and protection of the environment. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new phenomenon. Most of the existing laws on environmental issues were enforced over an extended period of time and are context-specific. The regulations relevant to the developmental projects are briefly reviewed below.

2.5.1 Sindh Environmental Protection Act, 2014
The legislative assembly of Sindh province of Pakistan passed the bill on 24th February 2014 to enact Sindh Environmental Protection Act 2014. The Act envisages protection, improvement, conservation and rehabilitation of environment of Sindh with the help of legal action against polluters and the green awakening of communities. It equally lays emphasis on the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its eco-system by avoiding all types of environmental hazards.

The act caters to the following aspects of the environment:
Biodiversity and related ecological complexes in the ecosystem to ensure and maintain an environmentally safe application of biotechnology and biomedical engineering.

Under the Sindh Environmental Protection Act, section 3, Environmental Protection Council should be established which would look after all aspects of the environment, its dynamism and interacting units.

The Sindh Environmental Protection Act, would also cater for and regulate all pollution-emitting bodies including emissions in air, land and water.

The act also gives provision of the environmental audit which would accommodate systemic scrutiny of the environmental performance of an organization, factory, company or manufacturing and production unit regarding all its operations. In light of which an environmental impact assessment involving a qualitative and quantitative impacts assessment must be conducted followed by devolution and implementation of an Environmental Management Plan to protect the environment and comply with all the relevant legislation.

To ensure the maintenance of qualitative and quantitative standards, Sindh Environmental Quality Standards must be established by the Agency under clause (e) of sub-section(1) of section 6 and approved by the Council under clause (c) of sub-section(1) of section 4 made under this Act.

The Act would also accommodate trans-boundary environmental impacts which would cater for all the adverse environmental impact or pollution in the air, land, water and coastal waters of Sindh province, adjacent to the land territory as may be specified in the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976).

2.5.2 Sindh Environmental Protection Agency (Review of IEE and EIA Regulations), 2014

Sindh Environmental Protection Agency (Review of IEE and EIA Regulations), 2014 (the Regulations) prepared by the Sindh Environmental Protection Agency under the powers conferred upon it by the Act, provide the necessary details on preparation, submission and review of the IEE and the EIA. Categorization of projects for IEE and EIA is one of the main components of the regulations.

Projects have been classified on the basis of the expected degree of adverse environmental impacts. Project types listed in Schedule-I are designated as potentially less damaging to the environment and those listed in Schedule-II as having potentially serious adverse effects. Schedule-I projects require an IEE to be conducted, provided they are not located in environmentally sensitive areas. For the schedule-II projects, conducting an EIA is necessary. Salient features of the regulation, relevant to the proposed project are listed below:

Categories of projects requiring IEE and EIA are issued through two schedules attached to the Regulations.

- A fee, depending on the cost of the project, has been imposed for review of EIA and IEE.
- The submittal is to be accompanied by an application in prescribed format included as schedule V of the Regulations.
- The EPA Sindh is bound to conduct preliminary scrutiny and reply within 10 days of submittal of the report: a) confirming completeness, b) asking for additional information, or c) requiring further studies.
- The EPA Sindh is required to make every effort to complete the review process for IEE within 45 days and of the EIA within 90 days, of the issue of confirmation of completeness.

EPA Sindh accords their approval subject to the following conditions:
• Before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions.
• Before commencing operation of the project, the proponent is required to obtain from EPA Sindh a written confirmation of compliance with approval conditions and requirements of the IEE/ EIA.
• An EMP is required to be submitted with the request for obtaining confirmation of compliance.
• The EPA Sindh are required to issue a confirmation of compliance within 15 days of receipt of the request and complete documentation.

The IEE/EIA approval will be valid for three years from the date of the accord.

A monitoring report is required to be submitted to the EPA Sindh after completion of construction, followed by annual monitoring reports during operations.

The project falls in Schedule-II of the regulations. Hence, this type of project needs an EIA to be conducted.

2.4 Hazardous Substance Rules, 2003
Section 4: A license will be required to import or transport a hazardous substance.

Section 5: EIA of the industrial activity involving generation, collection, transport, treatment, disposal, storage, handling or import of hazardous substance will be required along with safety and waste management plan.

The rules provide information on validity, renewal and cancellation of license; packing; and labelling; safety precautions; entry, inspection and monitoring; safety plan: waste management plan: import; and transport of hazardous substances.

2.5 Hospital waste management rules, 2005
Ministry of Environment, Government of Pakistan, had prepared the hospital waste management rules on August 03, 2005.

According to these rules, every hospital shall be responsible for the proper management of the waste generated by it until, its final disposal in accordance with the provision of the act and the rules 16 to 22.

The rules provide information on the roles and responsibilities of waste management team, waste management plan, waste segregation, waste collection, waste transportation, waste storage, waste disposal, accident and spillages, waste minimization and reuse, inspection and hospital waste management advisory committee.

2.6 Sindh Hospital Waste Management Rules 2014
These rules are made by the Sindh Government to ensure the safe handling and disposal of hospital waste.

The summary of the key features of these rules are:

• The hospital superintendent shall form a waste management team comprising different professionals of the hospital
• The responsibilities of the waste management team shall be defined
- Every hospital's waste management team should hold a review at least once a month
- Hospital engineer shall be appointed, and responsibilities should be established regarding hospital waste management
- The waste management plan shall be made by the waste management officer for approval by the waste management team
- Proper procedures shall be followed to collect, store, transport and dispose of the hospital waste
- The rules also discuss the accidents, spillage, waste minimization and reuse strategies
- Prior to waste disposal, segregation is required in terms of colour coding of waste (yellow, red, black and white) based on the nature of the waste generated.
- Non-risk waste which can be recycled is colour-coded to white/black waste whereas red waste consists of infectious waste including sharps. However, rest of all kinds of wastes generated are categorized under Yellow waste.

### 2.7 Sindh Environmental Quality Standards (SEQS)

The SEQS, promulgated under SEPA 2014, specify the following standards:

The Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources.

- For power plants operating on oil and coal:
- Maximum allowable emission of Sulphur dioxide,
- The maximum allowable increment in the concentration of sulfur dioxide in the ambient air,
- The maximum allowable concentration of nitrogen oxides in ambient air, and
- Maximum allowable emission of nitrogen oxide for steam generators as a function of heat input.
- The maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment and sea (three separate sets of numbers).

The SEQS for liquid effluents discharged to inland waters, gaseous emission from industrial sources and emissions from motor vehicles are provided as on the following website: http://epasindh.gov.pk/html/downloads.html.

The Sindh Environmental Quality Standards (SEQS) specify the following standards:

- The maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged into inland waters, sewage treatment facilities, and the sea (three separate sets of numbers).
- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources.
- Maximum allowable concentration of pollutants (02 parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles.
- Maximum allowable noise levels from vehicles.
- Ambient Noise and Air Quality Standards.

These standards also apply to the gaseous emissions and liquid effluents generated by the generator, process waste etc. The standards for vehicles will apply during the construction as
well as operation phase of the project. Standards for air quality have not been prescribed as yet.

2.7.1 Punjab Environmental Quality Standards for Treatment of Liquid and Disposal of Biomedical Waste by Incineration, Autoclaving, Microwaving and Deep Burial

During literature review, it was found out that Environmental Quality Standards for treatment of liquid and disposal of biomedical waste by incineration for Sindh have not been drafted yet. However, the Government of Punjab has drafted Environmental Quality Standards for treatment of liquid and disposal of biomedical waste by incineration, autoclaving, microwaving and deep burial.

The Environmental Protection Council has approved the Punjab Environmental Quality Standards for treatment of liquid and disposal of biomedical waste by incineration, autoclaving, microwaving and deep burial. The summary of the standards has been described below:

- The combustion efficiency, computed should be at least 99.0%
- The minimum temperature of the primary chamber shall be 800°C.
- The gas residence time in the secondary chamber shall be at least 1 second at the temperature of around 1200°C ± 50°C with at least 3% oxygen in the stack emission.

**Table 2.1: Emission Standards**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Parameters</th>
<th>Limiting concentration in mg/NM³ unless stated</th>
<th>Sampling Duration in minutes, unless stated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Particulate matter</td>
<td>50</td>
<td>30 or 1NM³ of samples volume, whichever is more</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Oxides expressed as NO²</td>
<td>400</td>
<td>30 for online sampling or grab sample</td>
</tr>
<tr>
<td>3</td>
<td>HCL</td>
<td>50</td>
<td>30 or 1NM³ of samples volume, whichever is more</td>
</tr>
<tr>
<td>4</td>
<td>Total Dioxins and Furans</td>
<td>0.1 ng TEQ/N3 (at 11% O₂)</td>
<td>8 hours or 5NM³ of sample volume, whichever is more</td>
</tr>
<tr>
<td>5</td>
<td>Hg and its compounds</td>
<td>0.05</td>
<td>2 hours or 1NM³ of samples volume, whichever is more</td>
</tr>
</tbody>
</table>

2.7.2 SEQS for Liquid Effluent

The Sindh Environmental Quality Standards (SEQS) for the discharge of effluent from industry are presented in Table 2.2.

**Table 2.2: SEQS for Liquid Effluent Discharge**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Into Inland Waters</th>
<th>Into Sewage Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>=&lt;3°C</td>
<td>=&lt;3°C</td>
</tr>
<tr>
<td>pH Value</td>
<td>6-9</td>
<td>6-9</td>
</tr>
<tr>
<td>Biological Oxygen Demand (BOD₅) at 20°C</td>
<td>80</td>
<td>250</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COC)</td>
<td>150</td>
<td>400</td>
</tr>
<tr>
<td>Parameters</td>
<td>Into Inland Waters</td>
<td>Into Sewage Treatment</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Total Suspended Solids (TSS)</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>3500</td>
<td>3500</td>
</tr>
<tr>
<td>Grease &amp; Oil</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Phenolic Compounds (as phenol)</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Chlorides (as Cl⁻)</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Fluoride (as F⁻)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Cyanide (CN⁻) total</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>An-ionic Detergents (as MBAs)</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>Sulphate (SO(^{2-}))</td>
<td>600</td>
<td>1000</td>
</tr>
<tr>
<td>Sulphide (S(^{2-}))</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Ammonia (NH(^{3}))</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Pesticides</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Chromium (trivalent &amp; hexavalent)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Lead (Ni)</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Selenium (Se)</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Silver (Ag)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Total Toxic Metals</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Barium (Ba)</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Chlorine (Cl₂)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: SEQS, Sindh Environmental Protection Agency

### 2.5.3 SEQS for Gaseous Emission

The Sindh Environmental Quality Standards (SEQS) for permissible limits of gaseous emission from industry are presented in Table 2.3.
Table 2.3: SEQS for Gaseous Emission

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Source of Emission</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke</td>
<td>Smoke opacity not to exceed</td>
<td>40% or 2 Ringlemann Scale or equivalent smoke number</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>Boilers &amp; Furnaces:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil Fired</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Coal Fired</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>Cement Kilns</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Grinding, crushing, clinker coolers and related processes, metallurgical processes, converters, blast furnaces and cupolas</td>
<td>500</td>
</tr>
<tr>
<td>Hydrogen Chloride</td>
<td>Any</td>
<td>400</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Any</td>
<td>150</td>
</tr>
<tr>
<td>Hydrogen Fluoride</td>
<td>Any</td>
<td>150</td>
</tr>
<tr>
<td>Hydrogen Sulphide</td>
<td>Any</td>
<td>10</td>
</tr>
<tr>
<td>Sulphur Oxides</td>
<td>Sulfuric Acid/sulphonic Acid Plants</td>
<td>5000</td>
</tr>
<tr>
<td></td>
<td>Other Plants except power plants operating an oil and coal</td>
<td>1700</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>Any</td>
<td>800</td>
</tr>
<tr>
<td>Lead</td>
<td>Any</td>
<td>50</td>
</tr>
<tr>
<td>Mercury</td>
<td>Any</td>
<td>10</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Any</td>
<td>20</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Any</td>
<td>20</td>
</tr>
<tr>
<td>Copper</td>
<td>Any</td>
<td>50</td>
</tr>
<tr>
<td>Antimony</td>
<td>Any</td>
<td>20</td>
</tr>
<tr>
<td>Zinc</td>
<td>Any</td>
<td>200</td>
</tr>
<tr>
<td>Oxides of Nitrogen</td>
<td>Nitric Acid Manufacturing Unit</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td>Other plants except for power plants operating on oil or coal:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gas fired</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>Oil fired</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Coal-fired</td>
<td>1200</td>
</tr>
</tbody>
</table>

Source: SEQS, Sindh Environmental Protection Agency

2.5.4 SEQS for Vehicular Emission

The Sindh Environmental Quality Standards (SEQS) for permissible limits of exhaust emissions from vehicles are presented in Table 2.4.
Table 2.2: SEQS for Vehicular Emission

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Standards (Maximum permissible limits)</th>
<th>Measuring Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke</td>
<td>40% or 2 on the Ringleman Scale During engine acceleration mode</td>
<td>To be compared with Ringleman chart at a distance of 6 meters or more</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>6%</td>
<td>Under idling conditions: non-dispersive infrared detection through the gas analyzer.</td>
</tr>
<tr>
<td>Noise</td>
<td>85 dB (A)</td>
<td>A sound meter at 7.5 meters from the source</td>
</tr>
</tbody>
</table>

Source: SEQS, Sindh Environmental Protection Agency

2.5.5 SEQS for Drinking Water, 2010

The Sindh Environmental Quality Standards (SEQS) for drinking water quality, 2016 are presented in Table 2.5.

Table 2.3: SEQS for Drinking Water Quality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard values</th>
<th>WHO standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All water intended for drinking (E. Coli or Thermo-tolerant Coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample.</td>
<td>Must not be detectable in any 100 ml sample.</td>
</tr>
<tr>
<td>Treated water entering the distribution system (E. Coli or Thermo-tolerant Coliform and total Coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample.</td>
<td>Must not be detectable in any 100 ml sample.</td>
</tr>
<tr>
<td>Treated water in the distribution system (E. Coli or Thermo-tolerant Coliform and total Coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample.</td>
<td>Must not be detectable in any 100 ml sample.</td>
</tr>
<tr>
<td>In the case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>$\leq 15$ TCU</td>
<td>$\leq 15$ TCU</td>
</tr>
<tr>
<td>Taste</td>
<td>Non-acceptable</td>
<td>Non-acceptable</td>
</tr>
<tr>
<td>Odour</td>
<td>Non-acceptable</td>
<td>Non-acceptable</td>
</tr>
<tr>
<td>Turbidity</td>
<td>$&lt; 5$ NTU</td>
<td>$&lt; 5$ NTU</td>
</tr>
<tr>
<td>Total hardness</td>
<td>$&lt; 500$ mg/L</td>
<td>---</td>
</tr>
<tr>
<td>TDS</td>
<td>$&lt;1000$</td>
<td>$&lt;1000$</td>
</tr>
<tr>
<td>pH</td>
<td>6.5- 8.5</td>
<td>6.5- 8.5</td>
</tr>
</tbody>
</table>
### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard values</th>
<th>WHO standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Essential Organic</td>
<td>mg/Litre</td>
<td>mg/Litre</td>
</tr>
<tr>
<td>Aluminium</td>
<td>≤ 0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Antimony</td>
<td>≤ 0.005</td>
<td>0.02</td>
</tr>
<tr>
<td>Arsenic</td>
<td>≤ 0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Barium</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Boron</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.01</td>
<td>0.003</td>
</tr>
<tr>
<td>Chloride</td>
<td>≤ 250</td>
<td>250</td>
</tr>
<tr>
<td>Chromium</td>
<td>≤ 0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Copper</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Toxic Inorganic</td>
<td>mg/Litre</td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>≤ 0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Flouride</td>
<td>≤ 1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Lead</td>
<td>≤ 0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Manganese</td>
<td>≤ 0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Mercury</td>
<td>≤ 0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Nickel</td>
<td>≤ 0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Nitrate</td>
<td>≤ 50</td>
<td>50</td>
</tr>
<tr>
<td>Nitrite</td>
<td>≤ 3</td>
<td>3</td>
</tr>
<tr>
<td>Zinc</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Pesticides mg/L</td>
<td></td>
<td>PSQCA No.4639-2004.page No 4 Table No. 3serial No. 20-58</td>
</tr>
<tr>
<td>Phenolic Compounds</td>
<td></td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>Polynuclear aromatic hydrocarbons</td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Radioactive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpha emitters bq/L</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Beta emitters</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Source:** SEQS, Sindh Environmental Protection Agency

### 2.5.6 SEQS for Ambient Air and Noise

The Sindh Environmental Quality Standards (SEQS) for Ambient Air and Noise, 2016 are presented in Table 2.6 and 2.7.
### Table 2.4: SEQS for Ambient Air

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Time Weighted Average</th>
<th>Concentration in Ambient Air (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur Dioxide (SO₂)</td>
<td>Annual Average*</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>120</td>
</tr>
<tr>
<td>Oxides of Nitrogen gas (NO)</td>
<td>Annual Average*</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>40</td>
</tr>
<tr>
<td>Oxides of Nitrogen gas (NO₂)</td>
<td>Annual Average*</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>80</td>
</tr>
<tr>
<td>Ozone (O₃)</td>
<td>1 hour</td>
<td>130</td>
</tr>
<tr>
<td>Suspended Particulate Matter (SPM)</td>
<td>Annual Average*</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>500</td>
</tr>
<tr>
<td>Respirable Particulate Matter (PM₁₀)</td>
<td>Annual Average*</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>150</td>
</tr>
<tr>
<td>Respirable Particulate Matter (PM₂.₅)</td>
<td>Annual Average*</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>1 hr</td>
<td>15</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>Annual Average*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>24 hrs**</td>
<td>1.5</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>8 hrs</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td></td>
<td>1 hr</td>
<td>10 mg/m³</td>
</tr>
</tbody>
</table>

** Annual Arithmetic mean of minimum 1040 measurements in a year taken twice a week 24 hourly at a uniform interval

* 24 hourly /8 hourly values should be met 98% of the year, 2% of the time, it may exceed.

*Source: SEQS, Sindh Environmental Protection Agency*

### Table 2.5: SEQS for Noise

<table>
<thead>
<tr>
<th></th>
<th>Daytime</th>
<th>Night time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential area</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Commercial area</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>Industrial area</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Silence area</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

*Source: SEQS, Sindh Environmental Protection Agency*

### 2.8 Coastal Development Authority Act of 1994

This Act provides for the development, improvement and "beautification" of the coastal areas of Thatta and Badin districts, and establishes an Authority for this purpose. The Authority is responsible for the beautification of the coastal regions and monitoring development schemes, as well as drinking water facilities, communication systems, electricity, drainage, development of fisheries, livestock, horticulture and forests (section 7(1) and 7(2)). It develops marketing facilities and constructs jetties and harbours (section 7(2)). It acts as a coordinating agency...
for the federal and provincial Governments, local authorities or autonomous bodies (section 7(3)), and collaborates with them in development and environmental protection activities (section 7(4)). The Authority provides technical guidance including technical services for development activities (section 7(5)) and carries out research for development planning (section 7(7)). It assists in the establishment of coconut palm plantations (section 7(10)) and the development of fish harbours and oil refineries (section 7(11) and 7(12)).

2.9 Forest Act, 1927

The Act authorizes Provincial Forest Departments to establish forest reserves and protected forests. The Act prohibits any person to set a fire in the forest, quarry stone, remove any forest-produce or cause any damage to the forest by cutting trees or clearing up area for cultivation or any other purpose. Forest Act is also not likely to be applicable to the proposed project. No project activities will, however, be carried out in any protected forests, and no unauthorized tree cutting will be carried out for any facilities expansion or waste disposal.

2.10 Land Acquisition Act, 1894

The Land Acquisition Act (LAA) of 1894 amended from time to time has been the de-facto policy governing land acquisition and compensation in the country. The LAA is the most commonly used law for acquisition of land and other properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions.

2.11 Antiquity 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, illegal excavation, trade and export. Antiquity have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc.

The law prohibits new construction in the proximity of protected antiquity and empowers the Government of Pakistan to prohibit excavation in an area that may contain articles of archaeological significance.

Under the Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of protected antiquity, and
- If during the course of the project an archaeological discovery is made, it should be reported to the Department of Archaeology, Government of Pakistan.

2.12 Cutting of Trees (Prohibition Act), 1975

Section 3 of this Act states “No person shall, without the prior written approval of the local formation commander or an officer authorized by him in this behalf, cut fell or damage or cause to cut, fell or damage any tree."

2.13 Protection of Trees and Bush wood Act, 1949

This Act prohibits cutting or chopping of trees and bush wood without permission of the Forest Department.
2.14 Employment of Child Act, 1991

Section 3, Prohibition of Employment, of this Act starts “No child shall be employed or permitted to work in any of the occupations set forth in Part I of the Schedule or in any workshop wherein any of the processes set forth in Part II of that Schedule is carried on: Provided that nothing in this section shall apply to any establishment wherein such process is carried on by the occupier with the help of his family or to any school established, assisted or recognized by Government.”

The Employment of Child Act, 1991 is available at:


2.15 Factories Act, 1934

The clauses relevant to the proposed project are those that address the health, safety and welfare of the workers, disposal of solid waste and effluents, and damage to private and public property. The Act also provides regulations for handling and disposing toxic and hazardous substances. The Pakistan Environmental Protection Act, 1997 (discussed above), supersedes parts of this Act pertaining to the environment and environmental degradation.

2.16 Pakistan Penal Code, 1860

This outlines the penalties for violations concerning pollution of air, water bodies and land. Sections 272 and 273 of this Act deal with the adulteration of food or drink. Noise pollution has been covered in Section 268, which defines and recognizes noise as a public nuisance. “A person is guilty of a public nuisance who does any act or is guilty of an illegal omission which causes any common injury, danger or annoyance to the public or to the people in general who dwell or occupy property in the vicinity, or which must necessarily cause injury, obstruction, danger or annoyance to persons who may have occasion to use any public right.”

The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents. Most of the environmental aspects of the Code have been superseded by the Pakistan Environmental Protection Act, 1997.

2.17 Institutional Set Up

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), presided by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Gilgit-Baltistan), and environmental tribunals.

The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the proposed projects and provide their approval (or otherwise).

The Provision of Incinerators (Procurement, Installation and Commissioning of Incinerators) in different Hospitals in Sindh Project is located at Karachi, Jamshoro, Shaheed Benazirabad, Larkana and Sukkur is located in Sindh Province. Therefore, the EIA report will be submitted to the Sindh Environmental Protection Agency, Karachi for obtaining environmental approval for the project.
2.18 The obligation under International Treaties

Pakistan is a signatory to various international treaties and conventions on the conservation of the environment and wildlife protection. The country is obliged to adhere to the commitments specified in these treaties. The Convention on Biological Diversity (CBD) was adopted during the Earth Summit of 1992 in Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity and to integrate these plans into national development programs and policies.

Parties are also required to identify components of biodiversity that are important for conservation and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

The Convention on the Conservation of Migratory Species of Wild Animals, 1979 requires countries to take action to avoid endangering migratory species, where the term migratory species refers to species of wild animals of which significant proportions cyclically and predictably cross one or more national jurisdictional boundaries.

The parties are also required to promote or cooperate with research into migratory species. Under the international plant protection convention, 1951, Pakistan is required to take steps to ensure the protection of certain plant species that face the extinction threat.

Pakistan signed and ratified on a number of international agreements and Convention and bound to implement them in its territory.

2.19 The Implication of Legislations to the project

The implication of the above-mentioned legislation to the pre-construction, construction and operational phase of the provision of incinerators project in different Hospitals of Sindh would be as follows:

- Health Department, being the proponent of the project will ensure that the construction and operational phases of the project be carried out in accordance with the EIA report and Environmental Management Plan is effectively implemented.
- The project will be subjected to the following basic provisions relating to pollution control under the Sindh Environmental Protection Act 2014, as contained in section 11, 13, 14 and 15 as follows:
  - Section 11, prohibits discharge or emission of any effluent or waste or air pollutant or noise in excess of the SEQS, or the established ambient standards for air, water or land.
  - Section 13, prohibits hazardous wastes.
  - Section 14, prohibits the handling of hazardous substance except under license or in accordance with the provision of any local law or international agreement.
  - Section 15, prohibits the operation of motor vehicles for each air pollutant or noise is being emitted in excess of the SEQS or the established ambient standard.
- Vertex Medical (Pvt.) Ltd will install, commission and operate the incinerators as per Punjab Environmental Quality Standards for Treatment of Liquid and Disposal of Bio-Medical Waste by Incineration, Autoclaving, Microwaving and Deep Burial.
- All the selected hospital will comply with Sindh Hospital Waste Management Rules, 2014.
3 Description of the Project

3.1 Introduction
This chapter provides a description of the project namely, Provision of incinerators (Procurement, Installation, Commissioning & Operations) in different hospitals of Sindh, its salient features, locations, components and various phases. The project consists of the installation of eight 100 kg/hr incinerators at eight different hospitals of Sindh namely:

i. Jinnah Postgraduate Medical Center Karachi,
ii. National Institute of Child Health Karachi
iii. Dr Ruth Pfau Civil Hospital Karachi,
iv. Sindh Government Lyari General Hospital Karachi,
v. Liaquat University Hospital Jamshoro,
vi. Ghulam Muhammad Mahar Medical College Hospital Sukkur,
vii. Chandka Medical College Hospital Larkana,
viii. Peoples Medical College Hospital Shaheed Benazirabad.

3.2 Type and Category of the Project
The proposed project is the provision of the incinerator (procurement, installation, commissioning & operations) in different hospitals of Sindh in five districts of Sindh. The Project falls in Schedule II of Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014. Under category H. Waste Disposal and Treatment: 1. Handling, storage or disposal of hazardous or toxic wastes or radioactive waste (including landfill sites, incineration of hospital toxic waste).

3.3 The objective of the Project
The objective of the installation of the incinerators is to promote cleaner practices and complete combustion of infectious hospital wastes. The project will help to overcome the infectious hospital waste management and disposal problems under the Health Department, Government of Sindh.

3.4 Project Administrative Jurisdiction
The project sites are located within the administrative jurisdiction of Sindh Province whereby incinerators are being installed in the five districts of Sindh namely, Karachi, Jamshoro, Sukkur, Shaheed Benazirabad and Larkana.

3.5 Project Location
The Jinnah Postgraduate Medical Center, National Institute of Child Health, Dr Ruth Pfau Civil Hospital and Sindh Government Lyari General Hospital are located in Karachi; Liaquat University Hospital in Jamshoro; Ghulam Muhammad Mehar Medical College Hospital in Sukkur; Chandka Medical College Hospital in Larkana and Peoples Medical College Hospital in Shaheed Benazirabad.
3.5.1 Jinnah Postgraduate Medical Centre Karachi

The Jinnah Postgraduate Medical Centre (JPMC) also known as Jinnah Hospital, Karachi) is located at Rafiqi Shaheed Road in Karachi Cantonment area of Karachi, Sindh, Pakistan. Rafiqi Shaheed Road crosses Shahrah-e-Faisal on its North West. The coordinates of the incinerator site are 24°51’01.7”N and 67°02’53.4”E.

The new state of the art incinerators will be installed near to the existing under construction Friction Based Incinerator, located within the South-West of the hospital.

**Figure 3.1** shows the location Map of installation of Incinerator at JPMC Karachi. There is an existing workshop at the proposed incinerator site which will be demolished during the construction phase.

**Figure 3.2** shows Environmental Receptors near JPMC Karachi as follows:

- **East:** Gora Kabristan
- **West:** Edhi Hokey Ground
- **North:** Bizerta Lines
- **South:** PNS Shifa Hospital
- **North-West:** FG Boys College Karachi Cantt
- **North East:** National Medical Centre (NMC) Karachi
- **South West:** Pakistan Railways Karachi Cantt Station

**Figure 3.3** shows the location of Environmental Receptor near JPMC Karachi.
Figure 3.1: Location Map of installation of Incinerator at JPMC Karachi
Figure 3.2: Environmental Receptors near JPMC Karachi

- FG Boys College Karachi Cantt
- Edhi Hockey Stadium
- PNS Shifa
- NMC
- Gora Khabistan
- Railway Station
- FG Boys College Karachi Cantt
- Railway Station
- FG Boys College Karachi Cantt
- PNS Shifa
- NMC
- Gora Khabistan
Figure 3.3: Location of Environmental Receptor near JPMC Karachi
3.5.1.1 Access to JPMC Karachi

JPMC is connected to Rafiqi H J Road which crosses Shahrah-e-Faisal on its north. Hockey Club of Pakistan Road and School Road is connected to Rafiqi H J Road from West. Rafiqi H J Road is connected to Kala Pull Road on its South.

Access to JPMC is shown in Figure 3.4.
Figure 3.4: Access to JPMC Karachi
3.5.2 National Institute of Child Health Karachi

The National Institute of Child Health Karachi (NICH) is located at Rafiqi Shaheed Road in Karachi Cantonment area of Karachi, Sindh, Pakistan. Rafiqi Shaheed Road crosses Shahrah-e-Faisal on its North West. The coordinates of the incinerator site are 24°51′01.12.833″N and 67°02′53.30.382″E.

Figure 3.5 shows the location map of installation of the incinerator at NICH Karachi. Figure 3.6 shows the environmental receptors near NICH Karachi as follows:

- **East:** JPMU APPNA institute
- **West:** NICVD National Institute of Cardiovascular Diseases
- **North:** Shahra-e-Faisal
- **South:** ACELP Institute of Child
- **North-West:** Energy Update Monthly building
- **North East:** Karachi Cantonment
- **South West:** Abdul Sattar Edhi Hockey Stadium

Figure 3.7 shows the location of environmental receptor near NICH Karachi.
Figure 3.5: Location Map of installation of Incinerator at NICH Karachi
Figure 3.6: Environmental Receptors near NICH Karachi

JSMU Boys Hostel

NICVD

Construction site

Karachi Cantt

JSMU

NICVD
**Figure 3.7**: Location of Environmental Receptor near NICH Karachi
3.5.2.1 Access to NICH Karachi

NICH is connected to Rafiqi H J Road which crosses Shahrah-e-Faisal on its north. Hockey Club of Pakistan Road and School Road is connected to Rafiqi H J Road from West.

Access to JPMC is shown in Figure 3.8.
Figure 3.8: Access to NICH Karachi
3.5.3 Dr Ruth Pfau Civil Hospital Karachi

Dr Ruth Pfau Civil Hospital Karachi is located on Mission Road connected via Main MA Jinnah Road in the south and Princess Road in the north. It can also be approached through Yaqub Road and Ranchore Road in the east. The coordinates of the location are 24°51'36.76" North and 67°0'36.80" East.

The new state of art incinerator will be installed near the existing old incinerator which is located in the Southeast of the hospital.

**Figure 3.9** shows the location map of installation of Incinerator at Dr Ruth Pfau Civil Hospital Karachi

**Figure 3.10** shows environmental receptors near Dr Ruth Pfau Civil Hospital Karachi

**Figure 3.11** shows the location of environmental receptors near Dr Ruth Pfau Civil Hospital Karachi as follows:

- **East:** Sindh Institute of Urology and Transplantation
- **West:** City Court South Building
- **South:** Dow University of Health Sciences
- **North-West:** K.M.C. Football Ground
- **North East:** National Museum of Pakistan
- **South West:** Christ Church
**Figure 3.9:** Location map of installation of Incinerator at Dr Ruth Pfau Civil Hospital Karachi
Figure 3.10: Environmental Receptors near Dr Ruth Pfau Civil Hospital Karachi
Figure 3.11: Location of environmental receptors near Dr Ruth Pfau Civil Hospital Karachi
3.5.3.1 Access to Dr Ruth Pfau Civil Hospital Karachi

Dr Ruth Pfau Civil Hospital Karachi can be accessed through Hospital Road in the East and Mission Road in the West. Hospital Road and Mission Road are connected to Princess Street on the North and M.A Jinnah Road on the South.

The access to Dr Ruth Pfau Civil Hospital Karachi is shown in Figure 3.12.
Figure 3.12: Access to Dr Ruth Pfau Civil Hospital Karachi
3.5.4 Sindh Government Lyari General Hospital Karachi

Sindh Government Lyari General Hospital Karachi is located on Tannery Road which is connected via main Lyari Expressway. The coordinates of the project site of installation of the incinerator at Sindh Government Lyari General Hospital are 24°52’17.77” North and 66°59’34.41” East.

The new state of the art incinerator will be installed adjacent to the existing incinerator which is located in the Southeast of the hospital. Figure 3.13 shows the location of Incinerator at Sindh Government Lyari General Hospital Karachi.

Figure 3.14 shows environmental receptors near Sindh Government Lyari General Hospital Karachi.

Figure 3.15 shows the location of environmental receptors near the Sindh Government Lyari General Hospital Karachi as follows:

- **East:** Ahmed Shah Bukhari Govt. Urdu Boys School
- **West:** Lyari General Ground
- **North:** Sheikh Hayat Park
- **South:** Shree Radha Gokul and Temple
- **North-West:** Jama Masjid Park
- **South East:** Tohidi Masjid
- **South West:** Rahimia Jamat Kahan
Figure 3.13: Location of Incinerator at Sindh Government Lyari General Hospital Karachi
Figure 3.14: Environmental receptors near Sindh Government Lyari General Hospital Karachi

- Lyari River
- Jama Masjid Park
- Hazara Masjid
- Sheikh Hayat Park
- Lyari General Ground
- Rahimia Jamat Kahan
- Shree Radha Gokul Anand Temple
- Nadra Office
- Ahmed Shah Bukhari Govt. Urdu Boys School
- Tohidi Masjid
- Al-Qadir Model English School

Legend:
- Access Road
- Chokhiwara Road
- Chokhiwara Road
- Hazara Colony Road
- Lyari Expressway
- Lyari General Hospital Karachi
- Lyari River
- Rehman Hurdhar Lyari Road
- Proposed Incinerator Site
- Proposed Incinerator Site
- Shahinwala-Faisal Road
- Tohidi Road
- UBL Street
Figure 3.15: Location of environmental receptors near Sindh Government Lyari General Hospital Karachi
3.5.4.1 Access to Sindh Government Lyari General Hospital Karachi

Sindh Government Lyari General Hospital Karachi can be accessed through Tannery Road in the west and Rangiwara Street via main Chakiwara Road in the East. Hazara Colony Road in the North also provides a passage to Lyari General Hospital via service Roads in the north.

Access to the Sindh Government Lyari General Hospital Karachi is shown in Figure 3.16.
Figure 3.16: Access to Sindh Government Lyari General Hospital Karachi
3.5.5 **Peoples Medical College Hospital Shaheed Benazirabad**

People Medical College Hospital Shaheed Benazirabad is located at Civil Hospital Road via Shaheed Bhutto Road and Court Road. The coordinates of the incinerator installation site are 26°14’40.92” North and 68°24’15.97” East.

The new state of the art incinerator will be installed adjacent to the existing old incinerator which is located in the Southeast of the hospital. **Figure 3.17** shows the location of the incinerator at People Medical College Hospital Shaheed Benazirabad. **Figure 3.18** shows environmental receptors near People Medical College Hospital Shaheed Benazirabad.

**Figure 3.19** shows the location of environmental receptors near People Medical College Hospital Shaheed Benazirabad as follows:

Following listed are the receptors near the vicinity of the project:

- **East:** Convent High School
- **West:** Peoples University of Medical and Health Sciences
- **South:** Ghareebabad
- **North-West:** Shaheed Benazir Bhutto University
- **North-East:** Habib Sugar Mills
- **South East:** Nawabshah Railway Station
- **South West:** Eid Gah
Figure 3.17: Location of the incinerator at People Medical College Hospital Shaheed Benazirabad
Figure 3.18: Environmental receptors near People Medical College Hospital Shaheed Benazirabad
**Figure 3.19:** Location of environmental receptors near People Medical College Hospital Shaheed Benazirabad
3.5.5.1 Access to People Medical College Hospital Shaheed Benazirabad

People Medical College Hospital Shaheed Benazirabad is located at Civil Hospital Road via Shaheed Bhutto Road and Court Road.

The coordinates of the site of installation of the incinerator at People Medical College Hospital Shaheed Benazirabad are 26°14′40.92″ North and 68°24′15.97″ East.

**Figure 3.20** shows access to Peoples Medical Hospital Shaheed Benazirabad.
Figure 3.20: Access to Peoples Medical Hospital Shaheed Benazirabad
3.5.6 Liaquat University Hospital Jamshoro

Liaquat University Hospital Jamshoro is located on Hospital Road via main Bhurgari Road in east and Pathan colony Road in the west. The coordinates of the site of installation of the incinerator at Liaquat University Hospital Jamshoro are 25°25'56.23" North and 68°16'19.57" East.

The new state of art incinerator will be installed adjacent to the existing incinerator located within the hospital vicinity.

**Figure 3.21** shows the location of the incinerator at Liaquat University Hospital Jamshoro.

**Figure 3.22** shows the environmental receptors near Liaquat University Hospital Jamshoro.

**Figure 3.23** shows the location of environmental receptor near Liaquat University Hospital Jamshoro as follows:

- **East:** Sindh University Fuel Station
- **West:** Barren Land
- **South:** Ghareebabad
- **North-West:** Barren Land
- **North-East:** Chawara Buth (village)
- **South East:** Jamshoro Railway Station
- **South West:** Liaquat University of Medical and Health Sciences
Figure 3.21: Location of the incinerator at Liaquat University Hospital Jamshoro
Figure 3.22: Environmental receptors near Liaquat University Hospital Jamshoro
Figure 3.23: Location of Environmental Receptor near Liaquat University Hospital Jamshoro
3.5.7 Access to Liaquat University Hospital Jamshoro

Liaquat University Hospital Jamshoro is located on Hospital Road via main Bhurgari Road in East and Pathan Colony Road in West. The coordinates of the site of the installation of the incinerator at Liaquat University Hospital Jamshoro are 25°25'56.23" North and 68°16'19.57" East.

In total there are four main roads that connect with the project location namely, Bhurgari Road, Prince Ali Road, Market Road and Pathan Colony Road. Bhurgari Road is further connected to National Highway-5. Access to Liaquat University Hospital Jamshoro is shown in Figure 3.24.
Figure 3.24: Access to Liaquat University Hospital Jamshoro
3.5.8 Ghulam Muhammad Mahar Medical College Hospital Sukkur

Ghulam Muhammad Mahar Medical College Hospital Sukkur is located on main Sukkur-Faisalabad highway. The coordinates of the site of the installation of the new incinerator are 27°42'6.01" North and 68°52'34.82" East.

The new state of the art incinerator will be installed adjacent to the existing incinerator which is located in the Southeast of the hospital.

**Figure 3.25** shows the location of the incinerator at Ghulam Muhammad Mahar Medical College Hospital Sukkur.

**Figure 3.26** shows environmental receptors near Ghulam Muhammad Mahar Medical College Hospital Sukkur.

**Figure 3.27** shows the location of environmental receptors near Ghulam Muhammad Mahar Medical College Hospital Sukkur as follows:

- **East**: Hyderi Masjid
- **West**: Sukkur Railway Station
- **South**: Government Islamia Science College
- **North-West**: Old Sukkur
- **North-East**: Latif Park
- **South East**: Indus River
- **South West**: Sukkur Institute of Science & Technology, Sukkur Railway Stadium
Figure 3.25: Location of the incinerator at Ghulam Muhammad Mahar Medical College Hospital Sukkur
Figure 3.26: Environmental receptors near Ghulam Muhammad Mahar Medical College Hospital Sukkur
Figure 3.27: Location of environmental receptors near Ghulam Muhammad Mahar Medical College Hospital Sukkur
3.5.9 Access to Ghulam Muhammad Mahar Medical College Hospital Sukkur

Ghulam Muhammad Mahar Medical College Hospital Sukkur can be approached through Eid Gah Road which offers access through a link Road to the project site. The coordinates of the site of installation of the incinerator at Ghulam Muhammad Mahar Medical College Hospital Sukkur are 27°42’6.01” North and 68°52’34.82” East.

Access to Ghulam Muhammad Mahar Medical College Hospital Sukkur is shown in Figure 3.28.
Figure 3.28: Access to Ghulam Muhammad Mahar Medical College Hospital Sukkur
3.5.10 Chandka Medical College Hospital Larkana

Chandka Medical College Hospital Larkana is located on University Road via Shah Nawaz Bhutto Road. The coordinates of the location are 27°33'18.42" North and 68°12'33.20" East. The new state of art incinerator will be installed in Shaikh Zaid Block which is located within the premises of the hospital.

Figure 3.299 shows the location of the incinerator at Chandka Medical College Hospital Larkana.

Figure 3.30 shows environmental receptors near Chandka Medical College Hospital Larkana.

Figure 3.31 shows the location of environmental receptors near Chandka Medical College Hospital Larkana as follows:

Following listed are the receptors near the vicinity of the project:

- **East:** Farooq Medical & Dental Centre Larkana
- **West:** Jamia Masjid
- **North:** Municipal Stadium
- **South:** Larkana Junction
- **North-West:** SZABIST, Larkana Campus
- **North-East:** Zulfiqar Bagh Larkana
- **South West:** Government Degree College Larkana
Figure 3.30: Location of Incinerator at Chandka Medical College Hospital Larkana
Figure 3.31: Environmental Receptors near Chandka Medical College Hospital Larkana
3.5.11 Access to Chandka Medical College Hospital Larkana

Chandka Medical College Hospital Larkana is located on University Road and can be approached via main Shah Nawaz Bhutto Road. The coordinates of the site of the installation of the incinerator at Chandka Medical College Hospital Larkana are 27°33’18.42” North and 68°12’33.20” East.

Access to Chandka Medical College Hospital Larkana has been shown in Figure 3.32.
Figure 3.32: Access to Chandka Medical College Hospital Larkana
3.6 Description of the Project

The project consists of the provision of incinerators (procurement, installation, commissioning & operations) in the selected hospitals of Sindh. A total of eight units of 100 kg/hr incinerators, MP 500, Addfield Environmental Systems Limited, at eight hospitals of Sindh namely: Jinnah Postgraduate Medical Center Karachi, National Institute of Child Health Karachi, Dr. Ruth Pfau Civil Hospital Karachi, Sindh Government Lyari General Hospital Karachi, Liaquat University Hospital Jamshoro, Ghulam Muhammad Mahar Medical College Hospital Sukkur, Chandka Medical College Hospital Larkana and Peoples Medical College Hospital Shaheed Benazirabad.

There will be an incineration room (25 ft x 30 ft x16 ft), one supervisor room (12 ft x 15 ft x 10 ft), one yellow room (12 ft x 12 ft x 10 ft), furniture, washroom, yellow waste room, ash pit and boundary wall of 6 ft. with steel gate.

The utilities to be provided are a single phase 220 V, 50 Hz, 13-16 Ampere electricity connection with distribution box, electric cable from main to the distribution box and to the incinerator. The gas connection with the pressure of 22 bar with 4.32 m³/hr with GI pipe, further pressure gauge, shut off valves, pressure regulator and bypass scheme.

The water connection with 2-3 bar, water pipes and shut off valve. There will be standby Liquefied Petroleum Gas (LPG) Fuel with 2 large cylinders to run the incinerator for 12 hours having 6 mm gauge, pressure gauge, regulator, safety value and 4 wheels.

The incinerator will be provided with necessary accessories, i.e., ash removal tool, particulate removal tool, digital weighing scale, stainless steel trolley, bin trolley yellow, plastic bags yellow, leather gloves, safety shoes, disposable mask, smoke mask and fire extinguisher.

The technical specification of the incinerator has been provided hereunder:

**Incinerator:** Addfield Incinerate Cremate (Addfield Environmental Systems Limited), United Kingdom is the manufacturer of incinerators. The incinerator model number is MP-500 which is specifically designed for medical waste (The MP medical hot hearth Incinerator) and the most thermally efficient, robust and reliable medical incinerators in the market.

The Addfield range of Medical and Pathological incinerators (MP Series) are bespoke incinerators designed explicitly for the destruction of high category medical/pathological waste. These waste types generally have high moisture contents and low calorific values such as blood, human organs/tissues swab etc.

The MP series has been specifically designed to completely and efficiently destroy these wastes with the higher moisture contents of 50% and above.

The incinerator is equally suitable for plastic, paper, textile, rubber, along with a dry and wet infectious waste of the hospitals. The incinerator can be operated continuously for 12 hours daily.

**Unit of the Incinerator:** The MP range is designed as a two-stage incinerator unit comprising of a primary loading chamber that incorporates a hot hearth construction for the total destruction of the solid/liquid wastes.

The unit is further complemented by an integral afterburner system. This afterburner draws the hot gases from the primary chamber under the hearth through an integral refractory brick system. This ensures maximum gas turbulence/mixing is achieved thus aiding clean combusted gases.
All gases then reside inside the after-burner chamber for a minimum of 2 seconds at temperatures of 850-1150°C ensuring complete high-temperature termination/oxidation of the gas combustion products.

The turnkey project of installation, commissioning and operation includes:

- Hospital graded Incinerator,
- Wet Scrubber and Water Treatment,
- Accessories,
- Site Preparation, and
- Operational Services.

### 3.6.1 Certification and Compliance

The Addfield range of incinerators are CE Certified to BS EN 746-2: 1997 (Safety requirements for combustion and fuel handling systems which meets the definition for machinery given in BS EN 292-1:1991), a recent emissions testing concluded the following results based on two second residue time within the secondary chamber, results are well below the European Commission (EC) limits. They are also compliant with the most up to date legislation.

<table>
<thead>
<tr>
<th>Table 3.1: Composition of Exhaust Gases (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected Emissions</strong>*</td>
</tr>
<tr>
<td>Carbon Dioxide (CO\textsubscript{2})</td>
</tr>
<tr>
<td>Water (H\textsubscript{2}O)</td>
</tr>
<tr>
<td>Oxygen (O\textsubscript{2})</td>
</tr>
<tr>
<td>Sulphur Dioxide (SO\textsubscript{2})</td>
</tr>
<tr>
<td>Nitrogen (N\textsubscript{2})</td>
</tr>
<tr>
<td>Smoke</td>
</tr>
<tr>
<td>Odour</td>
</tr>
<tr>
<td>Volume of Ash</td>
</tr>
</tbody>
</table>

*These emissions are based on minimum waste calorific values of 6 kcal/g (blood) 45.7MJ/kg (human organs), 70-100% moisture contents. With no other waste streams present other than general packaging containers that do not make up more than 1.5% of the total load weight.

**Fuel Options:** The incinerator can operate on diesel, liquefied petroleum gas (LPG) and Natural Gas. The incinerator is ideal for Category 2 (Animal Waste), 3 (Microbiology and Biotechnology waste) and 4 (Waste Sharps) type red bag waste with high density and high moisture contents.

**Composition of fuel being used:** The primary source of fuel will be natural gas based on pyrolytic combustion with smokeless emissions having standby fuel arrangements of LPG when the pressure of LPG drops/supply fluctuates throughout the year. For ensuring the clean environment, it strictly complies with EPA standards.
### Table 3.2: Fuel Input and its Composition

<table>
<thead>
<tr>
<th>Fuel Input</th>
<th>Diesel</th>
<th>Composition %</th>
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<tbody>
<tr>
<td>Carbon</td>
<td>C</td>
<td>86%</td>
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<tr>
<td>Hydrogen</td>
<td>H1</td>
<td>13.2%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N₂</td>
<td>0.70%</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O₂</td>
<td>0.00%</td>
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</table>

### Incinerator Specifications:

#### Table 3.3: Incinerator Specification

<table>
<thead>
<tr>
<th>Machine Specifications MP-500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solid Waste C.V. range</strong></td>
</tr>
<tr>
<td><strong>Design throughput</strong></td>
</tr>
<tr>
<td><strong>Batch Capacity</strong></td>
</tr>
<tr>
<td><strong>Operating regime</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Maintenance regime</strong></td>
</tr>
<tr>
<td><strong>Overall availability</strong></td>
</tr>
<tr>
<td><strong>Design criteria</strong></td>
</tr>
<tr>
<td><strong>External Length (mm)</strong></td>
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<tr>
<td><strong>External Width (mm)</strong></td>
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<tr>
<td><strong>External Height (mm)</strong></td>
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<tr>
<td><strong>Primary Chamber Sizes:</strong></td>
</tr>
<tr>
<td><strong>Internal Length (mm)</strong></td>
</tr>
<tr>
<td><strong>Internal Width (mm)</strong></td>
</tr>
<tr>
<td><strong>Internal Height (mm)</strong></td>
</tr>
<tr>
<td><strong>Plant Utilities: -</strong></td>
</tr>
<tr>
<td><strong>Electric Consumption</strong></td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
</tr>
<tr>
<td><strong>Anticipated usage</strong></td>
</tr>
<tr>
<td><strong>Max Load Capacity</strong> (kg)</td>
</tr>
<tr>
<td><strong>Nominal Burn Rate UK</strong> (kg/hr)</td>
</tr>
<tr>
<td><strong>Burn Rate [Export Only]</strong> (kg/hr)</td>
</tr>
<tr>
<td><strong>Thermal Capacity (kw/hr)</strong></td>
</tr>
<tr>
<td><strong>Power Supply 50/60hz</strong></td>
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</tbody>
</table>

**Operational Data**
### Machine Specifications MP-500

<table>
<thead>
<tr>
<th>Primary Chamber: -</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Chamber: -</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
</tr>
<tr>
<td>Oxygen Content</td>
</tr>
<tr>
<td>Residence Time</td>
</tr>
</tbody>
</table>

*Based on general municipal waste streams

** Depending on the type of waste stream being loaded and excludes heat up time.

**Computational Fluid Dynamically Modelled Incinerator:** The incinerator has CFD (Computational Fluid Dynamic) modelled by utilizing some of the most advanced software available. By using Computational Fluid Dynamics software, it helps to predict gas velocities/movements within the chambers along with external surface temperatures whatever the external ambient parameters may be.

This information is also useful to develop a more durable, robust and efficient incinerator by:

- Identifying heat build-up and stress points within the structure.
- Reducing thermal heat loss by increasing insulation systems.
- Designing out hot and cold spots to ensure compete for combustion within the chamber.

**General Construction**

**Robust, Reliable and Efficient**

- Pre-fabricated 8 and 10 mm robust mild steel casing, seam welded and suitably stiffened/braced where necessary.
- Paint finishing – The steel structures are completely painted using a two-pack high-grade paint system that is baked onto the steel structure at 70°C for 10hrs. Standard colours of the MP Series are cherry red for the main body, with a solid black door and upper cover plates.
- Lightweight, resilient refractory fibre insulation door, providing a tight seal and gives an excellent thermal efficiency
- Primary and secondary chamber lining thickness – 221mm, rated at 1750°C.
- Low thermal mass roof lining, with removable roof and back plate for ease of maintenance.

**Primary Chamber:** The primary chamber casing would be fabricated from 8 and 10 mm steel plate, which would be suitably braced and stiffened where necessary. Internally the chamber would be lined throughout with fully insulating refractory high-quality brick materials to a thickness of 220 mm rated to 1,600°C. The floor of the incinerator curved hot hearth arrangement falling away from a high level insulated charging door.

The pyrolytic combustion process would be assisted by the introduction of combustion air at a controlled, regulated rate; combustion air would be distributed across the load and primary chamber. Consecutive loading will disturb the residues on the hearth, moving them to the rear side de-Ashing door.
The curved hearth arrangements initially comprise of full-width monolith silicon carbide sections where the waste mass is encouraged to separate in order to promote its destruction by exposing any unburnt matter.

The burners would be configured to fire on natural gas with LPG as a reserve system and would have a fully modulating temperature control action. Each burner will have a visual window to view the burner flame, and temperatures would be monitored with temperature thermocouples. The features of the primary chamber are:

- Fully insulated internal refractory lining, constructed from high-grade refractory brick ensuring a self-supporting interlocked arrangement.
- One fully interlocked, manually operated, access door.
- One waste ignition burner, temperature controlled on-off, complete with internal air fans.
- One hot hearth combustion burner, temperature controlled on-off, complete with internal air fans
- Secondary combustion burner air fans with automatically controlled distribution to their designated area.
- Two temperature sensor mounting points

Secondary after Chamber: Having a similar rectangular construction to that of the primary chamber with the hot hearth connecting the two chambers. The secondary after chamber would have an integrated combustion air delivery would be modulated via an automatic servo to allow controlled levels to be introduced to maintain an oxygen level of around 6%. The air control would be interfaced with monitoring equipment located at the chamber outlet.

The secondary chamber would be internally lined with fully insulating refractory materials in order to minimize the heat losses and maximize the heat recovery potential. It would be configured to ensure thorough destruction and treatment of the combustion process flue gas by ensuring that it is subjected to sufficient temperature in the oxygen-rich and turbulent environment.

The chamber would have a single pass arrangement, and the internal configuration would be designed to promote an even flow of the flue gas mixture in order to prevent any short-circuiting or the creation of any ineffectual areas.

The chamber volume, as verified by Computer Fluid Dynamic modelling, would be of sufficient capacity to allow for the entire flue gas stream to be resident for a minimum of two seconds at the required operational temperatures (in excess of 1100°C).

A single high capacity afterburner would be fitted to the chamber, which would be rated to ensure that reasonable preheating times were achieved and that an adequate chamber temperature was maintained during the burning cycles.

The burners would be configured to fire on natural gas with LPG as a reserve system and would have a fully modulating temperature control action. Each burner will have a visual window to view the burner flame, and temperatures would be monitored with temperature thermocouples. The features of the secondary chamber are:

- Fully insulated internal refractory lining, constructed from high-grade refractory brick and low thermal mass insulation.
- One secondary chamber burnout burner, temperature controlled on-off, compete with internal air fans.
- Integrated combustion burner air fans with automatically controlled distribution to their designated area.
- All combustion fuel pipework.
- All electrical requirements.
- One temperature sensor mounting point at the base of the exit flue ensuring the chamber reaches the necessary 850°C/1100°C minimum.

Steel Work: The main structure is fabricated from a robust 8 mm and 10 mm thick steel, internal surfaces protected with a tough acid-resistant coating and fully seam welded, creating a non-spill, bundled construction.

Exterior Finish: Painted in a highly durable, weather-resistant, two-pack paint system that is baked on at 70°C.

Combustion Systems: The MP medical incineration machines are equipped with natural gas-powered burners that are also equipped to delivery LPG as a standby fuel. The machine is equipped with:

- 2x Primary chamber burner
- 1x Secondary chamber afterburner
- 1x Hot Hearth burner

The 190 kW burners are automatically regulated from the main PLC controller. Door interlock switches prevent burners from firing when a charge door or de-ashing door is opened. Each burner is equipped with an individual control box that will shut down the burner should a problem be detected and feed the information back to the main PLC.

Both burners incorporate an integrated adjustable combustion air fan and adjustable fuel pressure dials. The burners boast environmentally friendly low noxious emissions, with pulse firing capabilities to save fuel and maintain optimum Incineration temperatures.

Each Burner will be equipped with:

- High energy ignition system.
- Ignition by a two-prong spark plug.
- Self-aspirating air supply via an integrated flam.
- Integrated and protection photocell (IR detectors).
- Complete delivery; cables, junction boxes and ignition unit.
- Protection from radiant fire bed via an integrated fan system.

The burner system comprises of fully automatic package burners; these burners come complete with the following features:

- Flame failure controls
- Adjustable flame patterns
- Integral fuel pump
- Solenoid valves
- Integral continuous air fan
- Fuel sensors
Electrical Systems

- Weather resistant, IP65 rated. In accordance with the BS7671 17th edition.
- 220v -240v, single phase 50-60Hz - 13-16-amp power supply required.

Control Systems: The facility control system, Programmable Logic Controller (PLC) based, will coordinate the monitored data to ensure the optimum, overall, the performance of the plant and associated equipment.

The system will consist of hardware to perform operational control and software for data command. Both processing hardware, with programmed software and the control hardware would be housed within a cubicle integral to the plant structure.

This main cubicle would be a sheet steel enclosure, with IP65, mounted within a rugged, lockable control box located away from any heat sources of the incinerator. It would house all the necessary switch and control gear required for the plant operation. An internal data log will provide a graphical record of operating cycles.

The cubicle facia would be fitted with a high-resolution full-colour HMI panel, which would be configured to display all of the plant operational data, inclusive of running and fault status, plant temperatures (Primary, secondary, hearth, wet scrubber), wet scrubber status, loading sequence position and other applicable information.

System malfunctions or excursions from permitted operating parameters would be instantly displayed on the terminal screen. Accessed screen menus would display corrective measures or activities for fault analysis and remedial action.

Further archived information regarding operational instruction and maintenance operations can be readily accessed utilising a series of coded log-in levels; stored data can also be retrieved through this terminal, both on display and exported on to an USB-out port for further analysis on a PC.

Key Features of Addfield Intelligent Controller:

- Plug and play design for easy and efficient replacement.
- Zone ramp sequence three zone controller
- Incoming and outgoing cable terminations
- Burner control gear
- Interface relays and contractors
- Temperature indication and control of the primary chamber
- Temperature indication and control of the secondary chamber
- Plant status indicators
- Cycle status indicators
- Fault status indicators
- Operator interface.

Waste types to be used in the MP Series - Category 4

- Minimum 50-100% moisture
- Surgery waste
- Hospital Waste
- Medical Waste
- Clinical Waste
- Pathological Waste
- Pharmaceuticals
  - Syringes/ needles
  - Blood, drips, human faeces
  - Human organs
  - Human Tissues
  - Human limbs
  - Cancer treatment wastes

**Waste types not to be incinerated:** The proposed incinerator is designed to incinerate infectious waste. Incineration of materials unsuitable for incineration can result in the release of pollutants into the air. The general waste, e.g. food waste should not be incinerated.

**Wet Scrubber System:** This bolt-on particle suppressant system can be added to any machine in the Addfield range and are scaled according to the specific application. Constructed from stainless steel the vessel encapsulates multiple water spraying nozzles.

The incoming gasses are cooled prior to entering the chamber; the primary purpose is to eliminate water being evaporated and emitted into the atmosphere. As a secondary purpose, the rapid cooling of incoming flue gasses drastically reduces De Novo Synthesis of dioxins and furans.

This gas stream enters the bottom of the tower and moves upward, while the liquid is sprayed downward into the incoming gas stream. This counter-current flow exposes the outlet gas to the lowest pollutant concentration to the freshest scrubbing liquid.

The smaller the droplets formed, the higher the collection efficiency achieved for both gaseous and particulate pollutants. However, the liquid droplets must be large enough not to be carried out of the scrubber by the scrubbed outlet gas stream as steam.

Therefore, spray towers use nozzles to produce droplets that are usually 500–1000 μm in diameter. The gas velocity is kept low, from 0.3 to 1.2 m/s (1–4 ft/s) to prevent excess droplets from being carried out of the tower.

A primary water pump (alongside a backup redundancy unit) provides water recirculation to reduce water consumption.

Calcium carbonate can also be added to water, with the resulting slurry sprayed into a flue gas scrubber. The process is found to be more efficient if a calcium hydroxide/water slurry is used, removing over 95% of sulphur dioxide. The sulphur dioxide is absorbed into the spray and precipitates as wet calcium sulphate. By re-circulating the slurry and injecting oxygen, calcium sulphate (gypsum) is formed which can be sold as a by-product.

\[
\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O} + 0.5\text{O}_2 + 1.5\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}
\]

A separate settling tank is supplied to provide a vessel for water treatment and the removal of sludge before discharging the waste to the main drain system.

**Chimney:** Constructed from stainless steel, the chimney section will have a nominal height from the floor of 15 m.
Due to the wet scrubbers cooling efficiency, flue gas will be below 80°C – as such an unlined stainless chimney will be supplied. A lined chimney will degrade faster as moisture from the scrubber will get trapped between the linings and steel – as such this is not recommended.

Two 4” BSP emission monitoring ports, at 90-degree angles, will be provided with the machine. As per United Kingdom Accreditation Services and MCERTS (Monitoring Certification Scheme for Environment Agency) standards.

**ID Fan:** Induced Draft Fan will be provided to convey exhaust gases through the chimney.

**Waste Loading and De-Ashing:** The MP Series of incinerators are designed for manual loading only through the main access door due to the type of wastes they incinerate, bio-security measures should be in place on the site of the incinerator due to the possibility of spillage and spread of disease.

At the end of every incineration, process ash should be discharged through the loading door onto the supplied catcher tray prior to being loaded for the next burn.

**Waste Loading – Pneumatic Ram System and Bin Tipper:** One pneumatically operated ram feeder unit is designed to introduce a measured quantity of loose waste material into the incinerator via a single sequenced cycle. It would be complete with:

- Fabricated mild steel assembly mounted upon a substantial framework.
- One infeed reception hopper is having a nominal capacity of 0.3m³.
- One manually operated hopper lid arrangement.
- One pneumatically operated ram pusher plate.
- One pneumatically operated vertically rising charge door fitted to the inlet vestibule of the primary chamber.

The automatic system would function via a separate control panel located adjacent to the loader. It will allow the operator to stay clear of the primary chamber and would not expose the user to heat during the loading process. The wheelie bin tipper can be added to the system. The system would be designed to accept 240L sized bins of clinical waste. This system would provide a much cleaner, hands-free loading mechanism.

The charge system process floor would consist of:

- Feeder hopper lid closes.
- Chamber charge door opens.
- Feeder pusher plate travels forward to full extent.
- Feeder pusher plate travels reverse to door vestibule.
- Chamber charge door closes.
- Feeder pusher plate water quench sprays are energized for 4 seconds.
- Feeder pusher plate travels reverse to park position.
- The hydraulic circuit is de-energized.

During the above sequence, each hydraulic movement is monitored to ensure that each part is completed therefore for example if at point 5 the charge door fails to close the sequence would be reset to point 2 and the process repeated in order to clear the blockage.

**Emission Standards:** Smokeless emission for at least 98% running time is ensured. The flue gases will remain within the limits of PEQs are ensured.
Standby LPG Fuel: Manifold system for LPG Cylinders to hook up six medium cylinders (45kg) to run the incinerator for at least 12 hours.

Accessories:

- Manual Ash removal tool removal pit
- Manual particulate removal pit
- Digital weighing scale with minimum 60x60 cm platform for weighing the waste
- Mobile main SS trolley (antimagnetic) with cover for transportation of hospital waste from wards to incinerator room approximately 125cm x 100cm x 90cm, 20cm wheels size. Quantity x 02.
- Bin trolley in yellow colour with a flap to open cover (foot operated) to hold yellow plastic bags of 5 kg mixed waste, plastic quantity 15.
- Plastic waste bags yellow, as per WHO approved standards for 5kg mixed waste, quantity 7,000)
- Pair of leather gloves for hospital waste handling staff (Quantity 05).
- Pair of long safety shoes for hospital waste handling staff (Quantity 05).
- Mask for odour, disposable (Quantity 20 x 100).
- Operator smoke mask 3M or equivalent as per environment standards (Quantity 01)
- Fire Extinguisher on mobile trolley 10 kg, Halotron
- Posters for instructions in suitable frames.

These items will be provided with the incinerator.

The layout of the MP-500 Incinerator: The layout of the proposed incinerator is shown in Figure 3.33 – 3.37.
Figure 3.33: Proposed MP-500 Medical Incinerator for the provision of an incinerator in different hospitals of Sindh
Figure 3.34: Isometric Layout Plan of the Incinerator MP 500

Addfield MP-500 Medical Disposal System

1. Thermal treatment machine
2. Bin tipper
3. Ram
4. Water inlet
5. Waste water outlet
6. LPG connection and manifold
7. Natural Gas Connection
Figure 3.35: Layout Plan of Incinerator
**Figure 3.36: Components of the Incinerator MP 500**

- Combustion system
- Data log Graph
- Wet Scrubber System
- Chimney
- Schematic Overview
- Feed System
Figure 3.37: General Structure of the Incinerator MP 500
3.7 Mass Balance Flow of the Incinerator

If 100 kg burnt, 2 kg ash and less than 1% sludge will be generated, and the rest becomes flue gases. Mass flow diagram of the incinerator is given in Figure 3.38.

![Mass Flow Diagram of the Incinerator](image)

3.8 Project Process Flow

- Planning stage/Pre-construction stage
  - Design Selection
  - Procurement
  - Shipping
  - Site Selection
  - Environmental Assessment

- Construction Phase
  - Construction of Civil Works
  - Installation and commissioning of Incinerator

- Operational Phase
  - Operation and maintenance
  - Stack emission monitoring
3.9 Compliance with Punjab Environmental Quality Standards for Treatment of Liquid and Disposal of Bio-Medical Waste by Incineration

Sindh Environmental Protection Agency, till now, has not yet formulated any Environmental Quality Standards for Bio-medical Waste in general and specifically by Incineration as well. Hence for reference, Punjab Environmental Quality Standards for Treatment of Liquid and Disposal of Bio-Medical Waste by Incineration, Autoclaving, Microwaving and Deep Burial is being followed to make the incineration and final disposal process more efficient and risk-free. Compliance of incinerator with SEQS is shown in Table 3.4.

M/s Vertex Medical Pvt. Ltd., has been qualified for the procurement of Hospital Waste Incinerator after it submitted a Stack Emission Monitoring Report to Health Department, Government of Sindh. This stack emission report was formulated by the test running of the installed incinerator at THQ Hospital Samundri, Faisalabad. Different stack parameters including CO, NOx, SOx, smoke and particulate matter, were compared to Punjab Environmental Quality Standards, as a reference mark. The experimental results showed that the emissions were within the permissible range. The Stack Emission Monitoring Report of the Incinerator installed in THQ Hospital Samundri is provided in Annexure-6 and shown in Table 3.5.

It is important to note that the incinerator installed at THQ Hospital Samundri is MP 200 whereas the eight incinerators to be installed at five districts of Sindh, are of MP 500 series, which is the latest model will be more effective, efficient and user-friendly.
### Table 3.4: Compliance of Incinerator with Punjab Environmental Quality Standards for Treatment of Bio-Medical Waste by Incineration, 2016

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limiting concentration in mg/NM³ unless stated</td>
<td>Sampling Duration in minutes, unless stated</td>
<td>Mean Concentration in mg/m³ unless stated</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>50</td>
<td>30 or 1NM³ of samples volume, whichever is more</td>
<td>28.5</td>
</tr>
<tr>
<td>Nitrogen Oxides expressed as NO₂</td>
<td>400</td>
<td>30 for online sampling or grab sample</td>
<td>226</td>
</tr>
<tr>
<td>HCL</td>
<td>50</td>
<td>30 or 1NM³ of samples volume, whichever is more</td>
<td>1.6</td>
</tr>
<tr>
<td>Total dioxin and Furans</td>
<td>0.1 ng TEQ/N3 (at 11% O₂) 8 hours or 5NM³ of sample volume, whichever is more</td>
<td></td>
<td>0.09 ng/m³</td>
</tr>
<tr>
<td>Hg and its compounds</td>
<td>0.05</td>
<td>2 hours or 1NM³ of samples volume, whichever is more</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

**Source:** Addfield Environmental Solutions Stack Emission Testing Report
### Table 3.5: Stack Emission Monitoring Report of the Incinerator installed in THQ Hospital Samundri

<table>
<thead>
<tr>
<th>Monitoring Date</th>
<th>Monitoring Locations</th>
<th>Monitoring Time</th>
<th>Model</th>
<th>Instrument Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Apr-2017</td>
<td>THQ Hospital Samundri, Faisalabad.</td>
<td>15:00</td>
<td>Addfield UK MP 200</td>
<td>Lancom 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monitoring Point</th>
<th>Monitoring Type</th>
<th>Fuel Type</th>
<th>Load</th>
<th>Parameters</th>
<th>Unit</th>
<th>Reading 01</th>
<th>Reading 02</th>
<th>Reading 03</th>
<th>Reading 04</th>
<th>Limits as per SEQS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Waste Incineration</td>
<td>Natural Gas</td>
<td>50 kg/hr.</td>
<td></td>
<td>Carbon Dioxide (CO2)</td>
<td></td>
<td>5.72</td>
<td>5.75</td>
<td>5.75</td>
<td>5.81</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Oxygen (O2)</td>
<td></td>
<td>16.71</td>
<td>16.69</td>
<td>16.69</td>
<td>16.68</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Carbon Monoxide (CO)</td>
<td>mg/Nm³</td>
<td>20.30</td>
<td>21.31</td>
<td>21.44</td>
<td>22.41</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sulphur Dioxide (SO2)</td>
<td>mg/Nm³</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1700</td>
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<td></td>
<td></td>
<td></td>
<td>Nitrogen Dioxide (NO2)</td>
<td>mg/Nm³</td>
<td>86.32</td>
<td>88.31</td>
<td>88.59</td>
<td>88.51</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nitrogen oxide (NO)</td>
<td>mg/Nm³</td>
<td>64.11</td>
<td>65.11</td>
<td>68.17</td>
<td>68.93</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NOx</td>
<td>mg/Nm³</td>
<td>150.43</td>
<td>153.42</td>
<td>156.76</td>
<td>157.44</td>
<td>400</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Smoke</td>
<td></td>
<td>1</td>
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<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Particulate Matter</td>
<td>mg/Nm³</td>
<td>60.66</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
3.10 Proposed Development components of the project

The incinerator project will be comprised of the following components to be considered in the design:

3.10.1 Waste Reception/ Yellow Room

The yellow waste from the yellow dustbins will be transported to the Yellow room having a size of 12 ft. x 12 ft. x 10 ft. The yellow room will be constructed near to the incinerator room. The yellow room will be designed especially for storing yellow waste where the temperature of 4 °C will be maintained. The incinerators are installed within hospital premises because the infectious hospital waste is disposed of within 24 hours of its generation."

3.10.2 The Incinerator Room

The incinerator room is having a size of 25 ft. x 30 ft. x 15 ft., will be constructed. The yellow waste from the yellow room will be shifted to the incinerator room when it is to burn. The incinerator room will have a place to keep incinerator, bins, wet scrubber, cooling duct, and washroom.

3.10.3 Manager Room

The Manager room will 12 ft. x 15 ft. x 10 ft with a bathroom.

3.10.4 Ash Disposal System

Approximately, two kg of ash will be produced from every 100 Kg/hr waste burning. The ash produced is fine sterile and inert. An ash pit is having a size of 8 ft. x8ft.x8 ft. will be constructed in the vicinity of the incinerator room where the ash residue will be buried. Concrete pit which will be made watertight so no water can seep into the ash pit.

3.10.5 Wastewater Treatment Mechanism

The incinerator comes with water treatment technology, and an auto recycles unit. The water used for the operational purpose will be treated in the water treatment facility and reused. The sludge created by the treatment will be settled in the settling tank. The settled sludge will be basically gypsum which has commercial value. Thus, the water consumption of the incinerator will be reduced.

500-liter tank for a wet scrubber is available where 25% Caustic Soda and 75 % Water slurry will be sprayed over the exhaust gases. The resulting wastewater will be directed to 690 litres settling tank to reuse the cleared water after settling of sludge. The water is reused as much as possible approximately 4 -5 cycles are easily carried out by 500 litres.

Sludge will be minimum, and it will be deposited in the ash pit.

3.10.6 Water Supply

Water supply connection will be provided at the incineration room.
Water Balance Sheet:

<table>
<thead>
<tr>
<th>Water Balance Sheet</th>
<th>Volume</th>
<th>The input of Water in the water table</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>output of Water from the water table</td>
<td>(g/d)</td>
<td>Estimated Rainfall (A value)</td>
<td>(g/d)</td>
</tr>
<tr>
<td>During Construction Phase</td>
<td>10,000</td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>During Operational Phase (Per Cycle)</td>
<td>33</td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>Total Demand</td>
<td>10,033</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>The difference in output and input</td>
<td></td>
<td>10,033</td>
<td></td>
</tr>
</tbody>
</table>

The water balance shows that minimum water usage will take place during the operational phase of the incinerator due to the water treatment and auto-recycle technology fitted in the incinerator.

During the construction phase, it is estimated around 10,000 gallons of water will be used for the construction of incinerator room, office room and yellow room.

During the operational phase, the incinerator will use 500 litres of water for each cycle. After the completion of each cycle, the water will be treated and reused again.

3.11 Vegetation Features of the Site

The selected hospitals, where incinerators are going to be installed, have different vegetation cover in the form of green areas, plants, ornamental plants, flowering and grass. The hospitals are actively working on enhancing their environment through plantation activities. No tree will be cut due to the project at any of the selected hospitals.

3.12 Cost and Magnitude of Operation

The total estimated cost of the Project is Rs. 218.171 million. The land cost is not included as the incinerator is to be installed on the premises of the selected hospitals.

<table>
<thead>
<tr>
<th>Table 3.6: Cost breakup of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
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<tr>
<td>4</td>
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<tr>
<td>5</td>
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<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td><strong>Sum Total</strong></td>
</tr>
</tbody>
</table>

Total Project Cost 218,171,720

*Land Cost is not included in any of the proposed sites since incinerators are to be installed within the respective hospital premises.*
3.13 Land Acquisition
The incinerators are being installed adjacent to the existing old incinerators within the premises of the respective hospitals as shown in Table 3.6. The project sites are free from all encumbrances. Therefore, there is no issue of land acquisition or resettlement of the community due to the project.

3.14 Current Land Use of the Project Site
The current use of the selected project sites is non-agricultural flat land.

3.15 Status of the Project
The incinerators are being shipped from the UK and expected to arrive at the project sites soon. Presently, there is no construction activity at the project sites.

3.16 Restoration and Rehabilitation Plans
JPMC Karachi has an existing workshop near the incinerator site which will be demolished, and the land area will be cleared before the installation of the new incinerator.

At NICH Karachi, the proposed site has an old store room. The dismantling and demolition work of existing structure at the proposed location of incinerator will be carried out by the Public Works Department.

Similarly, in GMMCH Sukkur, land area will also be cleared of construction debris. However, in rest, all the hospital's new incinerator will be installed near the existing old incinerator sites where no demolishing activities will be carried out. The existing old incinerators will be decommissioned by respective hospital authorities once the new incinerator is operational.

During decommissioning, the existing components of old incinerators, incinerator rooms, old ash burial pits, and chimney will be demolished/sealed. The demolition material and equipment, fixtures and construction waste will be dumped at the existing dumpsites which will be identified in consultation with respective district Municipal Committees.

Once all the demolition material is removed from the project site, then the ground will be levelled, and grass will be grown.

3.17 Government Approval
Health Department, Government of Sindh, has already selected the discussed eight hospitals for the installation of the incinerator. Only environmental approval from the Environmental Protection Agency, Government of Sindh is required.

3.18 Schedule of Implementation
The installation and commission of the incinerators will be completed in a period of 4 months; the work will start simultaneously at all hospitals.
### Table 3.7: Time Schedule for Provision of Incinerator (Procurement, Installation, Commissioning & Operations) In Different Hospitals of Sindh

<table>
<thead>
<tr>
<th>Activity/Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of utilities at the project site</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil works for incinerator room, supervisor room and yellow room, ash pit, boundary wall with a gate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placement of incinerator on a concrete base at the incinerator room</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly of Main Unit with loading system, scrubber system, installation of PLC with electric works, installation of a chimney, connection with utilities and test fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training of staff on operation and maintenance of incinerator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of Installation Report to HD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Vertex Medical (Pvt) Ltd. Lahore

### 3.19 Project Phases

The installation of the incinerators at respective hospitals would be implemented in three phases, i.e. Pre-construction/design, construction and operation.

#### 3.19.1 Pre-construction/ Design Phase

**Design phase:** M/s Vertex Medical Pvt. Ltd., will prepare a detailed design for the installation of an incinerator with all utilities and facilities.

**Selection of Contractor:** M/s Vertex Medical Pvt. Ltd., will engage a local contractor for construction of civil works.

#### 3.19.2 Construction Phase

**Contractor Mobilization:** This component involves the transportation of construction machinery and equipment to the project site and the establishment of the contractor’s camp and office.

Road access and networking in the area are well structured; hence all the equipment and machinery will be brought to the project site via main Roads and connecting Roads as depicted in the project accessibility map. The campsite facilities of the contractor include site office and area for equipment and installation materials. There will be no residential accommodation for the staff due to the small nature of the construction works and short duration. The contractor office will be established at the project site.

**Site Preparation:** Usually this activity involves the operation of heavy earth-moving machinery for land clearing, levelling and grading.

The first task of this activity is to demarcate the project site in accordance with the layout and other benchmarks. Once the demarcation of the project site is complete; the land will be cleared and prepared for subsequent construction activities.
Construction Activities: The construction activities will be carried out using the conventional methodology and sequence of work. The activities will include excavation, masonry work, carpentry, wiring, piping and plumbing, flooring, painting and installation of fixtures. Other activities will include the laying of cables, water supply, wastewater and storm drainage systems, junction boxes and providing electricity and Natural gas connections to all buildings. Supervision of this whole activity will be carried out by M/s Vertex Medical Pvt. Ltd., staff.

Staffing: Construction crews will have the responsibility of the contractor. It is estimated that a maximum of 10 personnel will be working at the project site during the peak construction period. These will essentially include masons, carpenter, electricians, painters, plumbers and general labourers. For unskilled employment, preference will be given to local residents of the project area.

Following steps will be taken for effective management of construction crew:

- A complaint cell for workforce will be established, where they can register their reservations related to work.
- The contractor will develop an effective system of communication/consultation and will ensure that the staff concerns are addressed.
- Employees will be discouraged from working excessive hours and/or missing break periods (this may involve a detailed job evaluation).
- Child labour will be avoided.
- Incidents of bullying, sexual and racial harassment will be monitored and, where necessary disciplinary actions will be taken.
- Clear job descriptions will be developed for the workforce, and it will be ensured that the individual is matched to them.

Construction Machinery: The contractor will bring construction machinery comprising of concrete mixing plant, transit mixer, excavator, dumper, concrete pump, crane, water tanker, diesel generator at the project site as per requirement of construction activities.

Construction Material: The construction material will include cement, sand, crush, bricks, steel bars, paint, piping material, electrical material and finishing material. Most materials will be procured from Karachi, Hyderabad, Larkana, Sukkur and Benazirabad, i.e. from within Sindh, from or near to the project districts.

Disposal of Excavated/ Construction Waste: Construction waste will be recycled by the contractor if possible. Otherwise, it will be disposed of at a designated dumping site locally within the respective district which will be identified in consultation with the district Municipal Committee.

Traffic Load during Mobilization (and Demobilization) of The Contractor: All of the constructions material and equipment will be transported to the site through the main Road, service Roads and link Roads. However, the arrival of this construction material and equipment will be fairly staggered and controlled to avoid any disturbance to hospital staff and patients.

Traffic Load for Construction Materials Supplies: It is estimated that on average 1-2 truckloads per day will be supplying construction material and equipment to the project site during the peak construction period. The condition of the existing Road network is satisfactory and as such larger trucks will be used.
Water: During the construction phase, a maximum of about 5,000 gallons per day of water will be required for construction activities and human consumption. The water supply will be arranged by the contractor.

Fuels: For the construction equipment and vehicle, diesel will be required. The peak consumption of diesel would be 1,000 litres per day during the peak construction period. The diesel will be procured from the nearest Petrol Station.

Electricity: Temporary connections will be obtained from K- Electric and respective electric supply companies of respective districts for the construction activities and camp.

Camp Location: Contractor’s Camp will be established near the Project sites.

Camp Site Sanitation Facilities: The sanitation facilities will be provided at the campsites, and the contractor will construct a septic tank with a soakage pit at each project site.

Installation of Incinerator: The incinerators with all accessories will be installed as per the installation manual.

Commissioning of the Incinerator: The commissioning of the incinerators will be carried out as per manufacturers commissioning manual. Once, the incinerator is installed at each hospital then its performance will be checked, and the installation of incinerators report will be submitted to the Health Department, Government of Sindh.

3.19.3 Operation and Maintenance Phase

M/s Vertex Medical Pvt. Ltd., will be responsible for the operation and maintenance of the incinerators for three years from the date of commissioning. They will operate and maintain the incineration process. They will conduct periodic stake emission monitoring by the Environmental Protection Agency or their approved laboratory.

The incinerators will be handed over to hospital authorities after completion of three years.

Solid Waste Management: During the operation and maintenance phase, two categories of solid waste will be generated from the incineration process.

- Municipal Solid waste: Solid waste generated from the operator’s office will be dumped at the municipal waste storage site of the hospital which will be collected by the local district Municipal Committee for its final disposal.
- Ash: Ash produced from the incinerators as final residue will be collected in ash bins and will be deeply buried in the ash pit which will be constructed near the incinerator site.

Cleaning: M/s Vertex Medical Pvt. Ltd., will be responsible for ensuring regular washing and cleaning of all incineration facilities during the warranty period. The cleaning operations will involve the use of substantial amounts of water, disinfectants, detergents etc.

Staff: During the operational phase a team of 6 will be engaged in the operation and maintenance of each incineration facility by M/s Vertex Medical Pvt. Ltd.
### Table 3.8: Staff Engaged during the Operational Phases of the Project

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>For construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incinerator Engineer</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Technical Staff (Diploma Holder)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Sanitary Workers</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Security Guards</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

**Source:** PPI Estimates

**Staff Training:** Addfield Environmental Systems Limited, UK will send a technical person from the United Kingdom to train the staff of M/s Vertex Medical Pvt Ltd., and the respective hospital about the operation of the incinerator.

### 3.20 Existing Hospital Waste Management System at the selected Hospitals

#### 3.20.1 Existing Hospital Waste Management System in JPMC Karachi

JPMC management has constituted a team dealing with hospital waste management (especially infectious waste). The hospital waste management team holds regular meetings on a monthly basis to keep a check its performance particularly at OPD’s, wards, Operation Theater, Labor room etc. The team monitors the functioning of the hospital waste management system. Director, JPMC also conducts important inspections to check the condition of wards. The hospital waste management supervisory team consists of 6 members with 24 hours presence by dividing the team into 3 shifts of 8 hours.

Moreover, all the janitorial members have training on segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers mostly use personal protective equipment. All the staff member in JPMC, are immunized against infectious diseases.

Currently, the hospital has a proper hospital waste management system as per the Sindh Hospital Waste Management Rules 2014. The waste generated is collected in three types of bin coded with colours; red, yellow and black. The yellow colour bin is used to collect the glass waste, red for infectious waste and black for general waste. Colour-coded bags are used to transfer waste within the hospital. All the waste that is sent to the incinerator is adequately documented. Hospital waste management is good. No activity related to Hospital waste is outsourced. The chemical waste is usually dumped into the sink.

The existing hospital waste management system is good except for the treatment and disposal of infectious hospital waste mainly due to the existing old incinerator which only gains a temperature of 134°C.

The existing incinerator was installed in the Year 2000. The existing old incinerator has a chimney height of only 25 feet, and during operation, it emits black smoke.

It is anticipated that with the installation of the new incinerator which meets Sindh Environmental Quality Standards. JPMC will be able to comply with Sindh Hospital Waste Management Rules, 2014 fully.

A pictorial view of the Hospital Waste Management at JPMC Karachi is shown in **Figure 3.39.**
Figure 3.39: Pictorial View of hospital waste management system at JPMC Karachi

Exhibit 3.1: Safety Signs displayed at JPMC, Karachi

Exhibit 3.2: Black, Yellow and Red bins at JPMC.

Exhibit 3.3: Danger box for needles at JPMC, Karachi

Exhibit 3.4: Storage facility for infectious waste in JPMC, Karachi

Exhibit 3.5: Incinerator working at JPMC Karachi

Exhibit 3.6: Proper documentation of waste being incinerated at JPMC, Karachi
3.20.2 Existing Hospital Waste Management System in Dr Ruth Pfau Civil Hospital Karachi

Dr Ruth Pfau Civil Hospital Karachi has constituted a team dealing with hospital waste management (especially infectious hospital waste). The team conducts meetings on a monthly basis to keep a check on various areas of the hospital waste management. The janitorial team has 24 hour’s presence by dividing the team into 3 shifts of 8 hours. However, the hospital does appoint a private janitorial member for management of infectious hospital waste.

All the janitorial members have proper training on segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers sometimes use protective equipment.

Currently, the hospital is partially following hospital waste management system as per the Sindh Hospital Waste Management Rules 2014. The waste generated is collected in three types of bin coded with colours; red, yellow and blue. The yellow colour bin is used to collect the Chemical Waste, red for Anatomical waste and Blue for Genotoxic waste. Covered buckets are used to transfer waste within the hospital. Hospital waste management is good. No activity related to Hospital waste is outsourced. The chemical waste is usually dumped into the sink.

The existing hospital waste management system is satisfactory except for the treatment and disposal of infectious hospital waste mainly due to the existing old incinerator. Existing FHS is working but not enough to manage hospital waste.

It is anticipated that with the proper training and the installation of the incinerator which meets Sindh Environmental Quality Standards Dr Ruth Pfau Civil Hospital Karachi will comply with Sindh Hospital Waste Management Rules, 2014.

A pictorial view of the Hospital Waste Management at Dr Ruth Pfau Civil Hospital, Karachi is shown in Figure 3.40.
Figure 3.40: Pictorial View of Hospital Waste Management System at Dr Ruth Pfau Civil Hospital Karachi

Exhibit 3.7: Colour Coding bin at Dr Ruth Pfau Civil Hospital Karachi

Exhibit 3.8: Danger Box at Dr Ruth Pfau Civil Hospital Karachi

Exhibit 3.9: Waste storage area at Dr Ruth Pfau Civil Hospital Karachi

Exhibit 3.10: FHS at Dr Ruth Pfau Civil Hospital Karachi

Exhibit 3.11: General view of the project site at Dr Ruth Pfau Civil Hospital Karachi

Exhibit 3.12: General view of the existing friction base incinerator site at Dr Ruth Pfau Civil Hospital Karachi
3.20.3 Existing Hospital Waste Management System at Sindh Government Lyari General Hospital Karachi

Sindh Government Lyari General Hospital has constituted a team to deal with hospital waste management. The hospital waste management supervisory team consists of 6 members with 63 janitorial staff. Most of the Janitorial staff perform their duties in the morning only for example hospital waste collection and sweeping. No janitorial member is present in afternoon and night shifts due to a shortage of staff.

All the janitorial members have training on segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers mostly use protective equipment. All the staff member in Sindh Government Lyari General Hospital are immunized against infectious diseases.

Currently, the hospital does not have a proper waste management plan as per the Sindh Hospital Waste Management Rules 2014. The hospital waste generated is collected in different types of bins. No colour coding is being used in the hospital. Segregation is performed at a minimal level. However, staff do perform segregation at the time of disposal. The hospital doesn't have any allocated budget for hospital waste management.

Covered bins are used to transfer waste within the hospital. All the waste is sent to FHS. The hospital waste that is sent to FHS is not properly documented. Hospital waste management is really poor. No activity related to hospital waste management is outsourced. Sindh Government Lyari General Hospital’s total infectious waste generation is 70 kg/day. The chemical waste is usually dumped into the sink.

The existing hospital waste management system is below satisfactory. It is anticipated that with the proper training and the installation of the incinerator which meets Sindh Environmental Quality Standards Sindh; Government Lyari General Hospital will comply with Sindh Hospital Waste Management Rules, 2014.

A pictorial view of the Hospital Waste Management at Sindh Government Lyari General Hospital is shown in Figure 3.41.
Figure 3.41: Pictorial View of Hospital Waste Management system at Sindh Government Lyari General Hospital Karachi

Exhibit 3.13: General view of the project site at Sindh Government Lyari General Hospital

Exhibit 3.14: Bins inside the wards

Exhibit 3.15: Covered Bins used for hospital waste transportation

Exhibit 3.16: Needle cutter is not in working condition.

Exhibit 3.17: a Storage facility for waste in Lyari General & teaching Hospital Karachi

Exhibit 3.18: FHS at Lyari General Hospital, Karachi
3.20.4 Existing Hospital Waste Management System in Peoples Medical College Hospital Shaheed Benazirabad

Peoples Medical College Hospital (PMCH) has constituted a team dealing with hospital waste management (especially infectious waste) and have meetings on a monthly basis to keep a check on its performance. The hospital waste management team consists of 84 members with 24 hours presence by dividing the team into 3 shifts of 8 hours.

Moreover, all the janitorial members have some training in segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers sometimes use personal protective equipment. All the staff members in PMCH are immunized against infectious diseases.

Currently, the hospital is partially following waste management system as per the Sindh Hospital Waste Management Rules 2014. The chemical waste is usually dumped into the sink. There have been reports that have accused the janitorial staff of selling used drips and cardboard.

The existing hospital waste management system is not good, and there is room for improvement. The existing old incinerator has a chimney height of only 25 feet, and during operation, it emits black smoke.

It is anticipated that with the proper training and installation of the new incinerator which meets Sindh Environmental Quality Standards that PMCH will fully comply with Sindh Hospital Waste Management Rules, 2014.

A pictorial view of the Hospital Waste Management at PMCH, Shaheed Benazirabad is shown in Figure 3.42.
Figure 3.42: Pictorial View of Hospital Waste Management System at Peoples Medical College Hospital Shaheed Benazirabad

Exhibit 3.19: Safety Signs displayed at PMC Shaheed Benazirabad

Exhibit 3.20: General waste disposal PMC Hospital Shaheed Benazirabad

Exhibit 3.21: Color coded bins at PMCH, Shaheed Benazirabad

Exhibit 3.22: Waste collection trolley

Exhibit 3.23: A Storage facility for infectious waste in PMCH Shaheed Benazirabad

Exhibit 3.24: Incinerator working at PMC Shaheed Benazirabad
3.20.5 Existing Hospital Waste Management System in Ghulam Muhammad Mahar Medical College Hospital Sukkur

GMMMCH, Sukkur had a supervisory member dealing with hospital waste management (especially infectious waste) and had meetings on a monthly basis to keep a check on its performance. The hospital waste management team consists of 43 members with 24 hours presence by dividing the team into 3 shifts of 8 hours.

Moreover, all the janitorial members have some training in segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers sometimes use protective equipment. All the staff member GMMMCH, Sukkur are immunized against infectious diseases.

Currently, the hospital is partially following waste management system as per the Sindh Hospital Waste Management Rules 2014. The waste generated is collected in three types of bin coded with colours; red, yellow and white. The yellow colour bin is used to collect the glass waste, red for infectious waste and white for general waste. Colour bags and buckets are used to transfer waste within the hospital. Hospital waste management is good. No activity related to Hospital waste is outsourced.

**Yellow Waste:** Yellow waste basically comprises of drips, syringes and vials contaminated from the preparation and administration of drugs. Injection cutters are available, and needles are dumped into the danger box. This waste is sent to the incinerator with in-hospital which temperature is 134°C to 135°C. Incinerator ash is then taken by the municipality to the landfill site.

GMMMCH, Sukkur is following the rules and regulations while dealing with infectious waste. The ash produced is taken by the municipal contractor to the burial pit.

**Red Waste:** The red waste is the infectious waste contaminated by any type of pathogens such as bacteria, viruses, parasite or fungi and includes cultures from laboratory work, waste from surgeries and autopsies, waste from infected patients, discarded or disposable materials and equipment which have been in contact with such patients and infected animals from laboratories. The red waste generated at GMMMCH, Sukkur is 40-50 kg/day.

**Black Waste:** The black waste or domestic waste is collected at a site in the hospital via a black closed container to the hospital storage area from where the municipal committee transports it to a designated dumping site. Chemical waste is usually dumped into the sink.

The existing hospital waste management system is satisfactory, and there is room for improvement. The existing old incinerator has a chimney height of only 25 feet, and during operation, it emits black smoke.

It is anticipated that with the installation of the new incinerator which meets Sindh Environmental Quality Standards that GMMMCH, Sukkur will fully comply with Sindh Hospital Waste Management Rules, 2014.

A pictorial view of the Hospital Waste Management at GMMMCH, Sukkur is shown in Figure 3.43.
**Figure 3.43:** Pictorial View of Hospital Waste Management System in Ghulam Muhammad Mahar Medical College Hospital Sukkur

**Exhibit 3.25:** Safety measures at GMMCH Sukkur

**Exhibit 3.26:** Bins inside the wards

**Exhibit 3.27:** Covered Bins used for waste transportation

**Exhibit 3.28:** Old incinerator room at GMMCH Sukkur

**Exhibit 3.29:** Incinerator at GMMCH Sukkur

**Exhibit 3.30:** Storage disposal system at GMMCH Sukkur
3.20.6 Existing Hospital Waste Management System in Chandka Medical College

Hospital Larkana

A hospital waste management survey was conducted on 3rd August 2018 in CMCH, Larkana. It is 1400 bedded hospital. CMCH, Larkana has no hospital waste management. The janitorial team consists of 4 members with 24 hours presence by dividing the team into 3 shifts of 8 hours. However, the hospital does appoint a private janitorial member for the management of infectious waste.

However, all the janitorial members don’t have training in segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers sometimes use protective equipment.

Currently, the hospital is not properly following waste management system as per the Sindh Hospital Waste Management Rules 2014. The Government had provided them with 3 colour coding bins (Red, Yellow and White) but they are not being implemented. The waste generated is collected in only one bin. Qingqis are being used to collect waste from all 4 blocks of the hospital. No activity related to Hospital waste is outsourced. According to Sindh Hospital Waste Management Rules 2014;

Yellow Waste: Yellow waste basically comprises of drips, syringes and vials contaminated from the preparation and administration of drugs. Injection cutters aren’t being used.

Red Waste: The red waste is the infectious waste contaminated by any type of pathogens such as bacteria, viruses, parasite or fungi and includes cultures from laboratory work, waste from surgeries and autopsies, waste from infected patients, discarded or disposable materials and equipment which have been in contact with such patients and infected animals from laboratories. CMCH Larkana’s total infectious waste generation is 250 kg/day.

White Waste: The black waste or domestic waste should be collected at a site in the hospital via a white closed container to the hospital storage area from where the municipal committee transports it to a designated dumping site.

This waste is sent to the incinerator within the hospital. Incinerator ash is then taken by the municipality to the landfill site.

Chemical waste is usually dumped into the sink. Moreover, the Janitorial staff has been taking used drips and cardboard for selling purpose.

The existing hospital waste management system is not good mainly due to the existing old incinerator which is not working.

Existing Incinerator is quite old, and the height of the incinerator chimney is only 30 feet; that’s why it causes problems. The adjoining community has complained about the efficiency of incinerator due to black smoke.

It is anticipated that with the installation of the new incinerator which meets Sindh Environmental Quality Standards that CMCH will fully comply with Sindh Hospital Waste Management Rules, 2014.
Figure 3.44: Pictorial View of Hospital Waste Management System in Chandka Medical College Hospital Larkana

Exhibit 3.30: Bins outside the wards

Exhibit 3.31: Bins inside the wards

Exhibit 3.32: Open dumping beside a hospital ward

Exhibit 3.33: Mixed general and infectious waste

Exhibit 3.34: Selected Site for incinerator installation

Exhibit 3.35: Mosque near the selected site
3.20.7 Existing Hospital Waste Management System in Liaquat University Medical Health Sciences, Hyderabad / Jamshoro

A hospital waste management survey was conducted on 1\textsuperscript{st} August 2018 in Liaquat Medical Hospital Hyderabad. Liaquat University Medical Health Sciences, Hyderabad is 800 bedded. Hospital has constituted a team dealing with waste management (especially infectious waste) and also monitor the waste management system. The waste management supervisory team consists of 3 members with 24 hours presence by dividing the team into 3 shifts of 8 hours. The total number of Janitorial staff are 260 in Hyderabad.

Moreover, all the janitorial staff have training on segregation practices, protective measures and their importance, waste handling, transportation and disposal. While dealing with hospital waste management, the workers mostly use protective equipment. All the staff member in Hyderabad are immunized against infectious diseases.

Currently, the hospital has a proper waste management system as per the Sindh Hospital Waste Management Rules 2014. The waste generated is collected in three types of bin coded with colours; red, yellow and black. The yellow colour bin is used to collect the glass waste, red for infectious waste and black for general waste. Colour-coded bags are used to transfer waste within the hospital.

All the infectious waste is sent to Liaquat University of Medical Health Science, Jamshoro for incineration. For the transportation of waste to Jamshoro, Qingqis trolley is used. Hospital waste management is good. No activity related to Hospital waste is outsourced. The chemical waste is usually dumped into the sink.

The new state of the art incinerator for Liaquat University Medical Health Sciences, Hyderabad will be installed at LUMHS, Jamshoro.

It is anticipated that with the installation of the new incinerator which meets Sindh Environmental Quality Standards that will fully comply with Sindh Hospital Waste Management Rules, 2014.

Existing Hospital Waste Management System: Liaquat Medical Hospital Jamshoro

The hospital has a proper waste management system as per the Sindh Hospital Waste Management Rules 2014. The waste generated is collected in three types of bin coded with colours; red, yellow and black. The yellow colour bin is used to collect the glass waste, red for infectious waste and black for general waste. Colour-coded bags are used to transfer waste within the hospital. All the infectious waste is sent to the incinerator within the hospital. Hospital waste management is normal due to a shortage of staff. No activity related to Hospital waste is outsourced. The chemical waste is usually dumped into the sink.

The existing hospital waste management system is satisfactory except for treatment and disposal of infectious waste mainly due mainly due to the existing old incinerator which does not gain the desired temperature.
**Figure 3.45:** Pictorial View of Hospital Waste Management System LUMHS at Jamshoro

**Exhibit 3.36:** Safety Signs displayed at Liaquat University Medical Hospital, Jamshoro

**Exhibit 3.37:** Bins inside the wards

**Exhibit 3.38:** Needle cutter in Liaquat University Medical Hospital, Jamshoro

**Exhibit 3.39:** Waste transportation within the hospital

**Exhibit 3.40:** Storage facility for infectious waste in Liaquat University Medical Hospital, Jamshoro

**Exhibit 3.41:** Incinerator working at Liaquat University Medical Hospital, Jamshoro
Exhibit 3.42: Existing incinerator at Liaquat University Hospital Jamshoro

Exhibit 3.43: Nimra cancer hospital near the proposed project site

Exhibit 3.44: Ash disposal site Liaquat University Hospital Jamshoro

Exhibit 3.45: Nimra cancer hospital's incinerator at Jamshoro

Exhibit 3.46: Vehicle used to transfer waste to Jamshoro

Exhibit 3.47: Segregation of waste at source at the Hospital
3.20.8 Existing Hospital Waste Management System in National Institute of Child Health Karachi

A hospital waste management survey was conducted on 27th February 2018 in the National Institute of Child Health Karachi. NICH Karachi is 500 bedded hospital.

In NICH Karachi, the quantity of infectious hospital waste to be treated on a daily basis is 1000 to 1500 Kg. The quantity of infectious waste generated each day varies between 350 – 500 Kg. The anatomical waste is disposed of by the hospital while radioactive, chemical and genotoxic wastes are disposed of by KMC and private contractors.

The waste is collected in color coded dustbins onsite and transported by Karachi Metropolitan Corporation (KMC). Although color coded bins are available, but there is no practice of sorting waste in designated bins. Syringes are destroyed while there is no treatment system available for red/infectious waste.

KMC’s sanitary incharge commented on the hospital waste collection system under its jurisdiction saying, KMC vehicles collect unsorted waste from hospitals and dispose of them at the disposal site. He further identified that conventional methods of disposal are in use which is not in compliance with HWM guidelines. While stringent control on informal recovery of hospital waste by employees is observed. He also receives complaints from sanitary workers about hospital waste mixing with municipal waste.

Presently, there is no hospital management framework or plan available. The hospital waste management team is comprised of 17 sanitary workers from within the hospital and 50-80 private sanitary personnel. The private contractors work for around 12 hours while hospital sanitary staff work 8 hours a day. They have not acquired any training on hospital waste management, and personal protective equipment (PPEs) are not used by sanitary staff.

There is dire need of infectious hospital waste treatment facility in NICH Karachi. Installation of the new incinerator will meet Sindh Environmental Quality Standards that will fully comply with Sindh Hospital Waste Management Rules, 2014.
**Figure 3.46:** Pictorial View of Hospital Waste Management System National Institute of Child Health Karachi

**Exhibit 3.48:** Public Consultation in the Office of MS, NICH

**Exhibit 3.49:** View of the Proposed Location

**Exhibit 3.50:** Another View of the Proposed Location

**Exhibit 3.51:** View of Separate Waste Bins inside the ward

**Exhibit 3.52:** View of the waste segregation bins at proposed

**Exhibit 3.53:** View of the waste segregation bins
4 Project Alternatives

4.1 Background
An analysis of available alternative is necessary to establish that the most suitable management and technology options will opt for the project.

4.2 Management Option
The two-significant alternative management option is the ‘No Project Option’ and ‘Build as Proposed Option’ were considered.

4.2.1 No Project Option
If we consider no project option then we will lose all positive impacts that will be caused due to the project; like compliance of Sindh Hospital Waste Management Rules, 2014; infection control, reduction in the spread of Hepatitis B and C in Sindh, loss of potential employment and business opportunity.

The “No Project Option” does not appear reasonable given the above fact. However, the expected negative environmental impacts can be minimized by adopting appropriate mitigation measures.

4.2.2 Build as proposed
The construction and installation of a new MP 500 incinerator at the selected project site within the premises of the selected hospitals is part of the built as a proposed strategy. There is an existing old incinerator at the project site which in most cases is either not working efficiently or is no more presently in use. Hence the new, highly efficient and effective in its working, state of the art incinerator will be replacing the old incinerators at eight different hospitals of the five districts, each with one incinerator installed whereas 4 incinerators will be installed at 4 different hospitals of Karachi, as discussed in the previous chapter.

All these incinerators will be installed on the hospital premises because the infectious hospital waste is disposed of within 24 hours of its generation. Therefore, build as proposed is the best option. However, the negative impacts due to the project construction and operation can be minimized, controlled or eliminated if the proposed mitigation measures as suggested in the EIA report are effectively implemented.

4.3 Site Alternatives
In reference to the project site alternatives, the land piece at each selected hospital was evaluated. The specific selection was based on the following reasons;

Nature of Infectious Waste: The infectious waste needs to be incinerated within 24 hours. If untreated, such waste for a long time has varying degrees of potential to cause disease. The nearer the incinerator facility to the hospital, the better it is for the environment.

Transportation hazards: If the infectious waste is transported to longer distances, there are more chances of spreading diseases throughout the distant areas to where it is being transported. Spatial and Temporal exposure to the human/environment will keep growing up. Also, it will add the cost of travelling on the project cost.
Existing Incinerator: There is already an existing incinerator at each selected hospital of Sindh District. The selected site adjacent to the old existing incinerator is suitable to install the new one. As there were no complaints with the old existing incinerators location hence making it the best possible site option.

Conclusion
In view of all the above criteria, it was concluded to install eight incinerators at eight different hospitals located in five different districts of Sindh province. Each hospital will have a single incinerator.

The project sites are located inside the Hospital, so administrative control on the proposed project will be easy for the proponent and Hospital. The location of the proposed project site is very good making the incinerator available for infectious waste to destroy within 24 hours without any transportation costs.

4.4 Technology alternatives
Although the Government of Sindh does not have Environmental Quality Standards treatment and disposal of bio-medical waste. However, the Government of Punjab has enacted Punjab Environmental Quality Standards for Bio-Medical Waste. The four technologies recommended for treatment and disposal of bio-medical waste will be compared to technological alternatives.

Incineration of wastes has been highly practised, and Incineration is chosen for most infectious healthcare waste treatment all over the globe. However, the other three alternatives such as autoclaving, deep burial and microwaving could also be evaluated to seek the best option for the final disposal of infectious hospital waste in Sindh.

A comparison to evaluate the best hospital waste treatment and disposal option of incineration with other technologies has been described as hereunder:

4.4.1 Incineration
Incineration is a process where complete combustion takes place in the presence of fuel and air. The fuel provides heat energy to attain incineration temperature, and air provides oxygen for combustion. In some cases, the waste itself provides heat energy. Incineration is effective when the waste is combustible, which is reduced to exhaust gaseous products and the incombustible waste is reduced to ash. The nature of gaseous emissions and ash from an incinerator depends upon the type of waste being incinerated and incineration conditions.

Incinerator can treat Healthcare and Industrial waste at the same time. Incineration a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very significant reduction of waste volume and weight... This process is usually selected to treat wastes that cannot be recycled, reused or disposed of in a landfill site.

Incineration breaks down the infectious, nonmetallic organic wastes and destroys bacteria and viruses, which is the main benefit of the incineration of hospital waste. In considering the infectious waste incineration option, one must weigh the benefits of incineration against the significant capital and operating cost, potential environmental impacts, and the technical difficulties of operating an incinerator.
Advantages of Incinerator

- Infectious waste incineration is cost-effective in regions where land for landfilling is not suitable and scarce.
- Volume reduction, especially for bulky solids with high combustible content.
- Detoxification of pathologically contaminated material, toxic organic compounds or biologically active materials.
- Power and Heat generation.
- Filters trap pollution.
- Socio-environmental compliance, especially for fumes containing odorous compounds, carbon monoxide or other combustible materials subject to regulatory emission limitations.
- Environmental Impact mitigation, especially for organic material that would leach from landfills or create an odour nuisance.
- Reducing atmospheric pollution caused by smoke emitted during open burning.

Disadvantages of Incinerator

- Incineration facilities are expensive to build, operate, and maintain.
- These facilities also require skilled staff to run and maintain them.
- Smoke and ash emitted by the chimneys of incinerators include acid gases, nitrogen oxide, heavy metals, particulates, and dioxin, which is a carcinogen if proper wet scrubber/ pollution control devices are not installed.
- Incinerators require large volumes of waste to keep the fires burning.
- The high temperature is required.

4.4.2 Steam Autoclaving

Steam is autoclaving the most efficient and widely used alternative medical- waste treatment-technology. Most available autoclaves are designed to handle both biohazard and normal hospital wastes in a simultaneous way. However, they cannot treat pathological, chemotherapy waste, low-level radioactive wastes. These wastes have to be treated separately.

Medical waste autoclaves usually jointly operate with a shredder and a compactor which is used to minimize the volume. In autoclaves, the effects of heat from saturated steam and increased pressure decontaminate medical waste by inactivating and destroying microorganisms. There are two types of autoclaves, gravity displacement and pre-vacuum. Those designed for medical wastes are mostly pre-vacuum.

Advantages

- Can treat most types of biomedical waste.
- High level of microbial inactivation of biomedical waste.
- Does not create hazardous combustion by-products (dioxins, furans etc.)
- Produces far fewer emissions than incinerators
- Treated wastes can be landfilled along with normal municipal solid waste.
- Autoclaves are the most widely used alternative to incineration of biomedical waste.
- Many autoclaves require low capital investment.
Easier to operate than incinerators
Most profitable investment unless there are no regulations at all on incineration emissions.

Limitations
Most autoclaves do not handle recognizable auto medical wastes.
Dose does not handle chemotherapeutic or other toxic chemical and radiological wastes
Large volumes of liquids in sealed containers may not be adequately treated.
Offensive odours can be generated.
May exhaust volatile organic compounds
May require the hospital to alter the method of separating waste.

4.4.3 Microwaving
The process combines shredding, steam injection and conventional microwaves to disinfect biomedical waste. The microwave process begins when an operator fills the loading bucket with waste.

An automatic hoist dumps the material into a hopper at the top of the unit. Before opening, hopper air is treated with high-temperature steam and then extracted with a high-efficiency particulate air filter to capture airborne pathogens. The computer controls the entire process, prompting the operator to feed more waste. Material feeds shredder evenly and emerges as small bits, recognizable as medical waste.

The granules are automatically conveyed into treatment steam. This mixture runs under a series of conventional microwave generators that disinfect each granule. The treated end product is ready for municipal solid waste landfills or waste-to-energy plants.

Advantages
Microwave system is easier to get permitted because it doesn’t generate potentially toxic air emissions.
No obnoxious odours and no noise at all.
It eliminates needle sticks and back problems.
Consequently, there is no need for pollution control devices.
The cost of microwaving is about the same as for incineration.

Limitations
Inappropriate for industrial waste
Not a co-generation process like incinerators.

4.4.4 Deep Burial
Alternatively, a special small burial pit could be prepared to receive health-care waste only. The pit should be 2 m deep and filled to a depth of 1–1.5m. After each waste load, the waste should be covered with a soil layer 10–15cm deep. If coverage with soil is not possible, lime may be deposited over the waste.
In case of an outbreak of an especially virulent infection, both lime and soil cover may be added. Access to this dedicated disposal area should be restricted, and the use of a pit would make supervision by landfill staff easier and thus prevent scavenging.

The burial site should be relatively impermeable, and no shallow well should be close to the site. When fresh waste is added to the pit, a layer of 10 cm of soil shall be added to cover the fresh waste.

The pit should be safely away from any habitation and sited so as to ensure that no contamination occurs to any surface or underground water source. The area should not be prone to flooding or erosion. The location of the site shall be authorized by the prescribed environmental agency, and the institution shall maintain a record of all pits for deep burial.

Deep burial of infectious hospital waste provides several advantages over disposal in surface structures or by shallow burial. The primary advantage is the high degree of physical isolation that it provides.

**Advantages**

- Increase in length of the flow path of contaminants that may become dissolved in groundwater.
- Increased protection of waste against weathering and erosion.
- For some wastes and waste containers, elimination of free oxygen that may mobilize certain constituents.
- For plutonic rocks and to some extent all rocks, reduction of permeability with depth.
- Human intrusion is less likely.

**Disadvantages**

- The high cost of exploration, development, and monitoring of deep disposal system
- Contamination of groundwater

**4.5 Conclusion**

After the evaluation of the benefits and drawbacks of all the alternatives explained above, also on the basis of many local factors the final choice is incineration. Incineration is the best choice for treating hospital waste for the following reasons:

- Volume and mass reduction efficiency
- Disinfection efficiency
- The quantity of waste treated per day and the disposal system
- Occupational health and safety considerations
- Almost all types of hospital wastes treated and disposed of.
- This type of technology is allowed to be installed by Sindh Hospital Waste Management guidelines.
- Training requirement for the operation of the method.
- Available space for installation of the plant on site of waste generation source.
- Investment and operating cost.
- Regulatory requirements

The summary of the comparison of the above technologies is given in Table 4.1.
### Table 4.1: Comparison of Hospital Waste Treatment Technologies

<table>
<thead>
<tr>
<th>Treatment Systems</th>
<th>Steam Autoclaving</th>
<th>Microwaving</th>
<th>Incinerator</th>
<th>Deep Burial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Steam sterilization (Direct heating) simultaneous shredding and dehydration</td>
<td>Microwave heating of pre-shredded waste</td>
<td>High-temperature waste incineration</td>
<td>Use of Land Pit to bury deep the waste.</td>
</tr>
<tr>
<td>Sterilization efficacy</td>
<td>Medium</td>
<td>Medium</td>
<td>High (total destruction of microorganisms)</td>
<td>Low</td>
</tr>
<tr>
<td>Capital cost</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Operating cost</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Operator maintenance skills</td>
<td>Low skill level required</td>
<td>Automated, but highly complex and high-level maintenance skill required</td>
<td>High-level operator and Maintenance skills required</td>
<td>High</td>
</tr>
<tr>
<td>Air emissions</td>
<td>Odorous but non-toxic</td>
<td>Somewhat odorous but nontoxic</td>
<td>Can be highly Toxic if without wet scrubber or combustion in incomplete or does not achieve 1150 °C±50</td>
<td>Medium</td>
</tr>
<tr>
<td>Water emissions</td>
<td>May exhaust volatile organic compounds</td>
<td>Negligible</td>
<td>None</td>
<td>High</td>
</tr>
<tr>
<td>Treated waste characteristics</td>
<td>Wet waste, all Recognizable material Dehydrated, cannot treat pathological, chemotherapy waste, low-level radioactive wastes.</td>
<td>Shredded but wet waste. Inappropriate for industrial waste</td>
<td>Mostly ash.</td>
<td>Decomposed matter, Leachate, CO₂ and methane gas.</td>
</tr>
</tbody>
</table>
5 Description of the Existing Environment

5.1 Introduction

This chapter describes the existing environmental and socioeconomic conditions of the project area of 8 hospitals where incinerators would be installed under the project. The hospitals are located in Karachi, Hyderabad, Sukkur, Larkana and Shaheed Benazirabad. A generic overview of the environmental conditions of this entire area is presented, in consolidated form.

The project site is the area where incinerator has to be installed in 8 hospitals. The project area is in the area falling within a 0.5 km radius of the project site. Four of the hospitals, i.e. Jinnah Postgraduate Medical Center, National Institute of Child Health, Dr Ruth Pfau Civil Hospital and Sindh Government Lyari General Hospital are located in Karachi, Liaquat University Hospital is located in Jamshoro, Ghulam Muhammad Mehar Medical College Hospital is in Sukkur, Chandka medical college hospital is located in Larkana, and Peoples Medical College Hospital is located in Shaheed Benazirabad.

5.1.1 Karachi

Karachi being the capital of the province of Sindh is one of the biggest cosmopolitan city of Pakistan. Situated on the bank of Arabian Sea. Just northwest of the Indus River Delta, Karachi has the coordinates of 24°51′36″N 67°0′36″E. Karachi is home to two of the largest seaports in Pakistan, i.e. port of Karachi and Bin Qasim Port.

Karachi is located in Pakistan's southern cost, on the Arabian Sea. Physically Karachi is mostly comprised of flat or rolling plains with mountains on the western and northern boundaries of the urban sprawl.

Two rivers pass through the city: the Malir River (north east to centre) and the Lyari River (north to south). Karachi has a coastal belt of 135 km and has the area of 3257 km2.

Though the Karachi region has been inhabited for millennia, the city was founded as the fortified village of Kolachi in 1729. By the time of the Partition of British India, the city was the largest in Sindh with an estimated population of 400,000. Following the independence of Pakistan, the city's population increased dramatically with the arrival of hundreds of thousands of Muslim refugees from India. The city experienced rapid economic growth following independence, attracting migrants from throughout Pakistan and South Asia.

Karachi is one of Pakistan's most secular and socially liberal cities. It is also the most linguistically, ethnically, and religiously diverse city in Pakistan. With a population of 14.9 million recorded in the 2017 Census of Pakistan, Karachi is the world's 6th most populous metropolitan area.

5.1.2 Hyderabad

Hyderabad is located 140 kilometres east of Karachi. Hyderabad is the 2nd largest in Sindh province by population and the 8th largest city in Pakistan.

The city was named in honour of Hazrat Ali (AS), the fourth caliph and cousin of the Prophet Muhammad (PBUH). Hyderabad's name translates literally as "Lion City."

Hyderabad city was initially founded on a limestone ridge on the eastern bank of the Indus River known as Ganjo Takkar also commonly known as Bald Hill. The limestone outcropping
provided several scenic vistas in the city, as well as inclined routes. The most famous incline, the Tilak Incline is also located in Hyderabad.

5.1.3 Larkana

Larkana is located in lower Indus plain and is one of the important districts of Sindh province. Being rich in arts, culture and language, Larkana is famous for its folk heritage and political history. There are four Tehsils or Talukas in Larkana district which are Taluka Dokri, Taluka Bakrani, Larkana Taluka and Taluka Ratto Dero.

Larkana is famous for its international export of berries whereby the annual output of the district stands thousands of tons hence strengthening the local economy of the region. Moreover, Guava orchids located in Dodai, Mahotta, Naudero, Chooharpur, Agani, Metla, Izzat Ji Wandh, Phulpota and other villages spread to a vast land area surrounding Larkana. The area is also famous for its rich cultivation of sugarcane which is also processed locally and distributed nationally and internationally.

Two main highways provide access to the city once being the Bakarin Road which passes through the city and conjoins itself to a vast network of Roads within the city, however, Larkana bypass Road also provides speedy access to Larkana city while avoiding the heavy traffic.

5.1.4 Sukkur

Sukkur is the third largest city of Sindh is situated on the west bank of Indus River. The word Sakhar in Sindhi means "superior", which in Sindhi is the origin of the name. Sukkur has always been an important strategic centre and trading route.

5.1.5 Shaheed Benazirabad

Shaheed Benazirabad District, previously known as Nawabshah District, is one of the districts in the province of Sindh, Pakistan. Nawabshah is the divisional headquarters of Shaheed Benazir Abad Division. Since divisions were restored back in 2008, the division currently consists of three districts namely; Naushahro Feroze District, Shaheed Benazir Abad District and Sanghar District.

The population of Shaheed Benazirabad counted in the 2017 census was 1,612,847\textsuperscript{13}. 96.3% of the population are Muslim, and 2.77% – Hindu. The major first language is Sindhi, accounting for 79% of the population. Urdu was the first language of 8.7%, Punjabi – 7.9% and Balochi – 1.8%.

Figure 5.1: Location map of study areas in Sindh Province, Pakistan
5.2 **Physical Environment**

### 5.2.1 Physical Environment of Karachi

**Topography**: Karachi can be broadly divided into two parts; the hilly areas in the north and west, and an undulating plain and coastal area in the south-east. The hills in Karachi are the off-shoots of the Kirthar Range. The highest point of these hills in Karachi is about 528m in the extreme north. All these hills are devoid of vegetation and have wide intervening plains, dry river beds and water channels.

Karachi has a long coastline in the south. The famous sea beaches include Hawks Bay, Paradise Point, Sands Pit, and Clifton. China Creek and Korangi Creek provide excellent calm water channels for rowing and other water activities. Away from the shoreline are small islands including Shamsh Pir, Baba Bhit, Bunker, Salehabad and Manora.

**Geology and Soil Texture**: Karachi is located on the coastline of Sindh province in southern Pakistan, along with a natural harbour on the Arabian Sea. Karachi is built on a coastal plain with scattered rocky outcroppings, hills and coastal marshlands. The coastal mangrove forests grow in the brackish waters around the Karachi Harbor, and farther southeast towards the Indus River Delta. West of Karachi city is the Cape Monze, locally known as Ras Muari, which is an area characterized by sea cliffs, rocky sandstone promontories and undeveloped beaches.

Within the city of Karachi are two small ranges: the Khasa Hills and Multi Hills, which lie in the northwest and act as a barrier between North Nazimabad Town and Orangi Town. Karachi's hills are barren and are part of the larger Kirthar Range, and have a maximum elevation of 528 meters (1,732 feet). There are wide coastal plains between the hills interspersed with dry river beds and water channels. Karachi has developed around the Malir River and Lyari Rivers, with the Lyari shore being the site of the settlement for Kolachi. To the west of Karachi lies the Indus River floodplain.

**Seismicity**: Karachi lies on Zone 2B on the seismic zone of Pakistan.

**Water Supply**: There are three sources of water supply in Karachi:

- River Indus supplies 1,200 cusecs daily equal to 645 MGD;
- Hub dam supplies about 50 MGD. The Hub dam supply is rain-fed, so it fluctuates between about 30-75 MGD;
- Underground water sources, transported to Karachi and adjoining areas through tankers.

The total water supply to Karachi is 695 MGD. However, 30 MGD are supplied to the Steel Mills and Port Qasim before the water reaches the Dhabeji Pumping Station leaving the city with 665 MGD.

**Ground Water**: The main source of drinking water in the area is groundwater, which is pumped through hand pumps, pressure pumps and tube wells. The groundwater (tube wells) are also used for irrigation purposes. Groundwater in the Municipal area is generally adequate. The depth of the water table varies from 600 to 800 ft.

**Climate & Temperature**: Karachi has a moderately temperate climate with a generally high relative humidity that varies from 58 per cent in December (the driest month) to 85 per cent in August (the wettest month). A cool evening breeze is a great boon to the inhabitants. The winds in Karachi for more than half the year, including the monsoons, blow south-west to west.

The wind in winter changes to east and north-east maintaining an average temperature of about 21°C.
The hottest months are May and June when the mean maximum temperature reaches 35°C. January is the coolest month of the year. During the rainy season in July and August, it remains cloudy almost every day with generally scanty rainfall. However, there are surprising variations from year to year.

The average annual rainfall is 256 mm, but in certain years rainfall is higher, and it may rain heavily within a short span of 48 hours. However, during the summer season, Karachi has displayed very high occasional day temperatures. In the case of Karachi, the heat index has been recorded to rise up to 58.3°C to 66.1°C.

**Table 5.1**: Month-Wise 30 Year Mean Maximum and Minimum Temperature at Karachi

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
</tr>
<tr>
<td>January</td>
<td>25.3</td>
</tr>
<tr>
<td>February</td>
<td>27</td>
</tr>
<tr>
<td>March</td>
<td>30.5</td>
</tr>
<tr>
<td>April</td>
<td>32.7</td>
</tr>
<tr>
<td>May</td>
<td>34.1</td>
</tr>
<tr>
<td>June</td>
<td>33.7</td>
</tr>
<tr>
<td>July</td>
<td>32.7</td>
</tr>
<tr>
<td>August</td>
<td>31.1</td>
</tr>
<tr>
<td>September</td>
<td>31.4</td>
</tr>
<tr>
<td>October</td>
<td>33.3</td>
</tr>
<tr>
<td>November</td>
<td>31.1</td>
</tr>
<tr>
<td>December</td>
<td>26.9</td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>30.8</td>
</tr>
</tbody>
</table>

**Rainfall**: The average annual rainfall for Karachi is 174.6 millimetres (6.87 in) (1981–2010); the highest annual rainfall of 713 millimetres (28.1 in) was recorded in 1967. Annual monsoon rains for Karachi amount to 146.5 millimetres (5.77 in). The city experienced above-normal monsoon rainfalls in 2003, 2006, 2007, 2009, 2010 and 2011, while in 2004 and 2005 the city received below-normal rainfall. In 2009, the country received 30% below normal rainfall with the exception of Sindh, including Karachi, which received above normal monsoon rains.
Table 5.2: Rainfall data of Karachi

<table>
<thead>
<tr>
<th>Month</th>
<th>Precipitation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>8</td>
</tr>
<tr>
<td>February</td>
<td>9</td>
</tr>
<tr>
<td>March</td>
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<td>July</td>
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<td>August</td>
<td>41</td>
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<td>September</td>
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<td>October</td>
<td>2</td>
</tr>
<tr>
<td>November</td>
<td>3</td>
</tr>
<tr>
<td>December</td>
<td>6</td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>16.16</td>
</tr>
</tbody>
</table>

Source: NOAA, PMD (extremes)

5.2.2 Physical Environment of Hyderabad

Topography: Hyderabad District is the second most urbanized in Sindh, after Karachi. Hyderabad District is 104,877 hectares in size. Hyderabad district coordinates, i.e. 25.367 °north and 68.367 °east and with an elevation of 13 meters, i.e. 43 ft., Hyderabad is located on the east bank of the Indus River and is roughly 150 kilometres away from Karachi, the provincial capital. Two of Pakistan's largest highways, the Indus Highway and the National Highway join at Hyderabad. Several towns surrounding the city include Kotri at 6.7 kilometres, Jamshoro at 8.1 kilometres, Hattri at 5.0 kilometres and Husri at 7.5 kilometres.

The topography of Hyderabad is composed of Limestone Ridges forming a narrow band of the hill like series, as the city was initially founded on a land area having huge limestone deposits. This ridge was formed by the deposits on the eastern bank of the Indus River known as Ganjo Takkar otherwise known as Bald Hill. The limestone outcropping has provided several scenic vistas in the city, as well as on the inclined routes.

Geology and Soil Texture: The soil of Hyderabad district is composed mainly of skeletal fragments of marine organisms such as coral, forams and molluscs. Its major materials are the minerals calcite and aragonite. The land area consists of sedimentary rock having high limestone deposits. These limestone deposits are mostly because of the presence of the limestone ridge and its outcroppings.

Another type of soil in Hyderabad is of clayey nature, i.e. consisting of soil material that combines one or more clay minerals with possible traces of quartz, metal oxides and other organic matter.
Seismicity: Hyderabad district is not located in a seismically active earthquake prone area. The area falls in seismic Zone II A which shows very less potential for the earthquake in the region.

Ground Water: The main source of drinking water in Hyderabad district is groundwater, which is pumped through hand pumps, pressure pumps and tube wells. The groundwater (tube wells) are also used for irrigation purposes. Groundwater in the Municipal area is generally adequate. The depth of the water table varies from 5 to 10 meters.

Climate: Hyderabad has a hot desert climate, with warm conditions year-round. The city is famous for its winds which moderate the otherwise hot climate. As a result, Hyderabadi homes traditionally feature wind-catching towers that funnel breezes down into living quarters in order to alleviate the heat.

The period from mid-April to late June (before the onset of the monsoon) is the hottest of the year, with highs peaking in May at 41.4 °C. During this time, winds that blow usually bring along clouds of dust, and people prefer staying indoors in the daytime, while the breeze that flows at night is more pleasant. Winters are warm, with highs around 25 °C, though lows can often drop below 10 °C at night. The highest temperature of 50 °C was recorded on 25 May 2018, while the lowest temperature of 1 °C was recorded on 8 February 2012.

Table 5.3: Month-Wise 30 Year Mean Maximum and Minimum Temperature of Hyderabad District

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
</tr>
<tr>
<td>January</td>
<td>25</td>
</tr>
<tr>
<td>February</td>
<td>28.1</td>
</tr>
<tr>
<td>March</td>
<td>33.9</td>
</tr>
<tr>
<td>April</td>
<td>38.9</td>
</tr>
<tr>
<td>May</td>
<td>41.6</td>
</tr>
<tr>
<td>June</td>
<td>40.2</td>
</tr>
<tr>
<td>July</td>
<td>37.4</td>
</tr>
<tr>
<td>August</td>
<td>36.3</td>
</tr>
<tr>
<td>September</td>
<td>36.8</td>
</tr>
<tr>
<td>October</td>
<td>37.2</td>
</tr>
<tr>
<td>November</td>
<td>31.9</td>
</tr>
<tr>
<td>December</td>
<td>26.3</td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>34.5</td>
</tr>
</tbody>
</table>

Rainfall: In recent years, Hyderabad has seen great downpours. In February 2003, Hyderabad received 105 millimetres (4.13 in) of rain in 12 hours, leaving many dead. The years of 2006 and 2007 saw close contenders to this record rain with death tolls estimated in the hundreds.
The highest single-day rain total of 250.7 millimetres (9.87 in) was recorded on 12 September 1962, while the wettest month was September 1962, at 286 millimetres (11.26 in).

Table 5.4: Rainfall data of Jamshoro / Hyderabad

<table>
<thead>
<tr>
<th>Month</th>
<th>Precipitation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1.2</td>
</tr>
<tr>
<td>February</td>
<td>3.9</td>
</tr>
<tr>
<td>March</td>
<td>5.1</td>
</tr>
<tr>
<td>April</td>
<td>5.8</td>
</tr>
<tr>
<td>May</td>
<td>3.5</td>
</tr>
<tr>
<td>June</td>
<td>13.9</td>
</tr>
<tr>
<td>July</td>
<td>56.7</td>
</tr>
<tr>
<td>August</td>
<td>60.8</td>
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<tr>
<td>September</td>
<td>21.4</td>
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<tr>
<td>October</td>
<td>1.5</td>
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<tr>
<td>November</td>
<td>2.1</td>
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<tr>
<td>December</td>
<td>2</td>
</tr>
<tr>
<td><strong>Annual (Average)</strong></td>
<td><strong>177.9</strong></td>
</tr>
</tbody>
</table>

Source: NOAA, PMD (extremes)

5.2.3 Physical Environment of Larkana

Topography: Larkana District and is bounded by hills of Baluchistan province, Shikarpur and district of Khairpur and Dadu district to the southern Sindh. Khirthar range extends along the west consisting of a wide range of hills and mountains; the highest peak of Sindh was reported to be in the Sindh segment of Khirthar range.

Larkana is situated at Latitude 24 56’ 00’ and Longitude 67 11’ 00’ and is situated in northwestern Sindh. The area is mostly arid with scant vegetation. The area lies in lower Indus plain.

Geographically, the district is divided into three part, i.e. the Kohistan Tract, Central Canal Irrigation Tract and the Eastern Tract. The microenvironment of Larkana district is located in the Central Canal Irrigation Tract. The Western portion of the district comprises the western parts of the now separated Shahdadkot-Qamber district, and the Warah Talukas fall in the Kohistan area. A range of limestone hills and mountains of the Khirthar range extends along an approximately 20 km boundary on the west of the district. The Khirthar range consists of an ascending series of ridges, generally running north to south with broad, flat valleys in between. The highest ridge of the range at its northern extremity is about 1,500 meters above sea level.
Geology and Soil Texture: Larkana tehsil is flat and is chiefly irrigated by Rice Canal, Dadu Canal, Ghar Canal and its network of branches. The south-western portion, irrigated by the Western Nala and is said to produce the finest rice in Sindh. Wheat is largely grown on the banks of the Indus which allows growth of several mango groves and date plantations surround Larkana town.

Water Supply: One of the main sources of water in Larkana is that from Ghar canal, Dadu canal which provides water for irrigation. 73.75% population in Larkana district had a water supply inside homes.

The rural areas also had 67% households depending on supplies inside homes and these included 54% depending on hand pumps while the 33% having outside sources included 16% drawing from hand pumps. The rest had the ponds and canals as the source.

Ground Water: The main source of drinking water in the area is groundwater, which is pumped through hand pumps, pressure pumps and tube wells. The groundwater (tube wells) are also used for irrigation purposes. Groundwater in the Municipal area is generally adequate. The depth of the water table varies from 80-120 feet.

Climate and temperature: Larkana District has extremes of climate in summer but moderate winters. The network of canals and general submergence of the rice fields under irrigation canal water during the summer add humidity to the heat. The humidity and heat continue up to the middle of October after which nights become cool and the day temperatures begin to recede. The District is situated far away from the sea is devoid of breeze.

The mean maximum and minimum temperature in summer season are approximately 43° C and 33° C while that of the winter season it is 21° C and 11° C respectively.

Table 5.5: Month-Wise 30 Year Mean Maximum and Minimum Temperature of Larkana

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
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<tbody>
<tr>
<td></td>
<td>Max</td>
<td>Min</td>
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</tr>
<tr>
<td>January</td>
<td>6.7</td>
<td>22.9</td>
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<tr>
<td>February</td>
<td>9.5</td>
<td>26.2</td>
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<tr>
<td>March</td>
<td>15.6</td>
<td>32.5</td>
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<tr>
<td>April</td>
<td>21.2</td>
<td>38.2</td>
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<tr>
<td>May</td>
<td>25.8</td>
<td>42.9</td>
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<tr>
<td>June</td>
<td>28.6</td>
<td>44.2</td>
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<tr>
<td>July</td>
<td>28.7</td>
<td>41.2</td>
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<td>August</td>
<td>27.5</td>
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<tr>
<td>September</td>
<td>25.2</td>
<td>38.5</td>
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<tr>
<td>October</td>
<td>19.3</td>
<td>36.5</td>
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<tr>
<td>November</td>
<td>12.9</td>
<td>30.3</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>8.1</td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>19.09</td>
<td>34.79</td>
<td></td>
</tr>
</tbody>
</table>
Rainfall: The average annual rainfall is about 100 to 125 millimetres per annum. Dust storms are common, and heat waves are rampant from mid-April to almost the end of May every year.

<table>
<thead>
<tr>
<th>Month</th>
<th>Precipitation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>5</td>
</tr>
<tr>
<td>February</td>
<td>9</td>
</tr>
<tr>
<td>March</td>
<td>7</td>
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<tr>
<td>April</td>
<td>4</td>
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<tr>
<td>May</td>
<td>3</td>
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<tr>
<td>June</td>
<td>4</td>
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<td>July</td>
<td>25</td>
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<td>August</td>
<td>25</td>
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<td>September</td>
<td>10</td>
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<tr>
<td>October</td>
<td>2</td>
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<tr>
<td>November</td>
<td>3</td>
</tr>
<tr>
<td>December</td>
<td>7</td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>8.67</td>
</tr>
</tbody>
</table>

Source: CLIMATE-DATA.ORG

5.2.4 Physical Environment of Sukkur

Topography: Sukkur district is divided into 5 administrative tehsils, namely Sukkur City, New Sukkur, Rohri, Saleh Pat and Pano Aqil. Among them, Sukkur City and new Sukkur are urban centres while Pano Aqil is famous for having one of the largest military cantonment of the country. Rohri is the smallest tehsil of the Sukkur district.

Sukkur has a desert-like a terrain, and its climate is characterized by very hot and hazy summers with dry and cool winters. Sukkur is known for its extremely hot summers and is listed as one of the hottest cities in Pakistan. Wind speed is low throughout the year, and sunshine is abundant. Summer is very hot as the temperature can reach up to 53 °C.

Geology and Soil Texture: Sukkur has a small Eocene limestone outcropping upon which Sukkur was founded. This is the most significant land deformation on the vast plains along the Indus Valley in Sindh and Punjab. The outcropping is part of the "Jacobabad-Khairpur High" and Rohri Hills. The outcropping, along with the similar outcropping on Bukkar Island is sometimes referred to as the "Sukkur Gorge," and has historically served as the traditional northern boundary of Sindh.

The land area of Sukkur is fertile and allows the growth of various fertile Rabbi Crops such as wheat, barley, graham and melons whereas Kharif crops include rice, bajra, cotton, tomatoes and peas. The natural vegetation in Sukkur has been replaced by agricultural crops. Dates from Sukkur are exported all over the world. The terrain of Sukkur is quite flat and level. It mostly has flat agricultural fields.
Surface Water: The source of surface water comes from the three adjoining link canals, i.e. Dadu Canal, Rice Canal and Amrati Mashid Khirtar Canal. However, groundwater sources are also good enough to fulfil the demands of the community.

Ground Water: The main source of drinking water in Sukkur is groundwater, which is pumped through hand pumps, pressure pumps and tube wells. The groundwater (tube wells) are also used for irrigation purposes.

With the advent of the Sukkur Barrage, the water table has risen considerably, and some wells, though not cleaned for many years, still contain 20’ of the water column. The wells, which are still being utilized, show an indication of the quality of water, existing only in the shallow depths varying between 20’ to 40’.

Climate: Sukkur has a desert-like a terrain, and its climate is characterized by very hot and hazy summers with dry and cool winters. Sukkur is known for its extremely hot summers and is listed as one of the hottest cities in Pakistan. Wind speed is low throughout the year, and sunshine is abundant. Summer is very hot as the temperature can reach up to 53 °C.

Weather in Sukkur is influenced by Subtropical Dry Arid desert-like climate as Sukkur lies under the low-latitude desert. Evaporation exceeds precipitation, but on average it is less than the potential half evaporation. The average temperature is more than 18°C. However, temperature doesn’t often go below 0 °C whereby frost is absent or infrequent. The hottest months starts in May, with temperature exceeding from 43°C to 53°C and sometimes even more.

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
<td>Min</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>7.8</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>10.7</td>
<td>26.1</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>16.4</td>
<td>32.2</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>21.7</td>
<td>37.6</td>
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<tr>
<td>May</td>
<td>26</td>
<td>42.1</td>
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<tr>
<td>June</td>
<td>28.3</td>
<td>43.2</td>
<td></td>
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<tr>
<td>July</td>
<td>28.4</td>
<td>40.7</td>
<td></td>
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<tr>
<td>August</td>
<td>27.3</td>
<td>39.3</td>
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<tr>
<td>September</td>
<td>25.8</td>
<td>38.4</td>
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<td>October</td>
<td>20.6</td>
<td>36</td>
<td></td>
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<tr>
<td>November</td>
<td>14.3</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>9.2</td>
<td>24.3</td>
<td></td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>19.71</td>
<td>34.41</td>
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</tr>
</tbody>
</table>
Rainfall: Never the less, Sukkur receives a considerate amount of rainfall and thunderstorm. Dry heat is experienced starting from April to early June until the Monsoon season starts to arrive. However, Monsoon in Sukkur is not very wet because of which high heat indices are observed in the region.

Monsoons recede by September, but it is not until late October that the short-lived autumn season is experienced before the onset of the cold winters. Apart from the monsoon, winter season also experiences a slight amount of rainfall; however mostly winters are harsh, dry but also short-lived in general.

<table>
<thead>
<tr>
<th>Month</th>
<th>Precipitation (mm)</th>
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<tbody>
<tr>
<td>January</td>
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<tr>
<td>February</td>
<td>6</td>
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<td>March</td>
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<td>April</td>
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<td>May</td>
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<tr>
<td>June</td>
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<td>July</td>
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<td>August</td>
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<td>September</td>
<td>4</td>
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<tr>
<td>October</td>
<td>0</td>
</tr>
<tr>
<td>November</td>
<td>2</td>
</tr>
<tr>
<td>December</td>
<td>4</td>
</tr>
<tr>
<td><strong>Annual (Average)</strong></td>
<td><strong>7.08</strong></td>
</tr>
</tbody>
</table>

Source: NOAA, PMD (extremes)

5.2.5 Physical Environment of Shaheed Benazirabad

Topography: With the exception of northeastern part of Nawabshah taluka which is desert known as Gunjo that, the rest of the district is a fertile plain formed by the Indus river. The soil is sandy with hard clay loams with the negligible exception where the soil is Kallarish.

Shaheed Benazirabad is that part of the Indus Valley which has benefited more than any other part of Sindh from the development of irrigation under Rohri Canal. The average elevation of the area is about 50 meters above sea level.

Geology and Soil Texture: The district lies in 670 52" to 680 27" 2’ east longitudes to 250 59" to 260 38" 5’ north latitudes. The district is bounded by district Khairpur and Saanghar on the east, district Jamshoro on the west, district Khairpur and Naushehro Feroze on the north and district Matiari on the south.

This district is located in the centre of the Sindh province of Pakistan and is therefore commonly known as the heart of Sindh. Indus River flows on the left bank of the district. The
total geographical area of the district is 451,000 hectares. The land structure of this district can be divided into three parts.

- First, on the northern side of the district is the kaccha (the lands alongside the Indus River), these lands are very fertile but are prone to riverine floods.
- Second, the central and major part of the district comprises the irrigated cultivable lands. This area consists of very productive agricultural land.
- Third, the eastern part of the district that comprises the barren desert lands in Daur taluka.

Seismicity: Shaheed Benazirabad falls in the Zone 2A of the Seismic Zoning Map of Pakistan. Seismic Zone 2A is the least prone area on the land to the Seismic Activities. Shaheed Benazirabad has no serious history of any seismic activity. However, the north side of Sindh, the coastal side, falls in zone 4 and prone to seismic activities and any activity in that area may lead to Shaheed Benazirabad.

Surface Water: Indus is the only river of the district and flows along the western boundary of the district for about 90 kilometres of its length. Presence of River Indus is the most dominant geographical factor. Indus plays a vital role in the livelihood and welfare of the people of Shaheed Benazirabad district can readily be understood when it is realized that average yearly rainfall in the district is only about five to eight inches.

The main source of drinking water in the area is groundwater, which is pumped through hand pumps, pressure pumps and tube wells. Groundwater in the Municipal area is generally adequate.

Climate & Temperature: The climate of Shaheed Benazirabad is extremely hot during the summers and cold/foggy during the winters.

The highest temperatures in Pakistan, rising up to 50°C, is recorded in Shaheed Benazirabad and Sibbi, from May to August. On 26 May 2010, a record-breaking severe heat wave hit the city, and the mercury level reached 52°C, which is the highest temperature ever recorded in Shaheed Benazirabad, the third highest temperature recorded in Pakistan and the sixth highest temperature ever recorded on earth. The climate is generally dry and hot, but sometimes, during winters, temperature falls to 0°C.
Table 5.9: Month-Wise 30 Year Mean Maximum and Minimum Temperature of Shaheed Benazirabad

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>January</td>
<td>24.3</td>
<td>6.1</td>
</tr>
<tr>
<td>February</td>
<td>27.5</td>
<td>8.8</td>
</tr>
<tr>
<td>March</td>
<td>33.6</td>
<td>14.3</td>
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<tr>
<td>April</td>
<td>39.6</td>
<td>19.7</td>
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<tr>
<td>May</td>
<td>43.4</td>
<td>24.6</td>
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<tr>
<td>June</td>
<td>43.6</td>
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<td>July</td>
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<td>September</td>
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<td>October</td>
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<tr>
<td>November</td>
<td>31.9</td>
<td>12.3</td>
</tr>
<tr>
<td>December</td>
<td>25.8</td>
<td>7.8</td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>35.4</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: NOAA, PMD (extremes)

Rainfall: The average annual rainfall for Shaheed Benazirabad is 11.92 millimetres (2010-2011); the highest annual rainfall of 52 millimetres was recorded in July 2011. There is a difference of 52 mm of precipitation between the driest and wettest months.

Table 5.10: Rainfall data of Shaheed Benazirabad

<table>
<thead>
<tr>
<th>Month</th>
<th>Precipitation (mm)</th>
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</thead>
<tbody>
<tr>
<td>January</td>
<td>1</td>
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<tr>
<td>February</td>
<td>3</td>
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<tr>
<td>March</td>
<td>3</td>
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<tr>
<td>April</td>
<td>2</td>
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<tr>
<td>May</td>
<td>1</td>
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<tr>
<td>June</td>
<td>10</td>
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<tr>
<td>July</td>
<td>52</td>
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<tr>
<td>August</td>
<td>47</td>
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<tr>
<td>September</td>
<td>17</td>
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<tr>
<td>October</td>
<td>1</td>
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<tr>
<td>November</td>
<td>2</td>
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<tr>
<td>December</td>
<td>4</td>
</tr>
<tr>
<td>Annual (Average)</td>
<td>11.92</td>
</tr>
</tbody>
</table>

Source: NOAA, PMD (extremes)
5.3 Ambient Air Quality and Noise Level Monitoring

The ambient air quality and noise level monitoring was conducted at all the 7 project sites for Sindh Environmental Quality Standards (SEQS) for Sulphur dioxide (SO₂), Oxide of Nitrogen (as NO), Oxide of Nitrogen (as NO₂), Ozone (O₃), Suspended Particulate Matter (as SPM), Respirable Particulate Matter (as PM₁₀), Respirable Particulate Matter (as PM₂.₅), and Carbon Monoxide (CO) for 24 hours as described hereunder:

5.3.1 Jinnah Postgraduate Medical College and National Institute of Child Health, Karachi

The ambient air quality and noise level monitoring were carried out for 24 hours at the project site at Jinnah Postgraduate Medical College, Karachi. The GPS coordinates of ambient air quality and noise level monitoring location are 24°51’01.7”N and 67°02’53.4”E.

The two hospitals, JPMC and NICH, are located adjacent to each other. It was in April 1990 that NICH was separated from JPMC, and made an attached department of the Federal Ministry of Health.

The ambient air quality and noise level monitoring were carried out by Sindh EPA approved laboratory Pakistan Space and Upper Atmosphere Research Commission (SPARCO) Environmental Laboratory, Karachi.

The average ambient temperature, wind speed and relative humidity for 24h from August 17, 2018, 1400 hrs to August 18, 2018, 1300 hrs were observed to be 30.63 °C, 7.06 km/h and 67.57% relative humidity respectively.

Wind Speed

The wind speed was observed at the project site for 24h from August 17, 2018, 1400 hrs to August 18, 2018, 1300 hrs. The wind rose diagram to indicate that around 50 % of the wind blew from West, 40% in the South West direction and remaining in the South direction. The mean speed of wind on the project site was 7.06 kph. The wind rose diagram of the monitoring site at Jinnah Postgraduate Medical College Karachi near NICH, is shown from Figure 5.2.

Figure 5.2: Wind Rose Diagram for project site at JPMC and NICH Hospital Karachi
Ambient Air Quality Monitoring

Sulphur dioxide (SO₂): Sulphur dioxide (SO₂) is a colourless, poisonous gas with a strong odour. Coal and petroleum containing Sulphur compounds produce Sulphur dioxide after their combustion. It is one of the main contributors of acid rains because of oxidation of SO₂ in the presence of a catalyst such as NO₂ forms H₂SO₄. It irritates eyes, nose and throat. It may impair lung function and aggravate respiratory diseases.

The 24h average concentration of SO₂ at the monitoring site was 8.7 µg/m³ which is in compliance with the SEQS (120 µg/m³) of Sindh.

The hourly variation graph shows that the concentration of SO₂ varies between 3.3 µg/m³ to 15.9 µg/m³ during 24 hrs monitoring.

Figure 5.3: Hourly Variation of Sulphur dioxide (SO₂) at JPMC and NICH Karachi

Nitrogen dioxide (NO): Nitric oxide (nitrogen oxide, nitrogen monoxide) is a molecular, chemical compound with a chemical formula of NO. One of several oxides of nitrogen, it is a colourless gas under standard conditions. It is also produced naturally by the extremely high air temperatures produced along the path of lightning in thunderstorms.

Nitric oxide should not be confused with nitrous oxide (N₂O), an anaesthetic, or with nitrogen dioxide (NO₂), brown toxic gas and a major air pollutant, the latter being a product to which nitric oxide is rapidly oxidized in air.

The averaged (24h) concentration of NO (11.65 µg/m³) remained in compliance with SEQS (40 µg/m³) at the monitoring site.

The highest concentration of 37.3 µg/m³ of NO was observed, and the lowest concentration of NO was 2 µg/m³.
**Figure 5.4:** Hourly Variation of Oxide of Nitrogen (as NO) at JPMC and NICH Karachi

Nitrogen dioxide ($NO_2$): Nitrogen dioxide ($NO_2$) is a light brown gas that can become an important component of urban haze. It is likely that oxides of nitrogen are the second most abundant atmospheric contaminants in many cities, ranking next to Sulphur dioxide.

Nitrogen oxides usually enter the air as a result of high-temperature combustion processes, such as those occurring in automobiles and power plants.

The primary sources of Nitrogen oxides ($NO_x$) are motor vehicles and thermal power generation. The averaged (24h) concentration of $NO_2$ (21.37 µg/m$^3$) remained within in compliance with SEQS (80 µg/m$^3$) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 47.7 µg/m$^3$ and the lowest concentration registered was 1.1 µg/m$^3$.

**Figure 5.5:** Hourly Variation of Oxide of Nitrogen (as $NO_2$) at JPMC and NICH Karachi
Ozone (O₃)

Ozone or tri-oxygen is an inorganic molecule with the chemical formula O₃. It is a pale blue gas with a distinctively pungent smell. It is an allotrope of oxygen that is much less stable than the diatomic allotrope O₂, breaking down in the lower atmosphere to normal oxygen.

The averaged (24h) concentration of O₃ (12.28 µg/m³) remained well within compliance limits of SEQS (130 µg/m³) at the project site. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

The O₃ concentration varies from 5.1 µg/ m³ to 18.1 µg/m³. This figure shows the baseline concentration of O₃ in a relatively untouched area.

**Figure 5.6:** Hourly Variation of Ozone (O₃) at JPMC and NICH Karachi

![Graph of Ozone Concentration](image)

**Particulate Matter:** Particulate matter (PM) is a solid matter from smoke, dust, fly ash, or condensing vapours that can remain suspended in the air for a long period of time. PM₁₀ means the particulate matter is having an aerodynamic diameter of 10 micrometres while PM₂.₅ means the particulate matter is having an aerodynamic diameter of 2.5 micrometres or less. Particulates include an array of atmospheric materials, carbon-based matter such as soot, ashes, windblown dirt, sand, soil dust, metals, and plant matter such as pollens. The composition of particulate matter varies with the place, season and weather conditions.

The fine PM can be sulfates, nitrates, organic matter (organic carbon compounds), elemental carbon (soot), and soil dust (crustal materials).

The time-averaged (24h) concentration of SPM is 370 µg/m³ and PM₁₀ is 112.8 µg/m³ and were in compliance with the SEQS limit 500 µg/m³ and 150 µg/m³ respectively. However, the averaged concentration of PM₂.₅ is 59.3 which is also below the SEQs limit (75 µg/m³).

**Carbon monoxide (CO):** Carbon monoxide is an odourless, colourless and highly poisonous gas that has its major origin in the incomplete combustion of carbonaceous materials. Although industrial processes contribute to CO pollution levels, however, the principal source of CO is automobiles.
Vehicles operating at colder temperatures (in winter, during engine warm-up or in stop-and-go traffic) produce significant quantities of this deadly gas and is of particular concern in urban areas.

The Carbon monoxide (CO) concentration was monitored for 24h at the selected site. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be 1.69 mg/m³ which is within the SEQS (i.e. 5mg/m³) and is presented in Figure 5.7.

**Figure 5.7: Hourly Variation of Carbon Monoxide (CO) at JPMC and NICH Karachi**

![Graph showing hourly variation of CO concentration](image)

**Lead (Pb):** Lead (Pb) is an elemental, heavy metal found naturally in the environment as well as in manufactured products. Lead can be released directly into the air, as suspended particles.

Historic major sources of lead air emissions were motor vehicles and industrial sources. Motor-vehicle emissions have been reduced by the phasing out of leaded gasoline, but the lead is still used in general-aviation gasoline for piston-engine aircraft. Lead that is emitted into the air can be inhaled or can be ingested, primarily through contact with contaminated soils or other surfaces.

The Lead (Pb) concentration was monitored for 24h at the selected site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration of Pb at the Project site was found to be 0.15 µg/m³ which is within the SEQS (i.e. 1.5 µg/m³).

**Noise Level Monitoring**

Ambient noise levels were also continuously recorded at the project site of JPMC near NICH, Karachi for 24 hours. The sound pressure level (dB) were frequency weighted on A-curve (dB (A)) and time weighted (dB (A) Leq) on an hourly basis.

Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison.
The average sound level was noted as 75 dB (A) for the 24 hours period. The SEQSs for noise at daytime in a commercial area is 65 dB (A).

This elevated noise levels can be associated with heavy traffic flowing in rush hours on the Rafiqi H J Road and other adjacent Roads and commercial activities near the hospital.

**The conclusion of ambient air quality and noise level monitoring**

The ambient air quality monitoring was carried out for 24h from August 17, 2018, 14:00 hrs to August 18, 2018, 13:00 hrs, were observed at the project site.

The time-averaged (24h) concentrations of SO$_2$, NO, NO$_2$, CO, O$_3$, Pb, SPM, PM$_{2.5}$ and PM$_{10}$ were found to be 8.7 µg/m$^3$, 11.65 µg/m$^3$, 21.37 µg/m$^3$, 1.69 mg/m$^3$, 12.28 µg/m$^3$, 0.15 µg/m$^3$, 370 µg/m$^3$, 59.3 µg/m$^3$, and 112.8 µg/m$^3$ respectively.

The SO$_2$, NO, NO$_2$, O$_3$, PM$_{10}$, CO concentrations meets the SEQS limits. A summary of ambient air quality and noise levels results are given in Table 5.11 below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Min.</th>
<th>Max.</th>
<th>Avg.</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m$^3$</td>
<td>40</td>
<td>37.3</td>
<td>3.3</td>
<td>11.65</td>
<td>NO, Analyzer</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO$_2$)</td>
<td>µg/m$^3$</td>
<td>80</td>
<td>1.1</td>
<td>47.7</td>
<td>21.37</td>
<td>NO, Analyzer</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m$^3$</td>
<td>5</td>
<td>1.2</td>
<td>2.2</td>
<td>1.69</td>
<td>NO, Analyzer</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO$_2$)</td>
<td>µg/m$^3$</td>
<td>120</td>
<td>3.3</td>
<td>15.9</td>
<td>8.7</td>
<td>NO, Analyzer</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O$_3$)</td>
<td>µg/m$^3$</td>
<td>130</td>
<td>5.1</td>
<td>18.1</td>
<td>12.28</td>
<td>NO, Analyzer</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM$_{2.5}$)</td>
<td>µg/m$^3$</td>
<td>75</td>
<td>59.3</td>
<td></td>
<td></td>
<td>PQ 200 BGI, USA</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM$_{10}$)</td>
<td>µg/m$^3$</td>
<td>150</td>
<td>112.8</td>
<td></td>
<td></td>
<td>Fine Dust Monitor</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m$^3$</td>
<td>500</td>
<td>370</td>
<td></td>
<td></td>
<td>High Volume Sampler</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Lead (Pb)</td>
<td>µg/m$^3$</td>
<td>1.5</td>
<td>0.15</td>
<td></td>
<td></td>
<td>High Volume Sampler/ ICPMS</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Noise</td>
<td>dB (A) Leq**</td>
<td>65***</td>
<td>75</td>
<td></td>
<td></td>
<td>Noise Meter</td>
<td></td>
</tr>
</tbody>
</table>

*SEQS: Sindh Environmental Quality Standards
**dB (A) Leq: Time weighed an average of the level of sound in decibel on a scale which is relatable to human hearing
***65: For daytime commercial Area

**5.3.2 Sindh Government Lyari General Hospital Karachi**

The Ambient Air Quality and Noise Level Monitoring were conducted for 24 hours at the project site of Sindh Government Lyari General Hospital Karachi.

The GPS coordinates of ambient air quality and noise level monitoring location are 24°52'17.77" North and 66°59'34.41" East. The ambient air quality and noise level monitoring were carried out by Sindh EPA approved laboratory Pakistan Space and Upper Atmosphere Research Commission (SPARCO) Environmental Laboratory.
The average ambient temperature, wind speed and relative humidity for 24h from August 16, 2018, 1300 hrs to August 17, 2018, 1200 hrs were observed to be 31.2 °C, 3.9 km/h and 62.9 % relative humidity respectively.

**Wind Speed**

The wind speed was observed at the project site for 24h from August 16, 2018, 1300 hrs to August 17, 2018, 1200 hrs. The wind rose diagram to indicate that around 46 % of the wind blew from West, 37% from South West direction and remaining in the South direction. The mean speed of wind on the project site was 3.93 kph.

The wind rose diagram of the monitoring site of the Sindh Government Lyari General Hospital Karachi is shown in Figure 5.8.

**Figure 5.8: Wind Rose Diagram for project site at Sindh Government Lyari General Hospital Karachi**

![](wind_rose.png)

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**Ambient Air Quality Monitoring**

**Sulphur dioxide (SO₂):** The 24h average concentration of SO₂ at the monitoring site was 6.62 ug/m³ which is in compliance with the SEQS (120 ug/m³) of Sindh.

The hourly variation graph shows that the concentration of SO₂ varies between 14.2 ug/m³ to 1.9 ug/m³ during 24 hrs monitoring.
Nitrogen dioxide (NO): The averaged (24h) concentration of NO (12.77 µg/m³) remained in compliance with SEQS (40 µg/m³) at the monitoring site.

The highest concentration (24.6 µg/m³) of NO was observed, and the lowest concentration of NO was 1.9 µg/m³.

Figure 5.10: Hourly Variation of Oxide of Nitrogen (as NO) at Sindh Government Lyari General Hospital Karachi
Nitrogen dioxide (NO$_2$): The primary sources of Nitrogen oxides (NO$_x$) are motor vehicles and thermal power generation. The averaged (24h) concentration of NO$_2$ (23.04 µg/m$^3$) remained within in compliance with SEQS (80 µg/m$^3$) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 47.9 µg/m$^3$ and the lowest concentration registered was 2.5 µg/m$^3$.

**Figure 5.11:** Hourly Variation of Oxide of Nitrogen (as NO$_2$) at Sindh Government Lyari General Hospital Karachi

Ozone (O$_3$): The averaged (24h) concentration of O$_3$ (13.9 µg/m$^3$) remained well within compliance limits of SEQS (130 µg/m$^3$) at the project site. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

The O$_3$ concentration varies from 5.7 µg/ m$^3$ to 22.6 µg/m$^3$. This figure shows the baseline concentration of O$_3$ in a relatively untouched area.

**Figure 5.12:** Hourly Variation of Ozone (O$_3$) at Sindh Government Lyari General Hospital Karachi
Particulate Matter: The time-averaged (24h) concentration of SPM is 364.5 \mu g/m^3 and PM_{10} is 116.2 \mu g/m^3 and were in compliance with the SEQS limit 500 \mu g/m^3 and 150 \mu g/m^3 respectively. However, the averaged concentration of PM_{2.5} is 47.9 which is also well below the SEQS limit (75 \mu g/m^3).

Carbon monoxide (CO): The Carbon monoxide (CO) concentration was monitored for 24h at the monitoring site. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be 2.01 mg/m^3 which is within the SEQS (i.e. 5mg/m^3) and is presented in Figure 5.13.

**Figure 5.13:** Hourly Variation of Carbon Monoxide (CO) at Sindh Government Lyari General Hospital Karachi

Lead (Pb): The Lead (Pb) concentration was monitored for 24h at the monitoring site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration of Pb at the Project site was found to be 0.11 \mu g/m^3 which is within the SEQS (i.e. 1.5 \mu g/m^3)

Noise Level Monitoring

Ambient noise levels were also continuously recorded at the project site of Sindh Government Lyari General Hospital Karachi for 24 hours. The sound pressure level (dB) were frequency weighted on A-curve (dB (A)) and time weighted (dB (A) L_{eq}) on an hourly basis.

Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison.

The average sound level was noted as 72 dB (A) for the 24 hours period. The SEQs for noise at daytime in a commercial area is 65 dB (A).

This elevated noise levels can be associated with heavy traffic flowing in rush hours on the Tannery Road and other adjacent Roads and commercial activities near the hospital. Overall the noise level exceeds the SEQ values at the project site.

The conclusion of ambient air quality and noise level monitoring
The ambient air quality monitoring was carried out for 24h from August 16, 2018, 13:00 hrs to August 17, 2018, 12:00 hrs, were observed at the project site.

The time-averaged (24h) concentrations of SO$_2$, NO, NO$_2$, CO, O$_3$, Pb, SPM, PM$_{2.5}$ and PM$_{10}$ were found to be 6.62 µg/m$^3$, 12.77 µg/m$^3$, 23.04 µg/m$^3$, 2.01 mg/m$^3$, 13.9 µg/m$^3$, 0.11 µg/m$^3$, 364.5 µg/m$^3$, 47.9 µg/m$^3$, and 116.2 µg/m$^3$ respectively.

The SO$_2$, NO, NO$_2$, O$_3$, SPM, PM$_{2.5}$, PM$_{10}$, CO concentrations meets the SEQS limits. Overall the noise level exceeds the SEQ values at the project site.

A summary of ambient air quality and noise levels results are given in Table 5.12 below:

### Table 5.12: Summary of Ambient Air Quality and Noise Results at Sindh Government Lyari General Hospital Karachi

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m$^3$</td>
<td>40</td>
<td>1.9</td>
<td>24.6</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO$_2$)</td>
<td>µg/m$^3$</td>
<td>80</td>
<td>2.5</td>
<td>47.9</td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m$^3$</td>
<td>5</td>
<td>1.1</td>
<td>3.2</td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO$_2$)</td>
<td>µg/m$^3$</td>
<td>120</td>
<td>1.9</td>
<td>14.2</td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O$_3$)</td>
<td>µg/m$^3$</td>
<td>130</td>
<td>5.7</td>
<td>22.6</td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM$_{2.5}$)</td>
<td>µg/m$^3$</td>
<td>75</td>
<td></td>
<td>47.9</td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM$_{10}$)</td>
<td>µg/m$^3$</td>
<td>150</td>
<td></td>
<td>116.2</td>
</tr>
<tr>
<td>8</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m$^3$</td>
<td>500</td>
<td></td>
<td>364.5</td>
</tr>
<tr>
<td>9</td>
<td>Lead (Pb)</td>
<td>µg/m$^3$</td>
<td>1.5</td>
<td></td>
<td>0.11</td>
</tr>
<tr>
<td>10</td>
<td>Noise</td>
<td>dBA (A Leq)*</td>
<td>65***</td>
<td>72</td>
<td></td>
</tr>
</tbody>
</table>

*SEQS: Sindh Environmental Quality Standards  
** dBA (A Leq): Time weighed an average of the level of sound in decibel on a scale which is relatable to human hearing  
*** 65: For daytime commercial Area

### 5.3.3 Dr Ruth Pfau Civil Hospital Karachi

The ambient air quality and noise level monitoring were carried out for 24 hours at the project site of Dr Ruth Pfau Civil Hospital, Karachi.

The GPS coordinates of ambient air quality and noise level monitoring location are 24°51'36.76" North, 67°0'36.80" East. The ambient air quality and noise level monitoring were carried out by Sindh EPA approved laboratory Health, Safety & Environment Consultant, Laboratories (HSE Services) (http://www.hse.com.pk).
The average ambient temperature, wind speed and relative humidity for 24h from September 4, 2018, 1000 hrs to September 5, 2018, 0900 hrs were observed to be 31 °C, 24 km/h and 75 % relative humidity respectively.

**Ambient Air Quality Monitoring**

**Sulphur dioxide (SO$_2$):** The 24h average concentration of SO$_2$ at the monitoring site was Below Detection Limit (BDL) which is in compliance with the SEQS (120 µg/m$^3$) of Sindh.

**Nitrogen dioxide (NO):** The averaged (24h) concentration of NO (38.5 µg/m$^3$) remained in compliance with SEQS (40 µg/m$^3$) at the monitoring site.

The highest concentration (49.50 µg/m$^3$) of NO was observed, and the lowest concentration of NO was 29.20 µg/m$^3$.

**Figure 5.14:** Hourly Variation of Oxide of Nitrogen (as NO) at Dr Ruth Pfau Civil Hospital Karachi

Nitrogen dioxide (NO$_2$): The primary sources of Nitrogen oxides (NO$_x$) are motor vehicles and thermal power generation. The averaged (24h) concentration of NO$_2$ (16.51 µg/m$^3$) remained within in compliance with SEQS (80 µg/m$^3$) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 61.2 µg/m$^3$ and the lowest concentration registered was 9.30 µg/m$^3$. 
**Figure 5.15:** Hourly Variation of Oxide of Nitrogen (as NO$_2$) at Dr Ruth Pfau Civil Hospital Karachi

![Graph showing hourly variation of NO$_2$ concentration](image)

**Ozone (O$_3$):** The averaged (24h) concentration of O$_3$ remained well within compliance limits of SEQS (130 µg/m$^3$) at the project site, and it was Below Detection Limit. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

**Particulate Matter:** The time-averaged (24h) concentration of SPM is 95.71 µg/m$^3$ and PM$_{10}$ is 72.16 µg/m$^3$ and were in compliance with the SEQS limit 500 µg/m$^3$ and 150 µg/m$^3$ respectively. Moreover, the averaged concentration of PM$_{2.5}$ is 23.99 which is also well below the SEQs limit (75 µg/m$^3$).

The SPM, PM$_{10}$ and PM$_{2.5}$ hourly variation in concentrations are shown in **Figure 5.16**, **Figure 5.17** and **Figure 5.18** respectively.

**Figure 5.16:** Hourly Variation of Suspended Particulate Matter (SPM) at Dr Ruth Pfau Civil Hospital Karachi

![Graph showing hourly variation of SPM concentration](image)
Figure 5.17: Hourly Variation of Respirable Particulate Matter (as PM$_{2.5}$) at Dr Ruth Pfau Civil Hospital Karachi

Carbon monoxide (CO): The Carbon monoxide (CO) concentration was monitored for 24h at the monitoring site. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be 0.21 mg/m$^3$ which is within the SEQS (i.e. 5 mg/m$^3$).
**Lead (Pb):** The Lead (Pb) concentration was monitored for 24h at the monitoring site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration of Pb at the Project site was found to be Below Detection Limit hence it is within the SEQS (i.e. 1.5 µg/m³).

The SO₂, NO, NO₂, O₃, SPM, PM₁₀, PM₂.₅, CO and Pb concentrations meet the SEQS limits.

Therefore, it is concluded that presently there is no air pollution at the project site. Proper plantation around the site will help to maintain the air quality of the area in future.

**Noise Level Monitoring**

Ambient noise levels were also continuously recorded at the project site of Dr Ruth Pfau Civil Hospital, Karachi for 24 hours. The sound pressure level (dB) were frequency weighted on A-curve (dB (A)) and time weighted (dB (A) Lₚₑq) on an hourly basis.

The 24-hour monitoring period for noise is divided into two periods, i.e. daytime hours (12h. 50m) and nighttime hours (11h. 10m). Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison.

The noise level data for daytime was 68.0 dB (A) and 48.98 dB (A) at night time. The average sound level was noted as 58.8 dB (A) for the 24 hours period. The SEQs for noise at daytime in a commercial area is 65 dB (A) and night time is 55 dB (A).

This elevated noise levels can be associated with heavy traffic flowing in rush hours on the adjacent Roads and commercial activities carrying around the project area.
Conclusion of ambient air quality and noise level monitoring

The ambient air quality monitoring was carried out for 24h from September 4, 2018, 1000 hrs to September 5, 2018, 0900 hrs, were observed at the project site.

The time-averaged (24h) concentrations of SO$_2$, NO, NO$_2$, CO, O$_3$, PM$_{2.5}$, PM$_{10}$ and Pb were found to be BDL, 38.5 µg/m$^3$, 16.51 µg/m$^3$, 0.216, BDL, 23.99 µg/m$^3$, 72.19 µg/m$^3$, 95.71 µg/m$^3$ and BDL respectively.

The SO$_2$, NO, NO$_2$, CO, O$_3$, PM$_{2.5}$, PM$_{10}$ and Pb concentrations meets the SEQS limits. A summary of ambient air quality and noise levels results are given in Table 5.13 below:

Table 5.13: Summary of Ambient Air Quality and Noise Results at Dr Ruth Pfau Civil Hospital Karachi

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m$^3$</td>
<td>40</td>
<td>38.5</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO$_2$)</td>
<td>µg/m$^3$</td>
<td>80</td>
<td>16.51</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m$^3$</td>
<td>5</td>
<td>0.216</td>
<td>ASTM D3162-12</td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO$_2$)</td>
<td>µg/m$^3$</td>
<td>120</td>
<td>BDL</td>
<td>ASTM D-2914</td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O$_3$)</td>
<td>µg/m$^3$</td>
<td>130</td>
<td>BDL</td>
<td>ASTM-3608</td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM$_{2.5}$)</td>
<td>µg/m$^3$</td>
<td>75</td>
<td>23.99</td>
<td>RFPS-0316-232</td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM$_{10}$)</td>
<td>µg/m$^3$</td>
<td>150</td>
<td>72.19</td>
<td>RFPS-0706-162</td>
</tr>
</tbody>
</table>
No. | Parameters | Unit | SEQS* | Results | Method/Instrument |
--- | --- | --- | --- | --- | --- |
8 | Suspended Particulate Matter (SPM) | µg/m³ | 500 | 95.71 | ASTM-D 3685 |
9 | Lead (Pb) | µg/m³ | 1.5 | BDL*** | By Dragger Tube |
10 | Noise | dB (A) Leq** | 65 (Day) | 68.0 | STM E-1124 |
11 | Noise | dB (A) Leq** | 55 (Night) | 48.98 | STM E-1124 |

*SEQS: Sindh Environmental Quality Standards  
** dB (A) Leq: Time weighed an average of the level of sound in decibel on a scale which is relatable to human hearing  
***BDL: Below Detection Limit

5.3.4 Liaquat University Hospital, Jamshoro

The noise level monitoring was conducted for 24 hours at the project site of Liaquat University Hospital Jamshoro.

The GPS coordinates of ambient air quality and noise level monitoring location are 25°25'56.23" North and 68°16'19.57" East. The ambient air quality and noise level monitoring were carried out by Sindh EPA approved laboratory Health, Safety & Environment Consultant, Laboratories (HSE Services) (http://www.hse.com.pk).

The average ambient temperature, wind speed and relative humidity for 24h from August 28, 2018, 1230 hrs to August 29, 2018, 1130 hrs were observed to be 34 °C, 16.38 km/h and 55% relative humidity respectively.

Wind Speed:

The wind speed was an observer at the project site for 24h from August 17, 2018, 1400 hrs to August 18, 2018, 1300 hrs. The wind rose diagram shows that wind direction is mostly from South-Southwest Direction and the mean speed is 16.38 kph.

The wind rose diagram for of the monitoring site at Liaquat University Medical Hospital, Jamshoro is shown in Figure 5.21.
Figure 5.21: Wind Rose Diagram for project site at LUMHS, Jamshoro

Ambient Air Quality Monitoring

Sulphur dioxide (SO₂): The 24h average concentration of SO₂ at the monitoring site was 9.27 μg/m³ which is in compliance with the SEQS (120 μg/m³) of Sindh.

The hourly variation graph shows that the concentration of SO₂ varies between 17.90 μg/m³ to Below Detection Limit (BDL) for 24 hrs. monitoring.
**Figure 5.22: Hourly Variation of Sulphur dioxide (SO\textsubscript{2}) at Liaquat University Medical Hospital, Jamshoro**

Nitrogen dioxide (NO): The averaged (24h) concentration of NO (33.53 µg/m\textsuperscript{3}) remained in compliance with SEQS (40 µg/m\textsuperscript{3}) at the monitoring site.

The highest concentration (39.10 µg/m\textsuperscript{3}) of NO was observed at 0330 h. The lowest concentration of NO was (29.10 µg/m\textsuperscript{3}) at 0730 h.

**Figure 5.23: Hourly Variation of Oxide of Nitrogen (as NO) at Liaquat University Medical Hospital, Jamshoro**

Nitrogen dioxide (NO\textsubscript{2}): The averaged (24h) concentration of NO\textsubscript{2} (24 µg/m\textsuperscript{3}) remained within in compliance with SEQS (80 µg/m\textsuperscript{3}) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 27.70 µg/m\textsuperscript{3} and the lowest concentration registered was 21.50 µg/m\textsuperscript{3}.
**Figure 5.24**: Hourly Variation of Oxide of Nitrogen (as NO₂) at Liaquat University Medical Hospital, Jamshoro

**Figure 5.25**: Hourly Variation of Suspended Particulate Matter (SPM) at Liaquat University Medical Hospital, Jamshoro

Ozone (O₃): The averaged (24h) concentration of O₃ remained well within compliance limits of SEQS (130 µg/m³) at the project site and remained Below Detection Limit and was not even detectable. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

Particulate Matter: The time-averaged (24h) concentration of SPM is 123.6 µg/m³, PM₁₀ is 91 µg/m³ and PM₂.₅ is 32.5 µg/m³ and were in compliance with the SEQS limit 500 µg/m³, 150 µg/m³ and 35 µg/m³ respectively.

The SPM, PM₁₀ and PM₂.₅ hourly variation in concentrations are shown in **Figure 5.25**, **Figure 5.26** and **Figure 5.27** respectively.
Figure 5.26: Hourly Variation of Respirable Particulate Matter (as PM$_{2.5}$) at Liaquat University Medical Hospital, Jamshoro

![PM$_{2.5}$ Concentration](image)

Figure 5.27: Hourly Variation of Respirable Particulate Matter (as PM$_{10}$) at Liaquat University Medical Hospital, Jamshoro

![PM$_{10}$ Concentration](image)

Carbon monoxide (CO): The Carbon monoxide (CO) concentration was monitored for 24h at the monitoring site and most of the time remained below the detection limit. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be 0.49 mg/m$^3$ which is within the SEQS (i.e. 5mg/m$^3$) and is presented in Figure 5.28.
Figure 5.28: Hourly Variation of Carbon Monoxide (CO) at Liaquat University Medical Hospital, Jamshoro

Lead (Pb): The Lead (Pb) concentration was monitored for 24h at the monitoring site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration of Pb at the Project site was found to be Below Detection Limit hence it is within the SEQS (i.e. 1.5 µg/m³)

The SO₂, NO, NO₂, O₃, Pb, SPM, PM₁₀, and CO concentrations meet the SEQS limits. The PM₂.₅ concentration which is exceeding the permissible limit can be reduced by dust control from the unpaved path and by paving it during the construction of the new incinerator.

Therefore, it is concluded that presently there is no air pollution at the project site. Proper plantation around the site will help to maintain the air quality of the area in future.

Noise Level Monitoring

The 24-hour monitoring period for noise is divided into two periods, i.e. daytime hours (12h.50 m) and nighttime hours (11h.10m). Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison.

The noise level data for daytime was 67.4 dB (A) and 48.8 dB (A) at night time. The average sound level was noted as 59.3 dB (A) for the 24 hours period. The SEQs for noise at daytime in a commercial area is 65 dB (A) and night time is 55 dB (A).

This elevated noise levels in daytime can be associated with heavy traffic flowing in rush hours on the adjacent Roads and the commercial activities being carrying on near the project area.
Conclusion of ambient air quality and noise level monitoring

The ambient air quality monitoring was carried out for 24h from February 23, 2018, 15:30 hrs to February 24, 2018, 14:52 hrs, were observed at the project site.

The time-averaged (24h) concentrations of SO₂, NO, NO₂, CO, Pb, O₃, PM₂.5 and PM₁₀ were found to be 9.27 µg/m³, 33.53 µg/m³, 24 µg/m³, 0.49 mg/m³, BDL, BDL, 32.5 µg/m³, 91 µg/m³ and 123.6 µg/m³ respectively.

The SO₂, NO, NO₂, CO, O₃, PM₂.5, PM₁₀ and Pb concentrations meets the SEQS limits. A summary of ambient air quality and noise levels results are given in Table 5.14 below:

Table 5.14: Summary of Ambient Air Quality and Noise Results at Liaquat University Medical Hospital, Jamshoro, Incinerator Installation Site

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m³</td>
<td>40</td>
<td>333.53</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO₂)</td>
<td>µg/m³</td>
<td>80</td>
<td>24</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m³</td>
<td>5</td>
<td>0.49</td>
<td>ASTM D3162-12</td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO₂)</td>
<td>µg/m³</td>
<td>120</td>
<td>9.27</td>
<td>ASTM D-2914</td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O₃)</td>
<td>µg/m³</td>
<td>130</td>
<td>BDL</td>
<td>ASTM-3608</td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM₂.5)</td>
<td>µg/m³</td>
<td>75</td>
<td>32.5</td>
<td>RFPS-0316-232</td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM₁₀)</td>
<td>µg/m³</td>
<td>150</td>
<td>91</td>
<td>RFPS-0706-162</td>
</tr>
<tr>
<td>8</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m³</td>
<td>500</td>
<td>123.6</td>
<td>ASTM-D 3685</td>
</tr>
<tr>
<td>9</td>
<td>Lead (Pb)</td>
<td>µg/m³</td>
<td>1.5</td>
<td>BDI***</td>
<td>By Dragger Tube</td>
</tr>
</tbody>
</table>
5.3.5 Chandka Medical College Hospital Larkana

The ambient air quality and noise level monitoring were conducted for 24 hours at the project site of Chandka Medical College Hospital Larkana.

The GPS coordinates of ambient air quality and noise level monitoring location are 27°33’18.42” North and 68°12’33.20” East. The ambient air quality and noise level monitoring were carried out by Sindh EPA approved laboratory Health, Safety & Environment Consultant, Laboratories (HSE Services) (http://www.hse.com.pk).

The average ambient temperature, wind speed and relative humidity for 24h from August 17, 2018, 1800 hrs to August 18, 2018, 1700 hrs were observed to be 34 °C, 5.5 km/h and 68 % relative humidity respectively.

Wind Speed:

The wind speed was observed at the project site for 24h from August 17, 2018, 1400 hrs to August 18, 2018, 1300 hrs. The wind rose diagram shows the wind direction at the project site for 24 hrs. Predominately, the wind blew from South West and South East direction. The mean speed of wind was 5.50 kph.

The wind rose diagram of the monitoring site at Chandka Medical College Hospital Larkana is shown in Figure 5.30.

Figure 5.30: Wind Rose Diagram for project site at CMCH, Larakana
Ambient Air Quality Monitoring

Sulphur dioxide (SO$_2$): The 24h average concentration of SO$_2$ at the monitoring site was Below Detection Limit (BDL) which is in compliance with the SEQS (120 µg/m$^3$) of Sindh.

Nitrogen dioxide (NO): The averaged (24h) concentration of NO (33.59 µg/m$^3$) remained in compliance with SEQS (40 µg/m$^3$) at the monitoring site.

The highest concentration (39.10 µg/m$^3$) of NO was observed, and the lowest concentration of NO was 29.10 µg/m$^3$.

**Figure 5.31:** Hourly Variation of Oxide of Nitrogen (as NO) at Chandka Medical College Hospital Larkana

Nitrogen dioxide (NO$_2$): The primary sources of Nitrogen oxides (NO$_x$) are motor vehicles and thermal power generation. The averaged (24h) concentration of NO$_2$ (1.72 µg/m$^3$) remained within in compliance with SEQS (80 µg/m$^3$) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 2.10 µg/m$^3$ and the lowest concentration registered was 1.30 µg/m$^3$. 
Ozone ($O_3$): The averaged (24h) concentration of $O_3$ remained well within compliance limits of SEQS (130 $\mu$g/m$^3$) at the project site, and it was Below Detection Limit. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

Particulate Matter: The time-averaged (24h) concentration of SPM is 58.64 $\mu$g/m$^3$ and PM$_{10}$ is 37.75 $\mu$g/m$^3$ and were in compliance with the SEQS limit 500 $\mu$g/m$^3$ and 150 $\mu$g/m$^3$ respectively. However, the averaged concentration of PM$_{2.5}$ is 20.93 $\mu$g/m$^3$ which is also well below the SEQS limit (75 $\mu$g/m$^3$).

The SPM, PM$_{10}$ and PM$_{2.5}$ hourly variation in concentrations are shown in Figure 5.33, Figure 5.34 and Figure 5.35 respectively.
Figure 5.34: Hourly Variation of Respirable Particulate Matter (as PM$_{2.5}$) at Chandka Medical College Hospital Larkana

![Graph showing PM$_{2.5}$ concentration over 24 hours.]

Figure 5.35: Hourly Variation of Respirable Particulate Matter (as PM$_{10}$) at Chandka Medical College Hospital Larkana

![Graph showing PM$_{10}$ concentration over 24 hours.]

Carbon monoxide (CO): The Carbon monoxide (CO) concentration was monitored for 24h at the monitoring site. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be Below Detection Limit which is within the SEQS (i.e. 5mg/m$^3$).

Lead (Pb): The Lead (Pb) concentration was monitored for 24h at the monitoring site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration...
of Pb at the Project site was found to be Below Detection Limit hence it is within the SEQS (i.e. 1.5 µg/m³)

**Noise Level Monitoring**

Ambient noise levels were also continuously recorded at the project site of Chandka Medical College Hospital Larkana for 24 hours. The sound pressure level (dB) were frequency weighted on A-curve (dB (A)) and time weighted (dB (A) \( L_{eq} \)) on an hourly basis.

The 24-hour monitoring period for noise is divided into two periods, i.e. daytime hours (12h. 50m) and nighttime hours (11h. 10m). Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison.

The noise level data for daytime was 68.2 dB (A) and 46.6 dB (A) at night time. The average sound level was noted as 57.8 dB (A) for the 24 hours period. The SEQs for noise at daytime in a commercial area is 65 dB (A) and night time is 55 dB (A).

This elevated noise levels can be associated with heavy traffic flowing in rush hours on the adjacent Roads and the commercial activities carrying out in the project area.

![Figure 5.36: Hourly Noise Variations at Installation of incinerator Project at Chandka Medical College Hospital Larkana](image)

**Conclusion of ambient air quality and noise level monitoring**

The ambient air quality monitoring was carried out for 24h from August 16th, 2018, from 1600 hrs to August 17th, 2018, 1500 hrs, were observed at the project site.

The time-averaged (24h) concentrations of \( \text{SO}_2 \), \( \text{NO} \), \( \text{NO}_2 \), \( \text{CO} \), \( \text{O}_3 \), \( \text{PM}_{2.5} \), \( \text{PM}_{10} \) and Pb were found to be BDL, 33.59 µg/m³, 1.72 µg/m³, BDL, 459.5 ppm, BDL, 20.93 µg/m³, 37.75 µg/m³, 58.64 µg/m³ and BDL respectively.

The \( \text{SO}_2 \), \( \text{NO} \), \( \text{NO}_2 \), \( \text{CO} \), \( \text{O}_3 \), SPM, \( \text{PM}_{2.5} \), \( \text{PM}_{10} \) and Pb concentrations meets the SEQS limits. A summary of ambient air quality and noise levels results are given in Table 5.15 below:
Table 5.15: Summary of Ambient Air Quality and Noise Results at Chandka Medical College Hospital Larkana

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m³</td>
<td>40</td>
<td>33.59</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO₂)</td>
<td>µg/m³</td>
<td>80</td>
<td>1.72</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m³</td>
<td>5</td>
<td>BDL</td>
<td>ASTM D3162-12</td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO₂)</td>
<td>µg/m³</td>
<td>120</td>
<td>BDL</td>
<td>ASTM D-2914</td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O₃)</td>
<td>µg/m³</td>
<td>130</td>
<td>BDL</td>
<td>ASTM-3608</td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM₂.₅)</td>
<td>µg/m³</td>
<td>75</td>
<td>20.93</td>
<td>RFPS-0316-232</td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM₁₀)</td>
<td>µg/m³</td>
<td>150</td>
<td>37.75</td>
<td>RFPS-0706-162</td>
</tr>
<tr>
<td>8</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m³</td>
<td>500</td>
<td>58.64</td>
<td>ASTM-D 3685</td>
</tr>
<tr>
<td>9</td>
<td>Lead (Pb)</td>
<td>µg/m³</td>
<td>1.5</td>
<td>BDI***</td>
<td>By Dragger Tube</td>
</tr>
<tr>
<td>10</td>
<td>Noise</td>
<td>dB (A) Leq**</td>
<td>65 (Day)</td>
<td>68.2</td>
<td>STM E-1124</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*SEQS: Sindh Environmental Quality Standards

**dB (A) Leq: Time weighed an average of the level of sound in decibel on a scale which is relatable to human hearing

***BDI: Below Detection Limit

5.3.6 Ghulam Muhammad Mahar Medical College Hospital, Sukkur

The ambient air quality and noise level monitoring were conducted for 24 hours at the project site of Ghulam Muhammad Mahar Medical College Hospital Sukkur.

The GPS coordinates of ambient air quality and noise level monitoring location are 27°42'6.01" North and 68°52'34.82" East. The ambient air quality and noise level monitoring were carried out by EPA approved laboratory Health, Safety & Environment Consultant, Laboratories (HSE Services) (http://www.hse.com.pk).

The average ambient temperature, wind speed and relative humidity for 24h from August 17, 2018, 1800 hrs to August 18, 2018, 1700 hrs were observed to be 33 °C, 13.38 km/h and 67 % relative humidity respectively.

**Wind Speed**: The wind speed was an observer at the project site for 24h from August 17, 2018, 1400 hrs to August 18, 2018, 1300 hrs. The wind rose diagram for of the monitoring site at GMMMCH, Sukkur is shown in Figure 5.37.
Figure 5.37: Wind Rose Diagram for project site at GMMCH, Sukkur

![Wind Rose Diagram](attachment:image.png)

**Ambient Air Quality Monitoring**

**Sulphur dioxide (SO$_2$):** The 24h average concentration of SO$_2$ at the monitoring site was Below Detection Limit (BDL) which is in compliance with the SEQS (120 µg/m$^3$) of Sindh.

**Nitrogen dioxide (NO):** The averaged (24h) concentration of NO (35.95 µg/m$^3$) remained in compliance with SEQS (40 µg/m$^3$) at the monitoring site.

The highest concentration (39.20 µg/m$^3$) of NO was observed, and the lowest concentration of NO was 30.20 µg/m$^3$. 
Nitrogen dioxide (NO₂): The averaged (24h) concentration of NO₂ (1.54 µg/m³) remained within in compliance with SEQS (80 µg/m³) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 1.90 µg/m³ and the lowest concentration registered was 1.10 µg/m³.

Ozone (O₃): The averaged (24h) concentration of O₃ remained well within compliance limits of SEQS (130 µg/m³) at the project site, and it was Below Detection Limit. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

Particulate Matter: The time-averaged (24h) concentration of SPM is 63.37 µg/m³ and PM₁₀ is 45.72 µg/m³ and were in compliance with the SEQS limit 500 µg/m³ and 150 µg/m³
respectively. However, the averaged concentration of PM$_{2.5}$ is 17.65 which is also well below the SEQs limit (75 $\mu g/m^3$).

The SPM, PM$_{10}$ and PM$_{2.5}$ hourly variation in concentrations are shown in Figure 5.40, Figure 5.41 and Figure 5.42 respectively.

**Figure 5.40:** Hourly Variation of Suspended Particulate Matter (SPM) at GMMCH, Sukkur

![SPM Concentration Graph](image)

**Figure 5.41:** Hourly Variation of Respirable Particulate Matter (as PM$_{2.5}$) at GMMCH, Sukkur

![PM$_{2.5}$ Concentration Graph](image)
**Carbon monoxide (CO):** The Carbon monoxide (CO) concentration was monitored for 24h at the monitoring site. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be Below Detection Limit which is within the SEQS (i.e. 5mg/m³).

**Lead (Pb):** The Lead (Pb) concentration was monitored for 24h at the monitoring site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration of Pb at the Project site was found to be Below Detection Limit hence it is within the SEQS (i.e. 1.5 ug/m³)

**Noise Level Monitoring**

The noise level data for daytime was 67.9 dB (A) and 45.05 dB (A) at night time. The average sound level was noted as 56.17 dB (A) for the 24 hours period. The SEQs for noise at daytime in a commercial area is 65 dB (A) and night time is 55 dB (A).

This elevated noise levels at daytime can be associated with heavy traffic flowing in rush hours on the adjacent Road and the commercial activities carrying on near the project area.

**Figure 5.42:** Hourly Variation of Respirable Particulate Matter (as PM₁₀) at GMMMCH, Sukkur

![Graph showing PM₁₀ Concentration](image-url)
Conclusion of ambient air quality and noise level monitoring

The ambient air quality monitoring was carried out for 24h from August 16, 2018, 1600 hrs to August 17, 2018, 1500 hrs, were observed at the project site.

The time-averaged (24h) concentrations of SO$_2$, NO, NO$_2$, CO, O$_3$, PM$_{2.5}$, PM$_{10}$ and Pb were found to be BDL, 35.95 µg/m$^3$, 1.54 µg/m$^3$, BDL, 462.45 ppm, BDL, 17.65 µg/m$^3$, 45.72 µg/m$^3$, 63.37 µg/m$^3$ and BDL respectively.

The SO$_2$, NO, NO$_2$, O$_3$, SPM, PM$_{10}$, PM$_{2.5}$, CO, CO$_2$ and Pb concentrations meet the SEQS limits. Therefore, it is concluded that presently there is no air pollution at the project site. Proper plantation around the site will help to maintain the air quality of the area in future.

A summary of ambient air quality and noise levels results are given in Table 5.16 below:

**Table 5.16: Summary of Ambient Air Quality and Noise Results at the GMMMCH, Sukkur**

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m$^3$</td>
<td>40</td>
<td>33.95</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO$_2$)</td>
<td>µg/m$^3$</td>
<td>80</td>
<td>1.54</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m$^3$</td>
<td>5</td>
<td>BDL</td>
<td>ASTM D3162-12</td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO$_2$)</td>
<td>µg/m$^3$</td>
<td>120</td>
<td>BDL</td>
<td>ASTM D-2914</td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O$_3$)</td>
<td>µg/m$^3$</td>
<td>130</td>
<td>BDL</td>
<td>ASTM-3608</td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM$_{2.5}$)</td>
<td>µg/m$^3$</td>
<td>75</td>
<td>17.65</td>
<td>RFPS-0316-232</td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM$_{10}$)</td>
<td>µg/m$^3$</td>
<td>150</td>
<td>45.72</td>
<td>RFPS-0706-162</td>
</tr>
<tr>
<td>8</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m$^3$</td>
<td>500</td>
<td>63.37</td>
<td>ASTM-D 3685</td>
</tr>
</tbody>
</table>

Figure 5.43: Hourly Noise Variations at Installation of the incinerator, GMMMCH, Sukkur
### People Medical College Hospital Shaheed Benazirabad

The ambient air quality and noise level monitoring were conducted for 24 hours at the project site of People Medical College Hospital Shaheed Benazirabad.

The ambient air quality and noise level monitoring were carried out by Sindh EPA approved laboratory Health, Safety & Environment Consultant, Laboratories (HSE Services) (http://www.hse.com.pk).

The average ambient temperature, wind speed and relative humidity for 24h from August 16, 2018, 1600 hrs. to August 17, 2018, 1500 hrs. were observed to be 35 °C, 3.46 km/h and 68% relative humidity respectively.

**Wind Speed:** The wind speed was an observer at the project site for 24h from August 17, 2018, 1400 hrs to August 18, 2018, 1300 hrs. The wind rose diagram for of the monitoring site at People Medical College Hospital Shaheed Benazirabad is shown in **Figure 5.44.**

**Figure 5.44:** Wind Rose Diagram for wind at People Medical College Hospital Shaheed Benazirabad

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Lead (Pb)</td>
<td>µg/m³</td>
<td>1.5</td>
<td>BDL***</td>
<td>By Dragger Tube</td>
</tr>
<tr>
<td>10</td>
<td>Noise</td>
<td>dB (A) Leq**</td>
<td>65 (day)</td>
<td>67.9</td>
<td>STM E-1124</td>
</tr>
<tr>
<td>11</td>
<td>Noise</td>
<td>dB (A) Leq**</td>
<td>55 (Night)</td>
<td>45.05</td>
<td>STM E-1124</td>
</tr>
</tbody>
</table>

*SEQS: Sindh Environmental Quality Standards  
**dB (A) Leq: Time weighed an average of the level of sound in decibel on a scale which is relatable to human hearing  
***BDL: Below Detection Limit
The wind rose diagram depicts over 54% of the wind blew from South West Direction, 29% from the South East direction and less than 10 % in East and South East direction. The mean speed of the wind at the project site was 3.46 kph for 24 hours.

**Ambient Air Quality Monitoring**

Sulphur dioxide (SO\textsubscript{2}): The 24h average concentration of SO\textsubscript{2} at the monitoring site was Below Detection Limit (BDL) which is in compliance with the SEQS (120 µg/m\textsuperscript{3}) of Sindh.

Nitrogen dioxide (NO): The averaged (24h) concentration of NO (35.98 µg/m\textsuperscript{3}) remained in compliance with SEQS (40 µg/m\textsuperscript{3}) at the monitoring site.

The highest concentration (39.1 µg/m\textsuperscript{3}) of NO was observed at 1500 h. The lowest concentration of NO was (29.40 µg/m\textsuperscript{3}) at 1900 h.

**Figure 5.45:** Hourly Variation of Oxide of Nitrogen (as NO) at People Medical College Hospital Shaheed Benazirabad

[Graph showing hourly variation of NO concentration]

Nitrogen dioxide (NO\textsubscript{2}): The averaged (24h) concentration of NO\textsubscript{2} (1.59 µg/m\textsuperscript{3}) remained within in compliance with SEQS (80 µg/m\textsuperscript{3}) at the monitoring site.

The highest hourly average concentration of Nitrogen dioxide was 2.1 µg/m\textsuperscript{3} and the lowest concentration registered was 1.2 µg/m\textsuperscript{3}. 
Figure 5.46: Hourly Variation of Oxide of Nitrogen (as NO₂) at People Medical College Hospital Shaheed Benazirabad

![Graph showing hourly variation of NO₂ concentration](image)

Ozone (O₃): The averaged (24h) concentration of O₃ remained well within compliance limits of SEQS (130 µg/m³) at the project site and was Below Detection Limit. Ozone is formed indirectly by the action of sunlight on nitrogen dioxide.

Particulate Matter: The time-averaged (24h) concentration of SPM is 62.5 µg/m³ and PM₁₀ is 44.97 µg/m³ and PM₂.₅ 17.56 were in compliance with the SEQS limit 500 µg/m³, 150 µg/m³ and b 35 µg/m³ respectively.

The SPM, PM₁₀ and PM₂.₅ hourly variation in concentrations are shown in Figure 5.47, Figure 5.48 and Figure 5.49 respectively.

Figure 5.47: Hourly Variation of Suspended Particulate Matter (SPM) at People Medical College Hospital Shaheed Benazirabad

![Graph showing hourly variation of SPM concentration](image)
**Figure 5.48:** Hourly Variation of Respirable Particulate Matter (as PM$_{2.5}$) at People Medical College Hospital Shaheed Benazirabad

![PM$_{2.5}$ Concentration Graph](image)

**Figure 5.49:** Hourly Variation of Respirable Particulate Matter (as PM10) at People Medical College Hospital Shaheed Benazirabad

![PM10 Concentration Graph](image)

Carbon monoxide (CO): The Carbon monoxide (CO) concentration was monitored for 24h at the monitoring site. The 24h averaged value of CO was compared with SEQS for ambient air. The averaged concentration of CO at the Project site was found to be Below Detection Limit which is within the SEQS (i.e. 5mg/m$^3$).
Lead (Pb): The Lead (Pb) concentration was monitored for 24h at the monitoring site. The 24h averaged value of Pb was compared with SEQS for ambient air. The averaged concentration of Pb at the Project site was found to be Below Detection Limit hence it is within the SEQS (i.e. 1.5 ug/m³)

The SO₂, NO, NO₂, O₃, SPM, PM₁₀, PM₂.₅, CO, and Pb concentrations meet the SEQS limits. Therefore, it is concluded that presently there is no air pollution at the project site. Proper plantation around the site will help to maintain the air quality of the area in future.

**Noise Level Monitoring**

Ambient noise levels were also continuously recorded at the project site of People Medical College Hospital Shaheed Benazirabad for 24 hours. The sound pressure level (dB) were frequency weighted on A-curve (dB (A)) and time weighted (dB (A) Lₑq) on an hourly basis.

The 24-hour monitoring period for noise is divided into two periods, i.e. daytime hours (12h. 50m) and nighttime hours (11h. 10m). Since the project site is located near a commercial area, therefore, commercial area zone standard of SEQS was followed for comparison.

The noise level data for daytime was 67.8 dB (A) and 45.01 dB (A) at night time. The average sound level was noted as 56.14 dB (A) for the 24 hours period. The SEQs for noise at daytime in a commercial area is 65 dB (A) and night time is 55 dB (A).

This elevated noise levels can be associated with heavy traffic flowing in rush hours on the adjacent Roads and commercial activities carrying around the project area.

**Figure 5.50:** Hourly Noise Variations at People Medical College Hospital Shaheed Benazirabad, at the project site
Conclusion of ambient air quality and noise level monitoring

The ambient air quality monitoring was carried out for 24h from August 16, 2018, 1600 hrs to August 17, 2018, 1500 hrs, were observed at the project site.

The time-averaged (24h) concentrations of SO\(_2\), NO, NO\(_2\), CO, O\(_3\), PM\(_{2.5}\), PM\(_{10}\) and Pb were found to be BDL, 35.98 µg/m\(^3\), 1.59 µg/m\(^3\), BDL, 440.2 ppm, BDL, 17.56 µg/m\(^3\), 44.97 µg/m\(^3\), 62.5 µg/m\(^3\) and BDL respectively.

The SO\(_2\), NO, NO\(_2\), CO, O\(_3\), SPM, PM\(_{2.5}\), PM\(_{10}\) and Pb concentrations meet the SEQS limits. A summary of ambient air quality and noise levels results are given in Table 5.17 below:

Table 5.17: Summary of Ambient Air Quality and Noise Results at People Medical College Hospital Shaheed Benazirabad

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS*</th>
<th>Results</th>
<th>Method/Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m(^3)</td>
<td>40</td>
<td>35.98</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxide (NO(_2))</td>
<td>µg/m(^3)</td>
<td>80</td>
<td>1.59</td>
<td>ASTM D-3608</td>
</tr>
<tr>
<td>3</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m(^3)</td>
<td>5</td>
<td>BDL</td>
<td>ASTM D3162-12</td>
</tr>
<tr>
<td>4</td>
<td>Sulphur Dioxide (SO(_2))</td>
<td>µg/m(^3)</td>
<td>120</td>
<td>BDL</td>
<td>ASTM D-2914</td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O(_3))</td>
<td>µg/m(^3)</td>
<td>130</td>
<td>BDL</td>
<td>ASTM-3608</td>
</tr>
<tr>
<td>6</td>
<td>Particulate Matter (PM(_{2.5}))</td>
<td>µg/m(^3)</td>
<td>75</td>
<td>17.56</td>
<td>RFPS-0316-232</td>
</tr>
<tr>
<td>7</td>
<td>Particulate Matter (PM(_{10}))</td>
<td>µg/m(^3)</td>
<td>150</td>
<td>44.97</td>
<td>RFPS-0706-162</td>
</tr>
<tr>
<td>8</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m(^3)</td>
<td>500</td>
<td>62.5</td>
<td>ASTM-D 3685</td>
</tr>
<tr>
<td>9</td>
<td>Lead (Pb)</td>
<td>µg/m(^3)</td>
<td>1.5</td>
<td>BDL***</td>
<td>By Dragger Tube</td>
</tr>
<tr>
<td>10</td>
<td>Noise</td>
<td>dB (A) Leq**</td>
<td>65 (Day)</td>
<td>67.8</td>
<td>STM E-1124</td>
</tr>
<tr>
<td>11</td>
<td>Noise</td>
<td>dB (A) Leq**</td>
<td>55 (Night)</td>
<td>47.01</td>
<td>STM E-1124</td>
</tr>
</tbody>
</table>

*SEQS: Sindh Environmental Quality Standards
** dB (A) Leq: Time weighed an average of the level of sound in decibel on a scale which is relatable to human hearing
***BDL: Below Detection Limit

5.4 Biological Environment

The proposed sites for installation of the incinerators are located in an already developed hospital in Karachi, Hyderabad, Shaheed Benazirabad, Larkana and Sukkur.

The buildings and other structures in the hospitals including power-lines are resting places for a number of birds. Except for those resting places, and old trees, there is hardly any place in the microenvironment where wildlife can prosper.

All the project sites are located in the highly urbanized modified environment. There are no endangered species in the project area of all the hospitals and surrounding areas. During the survey, less number of species were recorded.

All the hospitals have well-organized horticulture departments which look after the plantation within the hospitals.
The biological environment of all the 8 hospitals are described hereunder:

5.4.1  Jinnah Postgraduate Medical College/Sindh Government Lyari General Hospital /Dr Ruth Pfau Civil Hospital Karachi/National Institute of Child Health Karachi

Flora: Since the project sites are located in dense urban areas, the floral species are fewer in number and mostly anthropogenic.

### Table 5.18: Common Floral Species found in Karachi

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Common Name</th>
<th>Biological Name</th>
<th>Family</th>
<th>Life Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mesquite</td>
<td>Prosopis juliflora</td>
<td>Mimoasaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>2</td>
<td>Neem</td>
<td>Azadirachta indica</td>
<td>Meliaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>3</td>
<td>Bargad</td>
<td>Ziziphus jujuba</td>
<td>Rhamnaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>4</td>
<td>Date Palm</td>
<td>Phoenix datykierea</td>
<td>Arecaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>5</td>
<td>Sacred fig/Peepal</td>
<td>Ficus religiosa</td>
<td>Moraceae</td>
<td>Tree</td>
</tr>
<tr>
<td>6</td>
<td>Bengal fig/Banyan</td>
<td>Ficua Bengalensis</td>
<td>Moraceae</td>
<td>Tree</td>
</tr>
</tbody>
</table>

Fauna: A limited number of mammals, birds and reptiles were recorded form the project site during the field visit for the EIA study. The vertebrate fauna recorded during the study, none of the key species may be regarded as key species or species of interest. All species of birds, mammals and reptiles are not protected under the SWPO.

Birds: During the field visit, the presence of solely seven bird species were recorded from the projected site. All the recorded species were resident, and none of the migratory birds was keen-sighted within the project area. Out of those species, one is torrential whereas half dozen were common. None of the species is less common or rare. Out of the species, solely black kite (Milvus migrans) is protected under SWPO, whereas none of the other species is listed under the IUCN Red List or CMS. The Kite observed isn't the Milvus migrans that have been classified as vulnerable.

The species of Kite determined throughout the survey is the common species. Because of roosting/nesting places in high-rise buildings and other towers together with transmission lines and communication structures, the population of kites has grown in urban elements of Karachi. The fish harbour and Native jetty close to Karachi Port Trust, the slaughterhouses and poultry farm are their main feeding places from wherever they get their food.
Table 5.19: Bird Species in Project area, Karachi

<table>
<thead>
<tr>
<th>No.</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
<th>Occurrence</th>
<th>Listing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Migratory</td>
<td>Resident</td>
<td>Common</td>
</tr>
<tr>
<td>1</td>
<td>Black Kite</td>
<td>Milvus migrans</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Blue Rock Pigeon</td>
<td>Columba Livia</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>3</td>
<td>Common Myan</td>
<td>Acridotheres tristis</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Common Crow</td>
<td>Corvus splendens</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>House Sparrow</td>
<td>Passer domesticus</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Koel</td>
<td>Eudynamys scolopacea</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Red Vented Bulbul</td>
<td>Pynotus cafer</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

Mammals:
Due to urban activates within the built surroundings of the project area and its surroundings, there's hardly any chance for mammals to survive. However, rodent's species that have adopted such conditions are well established using hollow structures or maybe buildings as their nesting places. Presence of four vertebrate species was observed within the project area and its surroundings. These embody rodents and tree abode species. None of those species is of ecological or economic importance. However, these are a supply of food for raptors and domestic cats.

Protected Areas/National Sanctuaries: There are no protected areas near the proposed area in Karachi.

5.4.2 Liaquat University Medical Hospital, Jamshoro

Flora: The flora of an area depends upon soil and amount of the moisture available in the soil of the area. Hyderabad, being an alluvial plain, therefore plants suitable for an alluvial region are found in the project area.
Table 5.20: Floral Species at Liaquat University Medical Hospital, Jamshoro and Surroundings

<table>
<thead>
<tr>
<th>No.</th>
<th>Common Name</th>
<th>Biological Name</th>
<th>Family</th>
<th>Life Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Babul</td>
<td>Acacia arabica</td>
<td>Fabaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>2</td>
<td>Ber</td>
<td>Ziziphus nummularia</td>
<td>Rhamnaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>3</td>
<td>Plai</td>
<td>Tamarisk gallica</td>
<td>Tamaricaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>4</td>
<td>Neem</td>
<td>Azadirachta indica</td>
<td>Meliaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>5</td>
<td>Tamarind</td>
<td>Tamarindus indica</td>
<td>Fabaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>6</td>
<td>Sacred fig/Peeple</td>
<td>Ficus religiosa</td>
<td>Moraceae</td>
<td>Tree</td>
</tr>
</tbody>
</table>

Few ornamental flowers were also found in the project area during the ecological survey of the project surroundings.

Table 5.21: Floral Species at Liaquat University Medical Hospital, Jamshoro and Surroundings

<table>
<thead>
<tr>
<th>No.</th>
<th>Common Name</th>
<th>Biological Name</th>
<th>Family</th>
<th>Life Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rose</td>
<td>Rosa Damascena</td>
<td>Rosaceae</td>
<td>Flowering Plant</td>
</tr>
<tr>
<td>2</td>
<td>Jasmine</td>
<td>Jasminum officinale</td>
<td>Oleaceae</td>
<td>Flowering Plant</td>
</tr>
<tr>
<td>3</td>
<td>Tuberose</td>
<td>Polianthes tuberosa</td>
<td>Asparagaceae</td>
<td>Flowering Plant</td>
</tr>
</tbody>
</table>

Fauna: The existence of all forms of fauna primarily depends upon the vegetation available in the area. The constant and rapid colonisation has deprived the area of vegetation which has resulted in diminishing and/or vanishing the wildlife.

In the project area, there is no such wildlife seen as the project area is located in a well-developed area of the city. There are no mammals which are endangered or listed as rare.

Birds: In the project area, there are no such birds found due to a populated and commercial area near the project site. However, in Hyderabad surrounding there is a number of different bird species were found.

Among birds Partridge both black and grey are common in the forest plantation. Many varieties of waterfowl like a Buffet-backed heron, Indian reef heron and Mongolian sand Plover are also found in the region.

The common species which are also seen in the city environment are a little brown dove, Koel, House sparrow etc.

Protected Areas/National Sanctuaries: There are no protected areas near the proposed area.
5.4.3 Chandka Medical College Hospital Larkana

Flora: The project area is located in Larkana which is part of the lower Indus valley. As the climate of the track is arid, subtropical, the original flora of the area consists of tropical thorn forest type vegetation, in which thorny usually hard wooded species predominate, acacia species being particularly characteristic. However, the natural vegetation has long ago been replaced completely by agricultural crops. At present, there is generally a mixture of species found in the track. The area has been used for agricultural purposes for almost a century; the natural flora has been completely replaced by cultivated species.

The dominated floral species include Acacia modest, Acacia nilotica, Dalbergia sissoo, Ziziphus nummularia and plantations of Eucalyptus globulus and Populus indica. On the banks of streambeds, the Saccharum spontaneum, Typha latifolia and Cymbopogon jwarancusa were observed.

Moreover, the dwarf palm, Acacia Rupestris (kher), and Tecomella undulata (lohirro) trees are typical of the western hill region. Acacia nilotica (babul) is the most dominant and occurs in thick forests along the Indus banks. The Azadirachta indica (neem), Zizyphys vulgaris (bir), Tamarix orientalis (jujuba lai) and Capparis aphylla (kirir) are among the more common trees. Mango, date palms and the more recently introduced banana, guava, orange and chiku are the typical fruit-bearing trees.

Fauna: Larkana district was rich in wildlife only five decades back. The Himalayan black bear (Urus torquatus) was found on the heights of Khirthar range. One was shot near kute-ji-kiabar in 1902 by Mr. W.H Lucas, Collector of Larkana. The smallest of Indian wild sheep, the “Urial” (Ovis vignei) is also becoming rare having withdrawn to the protected area of Mahal-Kohistan. At present, hyaena (hyena striata), jackal (canis palipes) and the fox are almost the only ones left in the microenvironment of Larkana district.

Mammals: Naturally occurring mammals have also been eradicated with the removal of natural Tropical Thorn Forests only the agriculture associated species remain. Important mammals which are still in abundance in Larkana, i.e., jackals, dogs, Squirrel, Mouse, Fox and Porcupine.

Domestic livestock includes buffalo, cattle, goats and sheep. Donkeys are kept to pull carts in the area. Some farmers are also engaged in horse breeding. Camel may be found occasionally. Livestock is mainly farm fed. Goats and sheep herds may be raised by feeding on wastelands.

Birds: Among the bird’s eagle (Aquila rapax ridhiana), hawak (accipiter badius cenchrodies), kite (milvus migrans govinda), parrot (palornis torquata), partridge (fvalcolines pondicerarianus mecranesis) common crow (corvidae splendens) and several varieties of water-fowls are in abundance.

Due to urban activates within the built surroundings of the project area and its surroundings, there’s hardly any chance for mammals to survive. However, rodent’s species that have adopted such conditions are well established using hollow structures or maybe buildings as their nesting places.

These embody rodents and tree abode species. None of those species is of ecological or economic importance. However, these are a supply of food for raptors and domestic cats.

Protected Areas/National Sanctuaries: There are no protected areas near the proposed area.
5.4.4 Ghulam Muhammad Mahar Medical College Hospital Sukkur

Flora: Sukkur also has a large Riverine forest along the course of the Indus. These tropical forests are found within the protective embankments on either side of the Indus.

Moreover, other indigenous trees most suited in the area are Shisham, Kikar, Bakain, Dharek, Siris (Albizia procera), Farash, Sukh chain, Jaman, Bohar, Peepal (Ficus reliogosa), Gullahr (Ficus glomerata), Sohanjana (Moringa oleifera), and Wan (Salvadora oleoides).

Plants of Economic or Medicinal Value: A number of plant species having medicinal value are found in Sukkur. Most of these plants are naturally grown and are used by local people for the treatment of various ailments. Desmostachya bipinnat and Typha elephantina are commonly used by the locals.

Rare or Endemic Species: No endemic or rare plant species were recorded during the field visit. All species have a wide range of distribution in other ecological zones of the country, especially at other locations of Sindh province in general and in similar habitats of target district in particular.

Table 5.22: Floral Species at Ghulam Muhammad Mahar Medical College Hospital Sukkur

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Common Name</th>
<th>Biological Name</th>
<th>Life Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shisham</td>
<td>Dalbergia sissoo</td>
<td>Tree</td>
</tr>
<tr>
<td>2</td>
<td>Kikar</td>
<td>Vachellia karroo</td>
<td>Tree</td>
</tr>
<tr>
<td>3</td>
<td>Bakain</td>
<td>Melia azedarach</td>
<td>Tree</td>
</tr>
<tr>
<td>4</td>
<td>Dharek</td>
<td>Melia azedarach</td>
<td>Tree</td>
</tr>
<tr>
<td>5</td>
<td>Siris</td>
<td>Albizia procera</td>
<td>Tree</td>
</tr>
<tr>
<td>6</td>
<td>Farash</td>
<td>Tamarix aphylla</td>
<td>Tree</td>
</tr>
<tr>
<td>7</td>
<td>Sukh chain</td>
<td>Pongamia pinnata</td>
<td>Tree</td>
</tr>
<tr>
<td>8</td>
<td>Jaman</td>
<td>Syzygium cumini</td>
<td>Tree</td>
</tr>
<tr>
<td>9</td>
<td>Peepal</td>
<td>Ficus reliogosa</td>
<td>Tree</td>
</tr>
<tr>
<td>10</td>
<td>Gullahr</td>
<td>Ficus glomerata</td>
<td>Tree</td>
</tr>
<tr>
<td>11</td>
<td>Sohanjana</td>
<td>Moringa oleifera</td>
<td>Tree</td>
</tr>
<tr>
<td>12</td>
<td>Wan</td>
<td>Salvador oleoides</td>
<td>Tree</td>
</tr>
</tbody>
</table>

Fauna: The species which exist in various areas of Sukkur district are bank myna, little green bee-eater, white-cheeked bulbul, crested lark, pied bush chat, common babbler, house crow, common myna, house sparrow tiliar (starling), parrot, quail, pintail and hummingbird.

Fauna and flora are an essential part of the environments and depend on each other in many ways. Due to a mix of dry and vegetative land area, the flora of the area is not only scattered but also plentiful and is enriched with lush green crops. The fauna of the area comprises of mammals, reptiles and birds etc.

Due to urban activates within the built surroundings of the project area and its surroundings, there's hardly any chance for mammals to survive. However, rodent’s species that have adopted such conditions are well established using hollow structures or maybe buildings as
their nesting places. Presence of four vertebrate species was observed within the project area and its surroundings. These embody rodents and tree abode species. None of those species is of ecological or economic importance. However, these are a supply of food for raptors and domestic cats.

Protected Areas/National Sanctuaries: In Sukkur, there are several areas of land devoted to the preservation of biodiversity through the dedication of national parks and wildlife sanctuaries. There are no protected areas near the proposed area at Sukkur.

5.4.5 People Medical College Hospital Shaheed Benazirabad

Flora: A conspicuous feature is the number of gardens found in the Shaheed Benazirabad district. Considering the character of soil and climate of the district, flora cannot be of striving grandeur or beauty. The number of different kinds of grasses and other plants with low growth is considerable. But there are not more than half a dozen species of trees of spontaneous growth. Near the canals, there is a good deal of timber. Lai is found in the flooded land. Its twigs are used for making baskets, also for fences to fields and sides to houses. Kikar is not uncommon along the canals. Its timber is used for agricultural implements and as fuel too. Its seeds are eaten readily by goats. The bark is used in tanning an in the distillation of native spirits.

A shrub, the babul is occasionally seen. It never grows to size as would make its timber valuable. The Bar tree is not uncommon in the cultivated parts of the district. The wood is of good quality and is used in buildings. It yields a fine fuel throwing out a clear heat. Good walking sticks are also got from this tree.

Kandi is always a small tree, rough gnarled and met everywhere in the district, where it has not been cleared away. The wood is strong and is made into agricultural implements and household furniture. It is used as fuel and charcoal in prepared from it. The seed vessels known as Singari are also used as an article of food.

The Karil sometimes become a tree. It generally remains a mere shrub and found throughout the district. Its wood is hard and is used for rafters and lathis, principally on account of its supposed immunity from attacks of white ants. As a fuel, it has a high reputation. Its fruit known as Dena is eaten and is a great standby to the poor in seasons of scarcity. Certain trees are

<table>
<thead>
<tr>
<th>No.</th>
<th>Common Name</th>
<th>Biological Name</th>
<th>Family</th>
<th>Life Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tamarisk or Jhaun</td>
<td>Tamerix dioica</td>
<td>Tamaricaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>2</td>
<td>Villon poplar or Bahan</td>
<td>Populus euphratica</td>
<td>Salicaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>3</td>
<td>Babul</td>
<td>Acacia arabica</td>
<td>Fabaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>4</td>
<td>Pilu</td>
<td>Salvadora oleoides</td>
<td>Salvadoraceae</td>
<td>Tree</td>
</tr>
<tr>
<td>5</td>
<td>Siru</td>
<td>Dalbergia siso</td>
<td>Fabaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>6</td>
<td>Nim</td>
<td>Melia azadirachta</td>
<td>Meliaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>7</td>
<td>Acacia or Sisis</td>
<td>Acacia lebbek</td>
<td>Fabaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>8</td>
<td>Termerind or Imli</td>
<td>Tamarindus indica</td>
<td>Fabaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>9</td>
<td>Karil</td>
<td>Capparis aphylla</td>
<td>Capparaceae</td>
<td>Tree</td>
</tr>
<tr>
<td>10</td>
<td>Pipal</td>
<td>Ficus religioso</td>
<td>Moraceae</td>
<td>Tree</td>
</tr>
</tbody>
</table>
There are few plants other than trees and grasses deserving much notice. Sar is most important which is generally found in sandy soil. It is abundant along the river and distributing channels of canals. These are of two kinds, white-topped or red-topped or rather purple topped. The ropes made from the later are much inferior to those made from the former. Every portion of this Reed is used.

**Fauna:** With the exceptions of such humbles species as the Jackal, wild animals may now be said to almost non-existent. Hyenas and wolves are now hardly ever seen. Jackals are fairly common, and foxes are seen in the rapidly contracting area of dry waste. Hog deer are seen along the banks of the river Indus and Pig, though much diminished by the villagers in defense of their crops are still found in small numbers.

Benazirabad district offers a great attraction to sportsmen. Among birds, Titur is remarkable. Both grey and black partridges are very common in the forest plantation. Geese are also found, penetrating to the fields of green wheat and Kunj are also regular winter visitor. Sand grouse of more than of one kind visit the district in winter weather, but the expansion of cultivated area is driving them away. This applies even more to the houbara or tilur which was in former times quite common. Quail is found in the spring and autumn.

Fish of many kinds are caught in canals, particularly in deep pools that are left standing during a closure. The principal kind of fish is palla, dambhro, mori, mali and jheenga or gangat.

**Protected Areas/National Sanctuaries:** There are no protected areas near the proposed area.

**Pictorial Presentation of Flora Recorded During Field Visit**

*Exhibit 5.1:* Peepal Tree near the project site in JPMC

*Exhibit 5.2:* Neem Tree at JPMC Tree
Exhibit 5.3: Large Neem tree at Lyari General Hospital

Exhibit 5.4: Young Neem saplings plantation in Lyari General Hospital

Exhibit 5.5: Conacarpus Plantation near LUHS, Jamshoro

Exhibit 5.6: View of the vegetation features at the project site at LUHS, Jamshoro

Exhibit 5.7: Eucalyptus & Neem trees at Peoples Medical College Nawabshah

Exhibit 5.8: Dry Eucalyptus tree near Pediatric Ward
5.5 Socio-Cultural Environment

5.5.1 Jinnah Postgraduate Medical College and National Institute of Child Health Karachi

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Naval Officers Residential
Estate III and Railway Colony. Figure 5.51 shows the project area map and the main environmental receptor in 0.5 km radius in Karachi city.

Quality of Life Values: The quality of the life values of the project area is discussed below:
Figure 5.51: Project Area Map for Installation of Incinerator Project JPMC and NICH, Karachi

Legend
- JPMC (440 m)
- Incinerator Site
- JPMC, Karachi
- Karachi Environment (800 m)
- Naval Officers Residential Estate III
- Naval Highigh Mosque
- Project Area (0.5 km)
- Railway Line (350 m)
Naval Officers Residential Estate III

**Location:** Naval Officers Residential Estate III is located on the south side of the JPMC Hospital Karachi. It is accessible from Kala Pull Road, Korangi Road and Shahrah-e-Faisal Road.

**Demographics:** According to the locals in the project area an estimated 1500 to 2000 houses with an estimated population of 10,000 people.

**Transport/Communications:** Naval Officers Residential Estate III can be accessed through Kala Pull Road. It is a wide and two-way Road which is further connected to Korangi Road, Rafiqi H Road and School Road. People of this area mostly use private cars for local mobility. Traffic level is moderate except for peak hours.

**Education:** The area has both public and private educational institutions. There are two Government institutes (Pakistan Railway Secondary School and Pakistan Navy High school) and 5 Private schools near Naval Colony. JPMS School of Nursing is also situated near Naval Officers Residential Estate III.

**Health Care:** The estate is located in the centre of the city. JPMC is located near North-West of the hospital. Moreover, there are 6 Private hospitals and 1 Clinic in the vicinity of Naval Officers Residential Estate III.

**Cultural Heritage and Archeology:** The major population of Naval Officers Residential Estate III is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.

**Other Facilities:** Inhabitants of Naval Officers Residential Estate III city have the facility of natural gas, electricity, telephone and mobile services. There is a commercial market in the area. Banks, Post office and other basic facilities are available in the project area.

Railway Colony

**Location:** Railway Colony is located on the south side of the JPMC. It is accessible from Kala Pull Road and Korangi Road.

**Demographics:** According to the locals in the project area an estimated 2,000 to 2,500 houses with an estimated population of 13,000 people.

**Transport/Communications:** Railway Colony can be accessed through Chanesar Rd and DHA Link Rd. It is a wide and two-way Road which is further connected to Kala Pull Rd and Korangi Road. People of the area mostly use public transport like rickshaws, Chingquis, cars and motorbikes for their local mobility. For regional mobility, there are bus stations available and also the area is very near to the train station. Traffic level is moderate except for peak hours.

**Education:** The area has both public and private educational institutions. Railway Colony has their own Pakistan Railway Secondary School. Moreover, Bahria University of Medical and Dental College is located near the colony.

**Health Care:** JPMC is located at the South of Railway Colony. Moreover, there are 5 Private hospitals 1 Lab and 1 Clinic in the vicinity of Colony.

**Cultural Heritage and Archeology:** The major population of Railway Colony is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.
Other Facilities: Inhabitants of Railway Colony city have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

5.5.2 Sindh Government Lyari general hospital, Karachi

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Panjguri Mohalla and Rangiwara. The project area map (Figure 5.52) shows the main environmental receptor in 0.5 km radius of the project site.

Quality of Life Values: The quality of the life values of the project area are discussed below:
Figure 5.52: Project Area Map for Installation of Incinerator Project at Sindh Government Lyari General Hospital Karachi
Panjguri Mohalla

Location: Panjguri Mohalla is located on the West side of the Sindh Government Lyari General Hospital Karachi. It is accessible from Tannery Rd.

Demographics: According to the locals in the project area an estimated 1000 to 1500 houses with an estimated population of 10,000 people.

Ethnic Structure: The very first inhabitants of Lyari were Sindhi fishermen and Baloch nomads. Lyari Town is home of the majority Kutchi speaking people. The ethnic groups include Balochs, Brahuis, Kutchis, Zikris, Gujratis, Muhajirs, Chhipas and others.

Transport/Communications: Lyari is served by a Road, serving approximately millions of vehicles per day. Lyari’s public transport infrastructure is inadequate and constrained by low levels of investment.

Lyari Expressway is a highway along the Lyari River in Karachi, Sindh, Pakistan connecting the Port of Karachi with M9 Motorway. This toll highway is designed to relieve congestion in the city of Karachi. It is a 16.5 km expressway that consists of four lanes on both sides, with two interchanges, five overpasses and five underpasses. Moreover, two lanes each are constructed on banks of the Lyari River.

People in the project area mostly use public transport like rickshaws, Chingqis and motorbikes for their local mobility. For regional mobility, there are bus stations available and also the project area is very near to the train station.

Education: The area has both public and private educational institutions. Most educational institutions are gender-based, from primary to university level. Karachi is home to two major public and private sector universities. The universities in Lyari Town include:

- Benazir Bhutto Shaheed University, Lyari (BBSUL)
- Shaheed Mohtarma Benazir Bhutto Medical College (SMBBMC)

Health Care: The present-day Lyari ought to be known more for Kharadar General Hospital (KGH) and Shaheed Benazir Bhutto Medical University (SBBMU) providing exemplary services to the downtrodden sections of the society.

Cultural Heritage and Archeology: The major population of Panjguri Mohalla is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.

Other Facilities: Inhabitants of Panjguri Mohalla have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

Rangiwara

Location: Rangiwara is located on the East side of the Sindh Government Lyari General Hospital Karachi. It is accessible from Tannery Rd and Chakiwara Road.

Demographics: According to the locals in the project area an estimated 1000 to 1500 houses with an estimated population of 10,000 people.
Ethnic Structure: The very first inhabitants of Lyari were Sindhi fishermen and Baloch nomads. Lyari Town is home of the majority Kutchi speaking people. The ethnic groups include Balochs, Brahuis, Kutchis, Zikris, Gujratis, Muhajirs, Chhipas and others.

Transport/Communications: Rangiwara can be approached through Tannery Rd and Chakiwara Rd. They are a narrow two-way Road which is linked to Lyari Express Way. Lyari Expressway is a highway along the Lyari River in Karachi, Sindh, Pakistan connecting the Port of Karachi with M9 Motorway. The Roads leading to Ragwira are quite congested and traffic jam most of the time. People in the project area mostly use public transport like rickshaws, Chingqis and motorbikes for their local mobility. For regional mobility, there are bus stations available and also the area is very near to the train station.

Education: The area has both public and private educational institutions. NED Foundation Higher Secondary School lies near the area.

Health Care: There are 7 private hospitals in the vicinity of Rangiwara and 1 Government hospital.

Cultural Heritage and Archeology: The major population of Rangiwara is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.

Other Facilities: Inhabitants of Rangiwara have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

5.5.3 Dr Ruth Pfau Civil Hospital Karachi

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Bhimpura and Narayan Pura. The project area map (Figure 5.53) shows the main environmental receptor in 0.5 km radius in Karachi city.
Figure 5.53: Project Area Map for Installation of Incinerator Project at Dr Ruth Pfau Civil Hospital Karachi
Bhimpura

Location: Bhimpura is located on the North West side of the Dr Ruth Phau Civil Hospital, Karachi. It is accessible from Nishtar Road and Saddiq Wahab Road.

Demographics: According to the locals in the project area an estimated 500 to 700 houses with an estimated population of 5,000 people.

Transport/Communications: Bhimpura can be approached through Nishtar Road, Saddiq Wahab Road and Napier Rd. Nishtar Road, Saddiq Wahab Road re-linked to M.A. Jinnah Road through Napier Road. These Roads are wide but two way, traffic flow is high at peak hours.

People in the project area mostly use public transport like rickshaws, Chingqis and motorbikes for their local mobility. For regional mobility, there are bus stations available and also the project area is very near to the train station.

Education: The area both public and private educational institutions. Most educational institutions in the area are gender-based, from primary to university level. There are two Government and 3 private institutes in the area.

Health Care: Bhimpura is situated in a very commercial and congested area of Karachi. There 3 private healthcare facility and 1 public healthcare facility lies in the vicinity of the colony.

Cultural Heritage and Archeology: The major population of Bhimpura is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.

Other Facilities: Inhabitants of Bhimpura have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

Narayan Pura

Location: Narayan Pura is located on the North-East side of the Dr Ruth Phau Civil Hospital, Karachi. It is accessible from Nishtar Road.

Demographics: According to the locals in the project area an estimated 400-500 houses with an estimated population of 2500 people.

Transport/Communications: Narayan Road can be approached through Hira Lal Road and Nishtar Rd. These Roads are two-way, but they are in quite a good condition. Traffic flow is good on these Roads. Nishtar Rd is the main Road which links several areas of Karachi.

People in the project area mostly use public transport like rickshaws, Chingqis and motorbikes for their local mobility. For regional mobility, there are bus stations available and also the project area is very near to the train station.

Education: The area has both public and private educational institutions. Most educational institutions are gender-based, from primary to university level. The area of Narayan Pura has 4 Colleges 1 govt. and 3 private schools.

Health Care: Narayan Pura lies in the Centre 3 private hospitals and 1 Government hospital.

Employment: Karachi is now Pakistan's premier industrial and financial centre. The city has a formal economy estimated to be worth $113 billion as of 2014. Approximately 30% of
Pakistani industrial output is from Karachi, while Karachi's ports handle approximately 95% of Pakistan's foreign trade. Approximately 90% of the multinational corporations operating in Pakistan are headquartered in Karachi. Up to 70% of Karachi's workforce is employed in the informal economy, which is typically not included in GDP calculations.

Cultural Heritage and Archeology: The major population of Narayan Pura is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.

Other Facilities: Inhabitants of Narayan Pura have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

5.5.4 Liaquat University Medical Hospital, Jamshoro

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Doctor's Colony. The project area map (Figure 5.54) shows the main environmental receptor in 0.5 km radius in Hyderabad city.

Quality of Life Values: The quality of the life values of the project area are discussed below:
**Figure 5.54:** Project Area Map for Installation of Incinerator Project Liaquat University Medical Hospital, Jamshoro
Doctors Colony LUMH

**Location:** Doctors Colony LUMHS is located on the southwest side of Liaquat University Hospital Jamshoro. It is accessible from Sindh Liaquat university Link Road and LMC Colony Road.

**Demographics:** According to the locals in the project area an estimated 200 to 300 houses with an estimated population of 15000 people.

**Ethnic Structure:** The city is now a multi-ethnic and has a mix of Sindhi, Urdu speaking Muhajirs, Brahnis, Punjabis, Pashtuns, Memons and Baloch people.

**Agriculture:** Jamshoro is surrounded by fertile alluvial plains, and is a major commercial centre for the agricultural produce of the surrounding area, including millet, rice, wheat, cotton, and fruit.

**Transport/Communications:** The M-9 motorway is a 6 lane motorway that connects Hyderabad to Karachi, 136 kilometres away. The city will also be connected to Sukkur by the M-6 motorway, being built as part of the wider China-Pakistan Economic Corridor. From Sukkur, motorways will continue onwards to Multan, Lahore, Islamabad, Faisalabad, and Peshawar. Hyderabad Junction railway station serves as the city's main rail station. Hyderabad Airport is no longer served by commercial air traffic. The last services were suspended in 2013.

**Education:** Mehran University of Engineering and Technology, Liaquat University of Medical Sciences and the University of Sindh are located in Jamshoro.

Liaquat University Medical Hospital, Jamshoro is the main public hospital in the area. There are other basic health units, private hospitals and medical stores as well. Overall, health facilities in the project area are good.

**Drinking Water Supply:** Groundwater is mostly used for drinking purposes.

**Employment:** The population of the people residing in the Doctors Colony consist of Doctors and their families.

**Cultural Heritage and Archeology:** The major population of doctor's colony is Muslim. The area has several mosques. No archaeologically significant site was found in the project area.

**Other Facilities:** Inhabitants of doctor's colony have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

5.5.5 Chandka Medical College Hospital Larkana

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Doctor's Colony and Wakel Colony. This area may get direct positive or negative impacts of the Installation of the Incinerator Project. The project area map (Figure 5.55) shows the main environmental receptor in 0.5 km radius in Larkana city.

**Quality of Life Values:** The quality of the life values of the project area are discussed below:
Figure 5.55: Project Area Map for Installation of Incinerator at Chandka Medical College Hospital Larkana
**Doctor’s Colony**

**Location:** Doctor’s Colony is located on the Southwest side of Chandka Medical College Hospital Larkana. It is accessible from Tannery Rd.

**Demographics:** According to the locals in the project area an estimated 100 to 150 houses with an estimated population of 500 people.

**Agriculture:** Larkana’s guava and berries are famous both nationally and internationally; the annual output of the district stands at thousands of tons. All the villages of Larkana on the right bank of River Indus have vast guava orchids spread over thousands of acres.

**Transport/Communications:** Larkana Railway Station is located in the centre of the city. It connects Larkana to the rest of Sindh and Pakistan. Pakistan Railway also assists in the transportation of agricultural products to provincial capital Karachi from Larkana. Mohenjo-Daro Airport is located near Mohenjo-Daro, 28 km away to the south of the city of Larkana.

**Education:** Several old and new schools, colleges, as well as a university are functioning in the city for both boys and girls. Many are private and public institutions. SZABIST opened its first campus in Larkana in 2004. A few years later the SZABIST Trust established two schools and college in the city Chandka Medical College (CMC) was established and inaugurated by the former Prime Minister of Pakistan Zulfiqar Ali Bhutto on 20 April 1973. It was the fourth public medical college to be established in the province of Sindh. Chandka Medical College is recognised by Pakistan Medical & Dental Council (PMDC).

The College of Physicians & Surgeons Pakistan (CPSP) has also established its regional centre at the campus of CMC Larkana. CMC is recently upgraded to Shaheed Mohtarma Benazir Bhutto Medical University. In 2009, Quaid-e-Awam University College of Engineering Science & Technology (QUCEST), Larkana, was established in the outskirt of Larkana.

**Health Care:** In terms of availability of healthcare services facility, there are 9 Government and 6 Private hospitals with a total number of 1417 beds. Additionally, there are 10 Government, 8 Departmental and 32 Local Bodies Dispensaries in Larkana district. There are 7 Rural Health Centres and 46 Basic Health Units BHUs. The healthcare units were manned by a total of 622 doctors. Thus there are a total of 109 healthcare institutions for a population of 1,927,066 or only 56 institutions per million population.

**Employment:** The majority of the workforce is employed in agriculture, fisheries and elementary/rudimentary occupations.

**Cultural Heritage and Archeology:** Majority of the population of Larkana district is Muslim. The cultural life here is greatly influenced by the Islamic way of life. The pirs and Murshid are held in high esteem and confidence amongst the Muslim particularly by the masses of the rural areas. Urs ceremonies of pirs are regularly held at their shrines. The Hindus also hold great confidence in Thakurs and Brahmans. The Brahmans usually perform spiritual rites of Hindus on their special occasions. No archaeologically significant site was found in the project area.

**Other Facilities:** Inhabitants of Doctor’s Colony have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

**Wakeel Colony**

**Location:** Wakeel Colony is located on the East side of the Chandka Medical College Hospital Larkana. It is accessible from College Road.

**Demographics:** According to the locals in the project area an estimated 100 to 150 houses with an estimated population of 500 people.
Transport/Communications: Wakeel colony can be approached through College Road and Jail Road. These Roads are two ways but are adequate for heavy traffic.

Education: Several old and new schools and colleges, are functioning in the area for both boys and girls. The institutes include Ranger Public School and College, Government Saint Joseph High School and Indus School

Health Care: In terms of availability of healthcare services facility in the area, there is 1 Government, and 6 Private hospitals lie in the vicinity of Wakeel Colony.

Employment: The majority of the workforce is employed in agriculture, fisheries and elementary/rudimentary occupations.

Cultural Heritage and Archeology: Majority of the population of Larkana district is Muslim. The cultural life here is greatly influenced by the Islamic way of life. The pirs and Murshid are held in high esteem and confidence amongst the Muslim particularly by the masses of the rural areas. Urs ceremonies of pirs are regularly held at their shrines. The Hindus also hold great confidence in Thakurs and Brahmans. The Brahmans usually perform spiritual rites of Hindus on their special occasions. No archaeologically significant site was found in the project area.

Other Facilities: Inhabitants of Wakeel Colony have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

5.5.6 Ghulam Muhammad Mahar Medical College Hospital Sukkur

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Nao Gaz Pir Colony and Thermal colony. This area may get direct positive or negative impacts of the Installation of the Incinerator Project. The project area map (Figure 5.56) shows the main environmental receptor in 0.5 km radius in Sukkur city.
Figure 5.56: Project Area Map for Installation of Incinerator at GMMCH, Sukkur
Nao Gaz Pir Colony

Location: Nao Gaz Pir Colony is located on the South side of the Ghulam Muhammad Mahar Medical College Complex Hospital, Sukkur. It is accessible from Masoom Shah Minar Road.

Demographics: According to the locals in the project area an estimated 1000 to 1500 houses with an estimated population of 10,000 people.

Agriculture: Nao Gaz Pir Colony is located near the west bank of the Dadu Canal because of which the southern side of the project area consists of fields and agricultural land. However, in the north of the area is a housing scheme known as township; hence the area is a mix of residential and agricultural genera.

Irrigation: Irrigation system in the area is very strong due to the presence of 3 link canals namely Dadu, Rice and Amroti Mashid Khirthar canal hence contributing to a good irrigation practice in the region.

Transport/Communications: People in the project area mostly use public transport like rickshaws, Chinggis and motorbikes for their local mobility. For regional mobility, there is Sukkur railway station, local bus stations and a Sukkur airport located 8 km outside the city which accommodated national flights to main cities of Pakistan.

The transport infrastructure in Sukkur is adequate for existing requirements but needs dire improvements. As a result, the effective capacity of the Road system is reduced by poor traffic management, poor compliance with traffic regulations and the mix of motorized and non-motorized traffic.

Education: Sukkur withholds Pakistan’s third largest business school namely IBA University, as included in the Higher Education Commission Pakistan’s Business School Ranking. Secondly, Ghulam Muhammad Mahar Medical College, a remarkable health institute of its kind is also a constituent College of Shaheed Mohtarma Benazir Bhutto Medical University.

Health Care: Ghulam Muhammad Mahar Medical College Complex Hospital is the main public hospital in the area. There are other basic health units, private hospitals and medical stores as well. Overall, health facilities in the project area are good.

Drinking Water Supply: Groundwater is mostly used for drinking purposes.

Employment: The population of the people residing in the project area consist of self-employed (including farming and trade), private employees and Government employees.

Cultural Heritage and Archeology: The population of the district is predominantly Muslim; however, Hindu population also resides here. Archaeological site has been found in Lakhian Jo Daro near Goth Nihal Khoso in the district of Sukkur which historians suspect maybe 5,500 years old whereby the remains are said to be older than those of Mohenjo-Daro.

Other Facilities: Inhabitants of Nao Gaz Pir Colony have the facility of natural gas, electricity, telephone and mobile services in the village. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

Thermal colony

Location: Thermal colony is located on the East side of the Ghulam Muhammad Mahar Medical College Complex Hospital, Sukkur. It is accessible from Lab-e-Mehran Road.
**Demographics:** According to the locals in the project area an estimated 300 to 500 houses with an estimated population of 1500 people.

**Agriculture:** Thermal colony is located in the city because of which the area has no agricultural land. However, some trees and ornamental plants have been seen in the area planted by locals to increase the serenity of the colony.

**Transport/Communications:** Thermal Colony can be approached through Lab-e-Mehran Rd which connected thermal colony to Sukkur Bridge. People in the project area mostly use public transport like rickshaws, Chingqis and motorbikes for their local mobility.

**Education:** Both Government and Private School can be found near the Thermal colony. They include; Hira Public School, Army Public School and colleges and Govt. M.K. High School.

**Health Care:** Ghulam Muhammad Mahar Medical College Complex Hospital is the main public hospital in the area. There are other basic health units, private hospitals and medical stores as well. Overall, health facilities in the project area are good.

**Drinking Water Supply:** Groundwater is mostly used for drinking purposes.

**Employment:** The population of the people residing in the project area consist of self-employed (including farming and trade), private employees and Government employees.

**Cultural Heritage and Archeology:** The population of the district is predominantly Muslim; however, Hindu population also resides here. Archaeological site has been found in Lakhian Jo Daro near Goth Nihal Khoso in the district of Sukkur which historians suspect maybe 5,500 years old whereby the remains are said to be older than those of Mohenjo-Daro.

**Other Facilities:** Inhabitants of the Thermal colony have the facility of natural gas, electricity, telephone and mobile services in the village. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.

**5.5.7 People Medical College Hospital Shaheed Benazirabad**

This section provides a detailed discussion of the socio-economic and socio-cultural environment of the local community in the project area namely Old doctor’s colony. This area may get direct positive or negative impacts of the Installation of the Incinerator Project. The project area map (Figure 5.57) shows the main environmental receptor in 0.5 km radius in Shaheed Benazirabad city.

**Quality of Life Values:** The quality of the life values of the project area are discussed below:
Figure 5.57: Project Area Map for Installation of Incinerator Project People Medical College Hospital Shaheed Benazirabad

Legend:
- DCO Office (500 m)
- Eid Chawk (500 m)
- Ehsanabad (400 m)
- New Doctors Colony (400 m)
- Old Doctors Colony (520 m)
- Proposed Medical Hospital Shaheed Benazirabad
- Project Area (500 m Radius)
- Proposed Incinerator Site
- Shaheed Benazirabad / Bhutto University (450 m)
Old Doctors Colony

Location: Old doctor’s colony is located on the West side of the People Medical College Hospital Shaheed Benazirabad. It is accessible from Court Road and Shaheed Bhutto Road.

Demographics: According to the locals in the project area an estimated 15 to 20 houses with an estimated population of 100 people.

Agriculture: Shaheed Benazirabad contributes significantly in the agriculture sector of Sindh because its climate is suitable for the production of various food items including the Kharif crops of maize, rice, sugarcane, cotton and bajra and Rabi crops of wheat, barley, Gram and barseen. In addition to these, fruit orchards are abundant in this district.

Transport/Communications: People in the project area mostly use public transport like rickshaws, Chinggis and motorbikes for their local mobility. For regional mobility, there are bus stations available and also the project area is very near to the train station. The transport infrastructure in Hyderabad is adequate for existing requirements but is in poor condition. As a result, the effective capacity of the Road system is reduced by poor traffic management, poor compliance with traffic regulations and the mix of motorized and non-motorized traffic. The project area has internet facility and other ways of communication.

Education: District Shaheed Benazirabad is ranked at the 125th position in the education score index of the Pakistan District Education Rankings 2017. The education score is composed of the learning score, retention score and gender parity score. In the middle school infrastructure index, which focuses on the availability of basic facilities and the building condition, Shaheed Benazirabad ranks 70th. However, it ranks 77th in the primary school infrastructure. Both have a comparatively above-average score of availability of electricity and drinking water, access to toilets, but the building conditions lie below average in both primary and middle schools.

Using data from the Standardized Achievement Test (SAT) report published by the Sindh Government in 2017, it was found in the “2013-2018 Five Years of Education Reforms in Sindh. Wins, Losses and challenges for 2018-2023.” report that Shaheed Benazirabad ranked 17th for student achievement in the language in grade 8. However, with a score of only 39.98, it is still below average.

Low learning outcome issues remain a hindrance for district Shaheed Benazirabad. Issues reported by the residents via the Taleem Do! App complains of the lack of primary schools in the area. The debate on whether basic education should be provided in the regional, national or official languages has been a point of debate in Pakistan for several years.

Employment: The sources of employment are less diversified in this district. The sources of employment in the urban areas include small business, services, agriculture extension services, private jobs, Government jobs and overseas employment but in the rural parts of this district, agriculture sector remains dominant among all the sectors.

Cultural Heritage and Archaeology: Islam is the major religion of this district representing 96.5% of the population. Hinduism is the religion of the minority, representing 2.8% of the population. Christians and Ahmadis are also minority religious communities in this district.

Other Facilities: Inhabitants of doctor’s colony have the facility of natural gas, electricity, telephone and mobile services. There is a significant market in the area. Banks, Post office and other basic facilities are available in the project area.
6 Stakeholder Consultation

6.1. Introduction
During the EIA processing, the stakeholders were involved in the public consultation to know their opinions, concerns, issues and suggestions regarding the Environmental Impact Assessment of the provision of the incinerator (procurement, installation, commissioning & operations) in different hospitals of Sindh. This chapter provides details of public consultations carried out with the community and stakeholders at a different level.

6.2. Approach to Public Consultation
The public consultation process has been approached to involve the community and stakeholders from the earliest stages. Public consultation has taken place during the planning and design phase of the project. The focus of attention has been the community living adjacent to the selected Hospital incinerator sites as well as hospital staff, patients and the visitors who may be affected by the project.

The viewpoint of the stakeholders has been taken into account, and their concerns and suggestions for possible improvements have been included in the EIA where appropriate.

Much of the public consultation process has revolved around concerns for the mitigation of construction and operational phase impacts which are mainly due to the poor performance of the existing old incinerators which will be dismantled and replaced with new state of the art incinerators at the selected hospitals.

The stakeholders involved in the process were the Director M/s Vertex Medical (Pvt) Ltd., Lahore, Health Department, Government of Sindh, Environmental Consultants, Medical Superintendent, Waste management team, doctors, Nurses and Patients of the respective hospitals, Doctors of private hospitals, Solid Waste Management Companies.

6.3. Objectives of Consultation
The overall objective of the consultation with the stakeholders is to verify the environmental and social issues that have been presumed to arise and to identify those which are not known or are unique to the project.

The objectives of the public consultation process are:

- Providing key project information to the stakeholders, and to solicit their views on the project’s potential or perceived impacts,
- Identification of potential problems and needs,
- To devise the way for collaborative problem solving,
- Develop and maintain communication links between the project proponents and stakeholders, providing opportunities to the public to influence the project design in a positive manner, and
- Ensure that views and concerns of the stakeholders are incorporated into the project design and implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed project.
6.4. Categories of Stakeholders Contacted

Potential stakeholders for consultation and participation were identified, and discussions were held with the community living in the respective project areas of impact, household women, pedestrians, vendors and business/shop owners. Moreover, Government and private employees, private sector hospitals staff were also contacted during the process.

6.5. Major Stakeholders Involved

The stakeholders contacted during the survey belonged to different categories of people as shown in Table 6.1.

Table 6.1: Categories of Stakeholders Interviewed in the Project Area

<table>
<thead>
<tr>
<th>No.</th>
<th>Stakeholder Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Staff, visitors and patients and the public in the vicinity of the project sites</td>
</tr>
<tr>
<td>3</td>
<td>Government Organizations</td>
</tr>
<tr>
<td>4</td>
<td>Environment and Social Experts (Public and Private Institutes/Solid Waste Management</td>
</tr>
<tr>
<td>5</td>
<td>Community living adjacent to the selected hospitals</td>
</tr>
</tbody>
</table>

6.6. Scoping Session

During the public consultation process, both primary and secondary stakeholders were consulted. Consultation with the primary stakeholders was in the form of informal meetings and interviews.

The consultation with the secondary stakeholders was formal since most of them are Government functionaries or professionals.

During these interviews, the simple, non-technical description of the project was given, along with an overview of the project’s likely impacts on the community and the environment. Following the project description, a discussion was held so that people could voice their concerns.

Generally, the community was not aware of the project, but they were informed about the project during the public consultation. The negative and positive impacts were communicated to them.

Moreover, the stakeholders complained about the black smoke emission from the existing old incinerators at all eight project sites and the smell of burning from the incinerators. They were briefed about the wet scrubbing process and that the new state of art incinerators will be not emitting smoke up to 98%.

Furthermore, with the complete combustion process, the stake emissions from the incinerator will be within SEQS limits. They were informed that the incinerators must be located near the source of infectious hospital waste, i.e., the hospitals, which must be incinerated within 24 hours.

On the other hand, a large group of educated individuals gave positive gestures towards the project of installation of incinerators because they were afraid of the consequences of
infectious hospital waste. Those who were aware of the project, indicated their full support as it will provide employment opportunity and enhance the overall healthcare of the community and will also reduce incidences of Hepatitis C in Sindh.

6.7. Issues Discussed

Following issues were discussed during the stakeholder consultation:

- Overall activities of the project and their possible impacts;
- Possible impacts on natural vegetation, flora and fauna;
- Possible mitigation measures and
- Beneficial factors and involvement opportunities of the local people in the set of activities of Project.

6.8. Major Stakeholders and their Apprehensions

Meetings with major stakeholders were organized to discuss project specific issues and their potential impacts on the local and regional environment.

Stakeholders consulted, their valuable suggestions and comments for all the selected hospitals are described hereunder in Table 6.2:
<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Name and Designation</th>
<th>Location</th>
<th>Opinions/Concerns/Issues/Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.08.2018,</td>
<td>Mr Ramzan Arif, Director</td>
<td>Vertex Medical</td>
<td>• Vertex Medical Pvt. Ltd., was established on 1st May 2000 under the auspices of well trained and experienced management fully committed to accomplishing the mission of the Firm.</td>
</tr>
<tr>
<td>11:25 - 12:00 pm</td>
<td>Vertex Medical Pvt. Ltd.,</td>
<td>Lahore</td>
<td>• “Vertex” provides “fast, accurate, timely and reliable” supply services to all major Hospitals and Medical Institutes of Pakistan both in public and private sectors.</td>
</tr>
<tr>
<td></td>
<td>Lahore</td>
<td></td>
<td>• Vertex Medical imports and distributes Healthcare Equipment’s, Instruments, and Consumable/Disposable Items. Medical Products but grown into one of the prominent companies of Pakistan in a very short span of time, particularly in the areas of Endoscopy, Operation Theatre, Cardiology Equipment’s, Disposable Items, Accessories, Allied Hospital Services, Ward Furniture, Sterilization System and Central Gas System.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The proposed MP-500 Incinerator by Addfield, United Kingdom is state of the art and meet the requirement of the Environmental Protection Department, Government of Punjab for exhaust emissions and Sindh do not have exhaust emissions standards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Vertex Medical Pvt. Ltd has a capable team for installation, commissioning and operation of the incinerator within the stipulated period. We will operate and maintain the incinerator as per contract agreement signed with the Health Department, Government of Sindh for three years afterwards it will be handed over to the respectively selected hospitals under the project.</td>
</tr>
<tr>
<td>30.08.2018,</td>
<td>Mr Farhan Lodhi, Director</td>
<td>Karachi</td>
<td>• The Government of Sindh has taken the right step for treatment and disposal of infectious hospital waste management in Sindh.</td>
</tr>
<tr>
<td>11:25 - 12:00 pm</td>
<td>Operations, Hangzhou Jinjiang</td>
<td></td>
<td>• The incineration facility should be open to the public and private sector hospitals only then there would have a visible impact.</td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.08.2018,</td>
<td>Engr. Syed Haq, Managing</td>
<td>Karachi</td>
<td>• There is a need for involvement of the private sector in hospital/Solid Waste Collection, Treatment and disposal in all mega cities of Sindh.</td>
</tr>
<tr>
<td>12:00 - 12:30 pm</td>
<td>Director, Ceres Associate Gulf</td>
<td></td>
<td>• There is a need for hospital waste management system should be outsourced to private contractors. The performance of the contractor should be monitored through third-party validation.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date &amp; Time</td>
<td>Name and Designation</td>
<td>Location</td>
<td>Opinions/Concerns/Issues/Suggestions</td>
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</table>
| 30.08.2018 12:30 | Imran Sabir, Assistant Director, Sindh Environmental Protection Agency, Karachi | Karachi   | - He appreciated that the Health Department, Government of Sindh to install incinerators at eight hospitals.  
- He emphasized that the incinerators must be state of the art and comply with national and international standards for emissions control. |
| 30.08.2018 04:00 | Mr Naveed Larik, Deputy Director, Sindh Solid Waste Management Board | Karachi   | - It is a welcome initiative of the Health Department, Government of Sindh to install incinerators at eight hospitals.  
- There is a need for installation of incinerators for treatment and disposal of infectious hospital waste in public and private sector Hospitals in Sindh. |
| 31.08.2018 10:00 | Dr Abdual Jabbar Memon, Additional Director, Development, Health Department, Government of Sindh | Karachi   | - The objective of installation of 8 incinerators at the selected 7 hospitals in Sindh is to protect the environment and public by managing and safe disposal of infectious hospital waste.  
- The installation of incinerator will be a milestone in the reduction of incidence of Hepatitis B and C in Sindh.  
- The Government of Sindh gives high priority to the installation of 8 incinerators at 7 selected hospitals in Karachi, Shaheed Benazirabad, Larkana, Sukkur and Jamhoro. |
| 31/08/2018 15:00 | Mr Shahid Lutfi, Environmental Consultant | Karachi   | - There is an alarming increase in Hepatitis B and C in Pakistan and according to WHO there are 10 million people are affected.  
- The installation of 8 incinerators will improve the hospital waste management situation in Sindh and will help in infection control.  
- The spreading of Hepatitis C is due to many factors. It is good that the Government of Sindh is tackling hospital waste management, but there is a need for taking measures against unsafe injections, unscreened blood transfusions etc. so that all possible causes are also eradicated.  
- The incinerator must meet the Punjab Environmental Quality Standards for Treatment of Liquid and disposal of bio-medical waste by incineration, autoclaving, microwaving and deep burial particularly for stake emissions as there are no such standards for Sindh.  
- There is a need for compliance with Sindh Hospital Waste Management Rule 2014 by all public and private sector healthcare facilities. |
<table>
<thead>
<tr>
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<th>Name and Designation</th>
<th>Location</th>
<th>Opinions/Concerns/Issues/Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/07/2018, 10:00- 10:30 am</td>
<td>Dr Tariq Mehmood, HOD of Radiology Department, Dr Shaista Nizami, Doctor</td>
<td>J.P.M.C. Karachi</td>
<td></td>
</tr>
</tbody>
</table>
|                     |                                       |                   | • J.P.M.C. Karachi is a 1700-bed hospital, and around 3,000 outpatients come daily.  
|                     |                                       |                   | • We have a proper Hospital Waste Management Plan in action in accordance with Sindh HWM Rules, 2014. The Hospital Waste Management team has been formed. We have regular meetings and training of staff on HWM, and which ensures that regular monitoring of HWM.  
|                     |                                       |                   | • Proper treatment and disposal of Healthcare is waste must, as improper disposal of infectious hospital waste increases the spread of Hepatitis C.  
|                     |                                       |                   | • Waste generation rate is also increased in the last few years due to higher patient rate. That's why a higher capacity incinerator is needed.  |
| 30/07/2018, 10:30- 10:40 am | Dr Muhammad Ali, Doctor of Medicine Ward | J.P.M.C. Karachi |  
|                     |                                       |                   | • It is HWMT responsibility to dispose of the waste properly. Infectious waste if improperly disposed of can lead to the spreading of infections particularly Hepatitis C.  
|                     |                                       |                   | • It should be made sure that the new incinerator does not pose any kind of hazards to the patients, the staff of the hospital and to the community working and living nearby  
|                     |                                       |                   | • All preventive measures that will be identified during the Environmental Impact Assessment should be implemented, and a focal person should make sure of the implementation.  
|                     |                                       |                   | • However, the project will bring positive impacts as well like infection control, unavailability of infected syringes for scavengers and will be burned so there will be no spreading of Hepatitis C.  
|                     |                                       |                   | • There is a need for compliance with Punjab Hospital Waste Management Rule 2014 by all public and private sector healthcare facilities.  |
| 30/07/2018, 10:40- 11:00 am | Mr Mehboob Alam., Plant Operator Mr Riaz Gill, Director of Admin Bagh Ali, Patient, Security Guard | J.P.M.C. Karachi |  
|                     |                                       |                   | • Presently, an incinerator is used to destroy infectious hospital waste being generated at JPMC. However, this friction based incinerator was installed in the Year 2000. It was locally manufactured with a capacity of 150 kg/cycle.  
|                     |                                       |                   | • It is a very good initiative of the Health Department to install incinerators at J.P.M.C.  
|                     |                                       |                   | • My suggestion would be that the wet scrubber should be efficient and should properly treat exhaust emissions before discharging into the air. Similarly, the technical staff should be adequately trained to operate the incinerator.  
<p>|                     |                                       |                   | • A traffic management plan detailing the route to be taken for the construction material supply should be discussed with the Hospital administration so that no inconvenience is caused to ambulances and patients arriving at the Hospital.  |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| 30/07/2018, 11:00-11:30  | Mr Bisharat Ali, Computer operator, Admin | J.P.M.C. Karachi             | ▪ Proper infectious hospital waste disposal can improve the environment and stop one major source of Hepatitis C infection.  
▪ Incineration reduces the volume of waste by manifolds plus smell and odour are also greatly reduced.  
▪ The old incinerator is creating problems, and we do not want to face those problems again with the new incinerator. The old one is emitting black toxic smoke, and the temperature is not enough to completely burn the waste.  
▪ This is a great initiative that the Environmental Impact Assessment of the project is being carried out before installing the new incinerator.                                                                                   |
| 30/07/2018, 11:40:00-12:10 pm | Dr. Seemin Jamili, Executive Director | J.P.M.C. Karachi             | ▪ We have a proper Hospital Waste Management Plan in action. We have regular meetings and training of staff which ensures that regular monitoring of HWM.  
▪ Incinerator being installed should comply with all the environmental pollutions standards. Secondly, regular monitoring of this incinerator should also be carried out once installed. During the construction phase, local people should be employed to stimulate the economy.  
▪ Lastly, this process should be expedited as soon as possible as the present the incinerator is not enough and we fully support this initiative.                                                                                                      |
| 31/07/2018, 12:10-12:30 am | Bashir Shah, Senior Manager  
Zahid Kundan, Assistant Manager | Liaquat National Hospital, Karachi | ▪ Hospital is complying about Sindh HWM Rules 2014, and we have our own guidelines for proper hospital waste management.  
▪ All the waste management staff is trained, and the supervisory team is present for inspection.  
▪ Two incinerators are already working in Liaquat National Hospital that is manufactured locally. We are only using one incinerator other one is in a standby condition in case of emergency.  
▪ The infectious waste generation rate of Liaquat National Hospital, Karachi is 3200-3500kg/day. That's why we operate incinerator for longer duration every day. The incinerator area is cleaned properly to avoid smell and infection.  
▪ It is a great initiative that the new incinerator is being installed in J.P.M.C and other hospitals in Sindh.  
▪ For the new incinerator, I would like to suggest that it should be of a reliable brand that could work efficiently and does not emit black smoke.  
▪ All mitigation measures should be followed that the environmental specialist will recommend. |
<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| 31/07/2018, 12:30-12:50 pm | Mr. Muhammad Amen, Assistant Maintenance Manager.  
Asif Majeed, Manager of Engineering and Maintenance  
Sayed Tariq, Electrical Supervisor | The Kidney Center, Karachi     | • The existing hospital waste management could be made with the state of art incinerator.  
• At last, I would say that the project will be of great importance for the hospital and the other private hospitals in controlling the infectious hospital waste problems. |
| 30/07/2018, 01:00-01:30 pm | Dr Jawad Memon, Administration Kitchen Sterilization  
Dr Ameer Memon, GMS paramedics  
Dr Naveed Ahmad, DMS acting charge | Lyari General & teaching Hospital | • It is really good that before the start of a project consultation is being carried out.  
• One of the ways to identify a quack (fake doctor) is to check whether he/she pays attention to hospital waste management. As hospital waste has a component of infectious waste which if left untreated causes problems for the nearby community.  
• We already have a working incinerator with 100kg/hr capacity. Some private hospitals also send their waste to us for incineration.  
• Incinerator installation is a must in J.P.M.C. Karachi in order to properly destroy infectious hospital waste. Once the incinerator will be installed private hospitals should also be directed to dispose of their waste in the incinerator that will eventually lead to less infection. |
| 30/07/2018, 01:30-01:40 pm | Ms Shazia Abdul Rashid, Staff Nurse | Lyari General & teaching Hospital | • Sindh Government Lyari General Hospital Karachi was established in 1970. It is a tertiary care hospital in Karachi. Sindh Government Lyari General Hospital Karachi is 524-bed, and around 4,000 outpatients come daily.  
• We do not have a proper Hospital Waste Management Plan. We have regular meetings and training of staff which ensures that regular monitoring of HWM.  
• It is a very good initiative of the Healthcare Department to install incinerator at Lyari General & teaching Hospital as controlling infection is a priority of the Government.  
• All preventive measures that will be identified during the Environmental Impact Assessment should be implemented. Proper treatment of Healthcare waste is a must. As improper disposal of infectious hospital waste increases the spread of Hepatitis C.  
• It is HWMT responsibility to dispose of the waste properly. Infectious hospital waste if improperly disposed of can lead to the spreading of infections particularly Hepatitis C.  
• In order to destroy them all the infectious hospital waste, there is an urgent need to install the incinerator.  
• The incinerator operators and HWM team should be given a detailed briefing about the new incinerator for its smooth operation.  
• It should be made sure that the new incinerator does not pose any kind of hazards to the patients, the staff of the hospital and to the community living nearby |
### Date & Time                  Name and Designation                  Location                         Opinions/Concerns/Issues/Suggestions

30/07/2018, 01:40- 01:45 pm       Ms Muniba Kanwal, HO Ms Toba Akbar, HO Lyari General & teaching Hospital  - One of the biggest positive impacts of this project will be that it gives a platform for the destruction of infectious hospital waste. This, in turn, makes reused syringes unavailable to scavengers.

30/07/2018, 01:45- 01:55 pm       An Bibi, Patient Zaib-Un- Nisa, Patient Lyari General & teaching Hospital  - Hospital Waste Management is a very serious issue in Pakistan. Proper infectious hospital waste disposal can drastically improve the environment and stop one major source of Hepatitis C infection.

30/07/2018, 01:55- 02:00 pm       Raja Natho, Sweeper Diyal, Sweeper Manzoor Ahmad, Ward Labour Aman Bakash, Ward boy Lyari General & teaching Hospital  - Incineration is one of the best options for destroying the infectious hospital waste as it reduces the volume of infectious waste by manifolds plus smell and odour is also greatly reduced.

30/07/2018, 01:40- 01:45 pm       Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - Waste is not properly segregated. There are no guidelines for proper waste management. There should be colour-coded bins for the sake of proper management.

30/07/2018, 01:45- 01:55 pm       Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - There is no proper disposal most of the waste is dumped without proper treatment which causes serious issues.

30/07/2018, 01:55- 02:00 pm       Raja Natho, Sweeper Diyal, Sweeper Manzoor Ahmad, Ward Labour Aman Bakash, Ward boy Lyari General & teaching Hospital  - The selected incinerators are the best option for hospital waste disposal as thorough as this all infections can be controlled effectively.

30/07/2018, 01:55- 02:00 pm       Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - There is no proper disposal most of the waste is dumped without proper treatment which causes serious issues.

30/07/2018, 01:55- 02:00 pm       Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - The selected incinerators are the best option for hospital waste disposal as thorough as this all infections can be controlled effectively.

30/07/2018, 01:55- 02:00 pm       Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - The selected incinerators are the best option for hospital waste disposal as thorough as this all infections can be controlled effectively.

### Dr Ruth Pfau Civil Hospital Karachi

05/09/2018, 10:00- 10:30 am      Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - Proper Personal Protective Equipment (PPEs) are very necessary while dealing with Infectious Hospital Waste. The Hospital management team should ensure that PPEs are available for the janitorial staff.

05/09/2018, 10:00- 10:30 am      Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - All the waste management staff should be trained, and the supervisory team should be present for inspection. Janitorial staff must be vaccinated.

05/09/2018, 10:00- 10:30 am      Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - Existing janitorial staff is not enough for proper Hospital Waste Management. The strength of Janitorial staff should increase.

05/09/2018, 10:00- 10:30 am      Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - There should be an adequate number of bins for in each ward for effective segregation and collection of infectious hospital waste generated.

05/09/2018, 10:00- 10:30 am      Dr. Arif, AMS Prof. Dr. Shahla Baki, AMS Dr Ruth Pfau Civil Hospital Karachi  - Dr Ruth K.M. Pfau Hospital was founded as civil hospital Karachi in 1898 in the wake of the third pandemic of Bubonic Plague. It is an 1800-bed hospital. Around 3,000 outpatients come daily.
### Opinions/Concerns/Issues/Suggestions

- There is a Hospital Waste Management Team comprising of eight doctors. The team has prepared a Hospital Waste Management Plan and work according to the plan.
- All the janitorial staff is trained. However, there should be regular training and assessment of the performance of the Hospital Waste Management Team.
- An awareness campaign should be started to inform people about the hazard of improper disposal of infectious hospital waste.
- Waste generation rate has also increased in the last few years due to higher in patients. Thus, there is an urgent need for an incinerator.

**Dr Saeed, Senior Medical Officer, Dr Ruth Pfau Civil Hospital Karachi**

- It is HWMT responsibility to dispose of the infectious hospital waste properly. Infectious hospital waste if improperly disposed of can lead to the spreading of infections particularly Hepatitis C.
- The new incinerator should not pose any kind of hazards to the patients, the staff of the hospital and to the community working and living nearby
- All preventive measures that will be identified during the environmental impact assessment should be implemented, and the Environmental Protection Agency should make sure that the mitigation measures are implemented.
- The installation of incinerators in 7 hospitals in Sindh is a very good initiative of the Health Department, Sindh.

**Dr Ramallah Shahzad, House Incharge, Shamim Qadir, Staff Incharge, Dr Ruth Pfau Civil Hospital Karachi**

- Presently, a friction based incinerator is used to destroy infectious hospital waste being generated at Dr Ruth Pfau Civil Hospital Karachi. This incinerator needs to be replaced by the state of the art technology.
- The basic technology that makes an incinerator an acceptable way of combusting infectious hospital waste is the wet scrubber. The wet scrubber is the Air Pollution Control Device that treats the exhaust emissions before emitting it into the atmosphere. The APCD should be robust and capable of working in tough conditions.

**Dr Asad, Chief Executive, Lady Duffer Hospital, Karachi**

- Incinerators are the need of the hour, especially in Karachi. To dispose of the infectious hospital waste incinerator is a technology which completely burns the waste.
- My suggestion for this incinerator that is going to be installed at Dr Ruth Phau Civil is that it should allow nearby private sector hospitals to dispose of their infectious hospital waste in this Hospital. Only then will this whole exercise become fruitful.

**Liaquat University Medical Hospital, Jamshoro**
<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Name and Designation</th>
<th>Location</th>
<th>Opinions/Concerns/Issues/Suggestions</th>
</tr>
</thead>
</table>
| 01/08/2018,       | Abdul Sattar Jatoi, Director       | LUMH, Hyderabad    | ▪ The Liaquat University Hospital started functioning as Civil Hospital Hyderabad, affiliated Liaquat University of Medical and Health Sciences. It is an 800-bed hospital. Around 3,000 outpatients come daily.  
▪ We have a proper Hospital Waste Management Plan in action. We have regular meetings and training of staff which ensures that regular monitoring of HWM.  
▪ The old incinerator is working in Jamshoro where both Liaquat University Medical Hospital of Hyderabad and Jamshoro send their hospital infectious waste regularly.  
▪ Improper disposal of infectious hospital waste is one of the avenues that lead to spread Hepatitis C. So to stop the spread of Hepatitis C in Sindh. It is a commendable effort by the Health Department to install incinerators at the different hospital of Sindh.  
▪ Recycling of syringes is commonly practised in different hospitals of Sindh. Therefore, proper awareness is required in the community to deal with this problem.  
▪ The operators of the incinerators should be equipped with PPEs, and they should be properly trained for its operation and maintenance. |
| 10:00- 10:30 am  | planning procurement and           |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                   | development                        |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                   | Dr Naeem Raza Memon, AHS Additional |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                   | MS General                         |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 01/08/2018,       | Dr Niaz Hussain Babar, RMO         | LUMH, Jamshoro      | ▪ Hospital Waste Management is a very serious issue in Pakistan. Proper infectious hospital waste disposal can drastically improve the environment.  
▪ Incineration is one of the best options for destroying the infectious hospital waste as it reduces the volume of waste by manifolds plus smell and odour is also greatly reduced.  
▪ The old incinerator is creating problems, and we do not want to face those problems again with the new incinerator. The old one is emitting black toxic smoke, and the temperature is not enough to completely burn the infectious waste.  
▪ It is a great initiative that the environmental impact assessment is being carried out before installing the new |
| 10:30- 10:40 am  |                                     |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                   |                                     |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 01/08/2018,       | Dr Asma Kafeel, HO                 | LUMH, Hyderabad     | ▪ It should be made sure that the new incinerator does not pose any kind of hazards to the patients, the staff of the hospital and to the community working and living nearby  
▪ The project will bring positive impacts as well like infection control, unavailability of syringes for scavengers and will be burned.                                                                                                                                                                                                                                                                                                                  |
| 10:40- 11:00 am  |                                     |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                   |                                     |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 01/08/2018,       | Mr. Patras Masih, Incinerator      | LUMH, Jamshoro      | ▪ Presently, an old incinerator is used to destroy infectious hospital waste being generated at LUMH Jamshoro/ Hyderabad. However, it was locally manufactured with a capacity of 300 kg/cycle. This incinerator needs to be replaced by the state of the art technology.  
▪ It is a very good initiative of the Health Department to install incinerator. Hospitals as controlling infection should be a priority of the Government.                                                                                                                                                                                                                       |
<p>| 11:00- 11:30 am  | operator                            |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |</p>
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</tr>
</thead>
</table>
| 01/08/2018,      | Ms Khushnood Bashir, Nurse                  | LUMH, Hyderabad     | • As it is being said that the incinerator will be imported from the UK. My suggestion is that the Incinerator Operators should be knowledgeable about the working and how to operate the Incinerator.  
• Similarly, nurses and sanitary staff should know what types of material this incinerator can incinerate.  
• The Hospital Waste Management Team tries its utmost to follow the Sindh Hospital Waste Management Rules, 2014. The waste is segregated, collected in different colour-coded bins and then only infectious hospital waste is taken to Liaquat University Medical Hospital, Jamshoro for disposal of infectious hospital waste.  
• I have heard that in Punjab, there is a specialized vehicle for transportation of Infectious hospital waste. A similar arrangement should also be carried out in Sindh as well.  
• In order to destroy them all the infectious hospital waste, there is an urgent need to replace the existing incinerator.  
• There is a need to have a mass awareness campaign about the impacts of improper infectious hospital waste disposal. Patients do not understand the concept behind colour coded bins. |
| 11:30- 11:40 am  |                                            |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 01/08/2018,      | Aslam Hussain, Patient Ghulam Ali, Patient | LUMH, Hyderabad     | • It is a fact that Hepatitis C is spreading all over Sindh. Every patient should monitor whether after usage of a syringe, is the syringe disposed of in a scientific manner.  
• Construction should be carried out in a manner that does not affect the patients being treated at Hospital. The contractor should minimize the use of heavy machinery at the hospital.  
• The incinerator should work with minimum noise and vibrations. |
| 11:40- 12:00 am  | Naveed, Patient Basit Ali, Patient Ali Noor, Patient attendant Masood, Patient attendant |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 02/08/2018,      | Dr Saida Rashida, AMS Dr Muhammad Hanif    | PMCH Shaheed        | • The exclusive Medical College for Girls Shaheed Benazirabad came into existence in April 1974 & Named as Peoples Medical College. It is an 800-bed hospital, and around 3,000 outpatients come daily.  
• We do not have a proper Hospital Waste Management Plan in action.  
• Training of staff should be must to avoid inconvenience.  
• Waste should be segregated properly on the source at all levels.  
• An awareness campaign should be started to inform people about the hazard of infectious hospital waste.  
• Waste generation rate is also increased in the last few years due to higher patient rate — that why higher capacity incinerator is needed. |
<p>| 10:00- 10:30 am  | Bhangwar, AMS Dr Abdul Aziz Sahito, HOD and Chairman of the Department of Medicine | Benazirabad         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |</p>
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<th>Opinions/Concerns/Issues/Suggestions</th>
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</table>
| 02/08/2018,     | Dr Samina, Women Medical Officer Dr Nazish Akhtar, HO | PMCH Shaheed Benazirabad | • It is HWMT responsibility to dispose of the waste properly. Infectious hospital waste if improperly disposed of can lead to the spreading of infections particularly Hepatitis C.  
• It should be made sure that the new incinerator does not pose any kind of hazards to the patients, the staff of the hospital and to the community working and living nearby  
• All preventive measures that will be identified during the Environmental Examination should be implemented, and a focal person should make sure of the implementation  
• However, the project will bring positive impacts as well as infection control, unavailability of syringes for scavengers and will be burned.                                                                                                                                                                                                                                          |
| 10:30- 10:40 am |                                                  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 02/08/2018,     | Dr Shahzad Memon, Admin                           | PMCH Shaheed Benazirabad | • Presently, there is an incinerator which is being used to destroy the infectious hospital waste being generated at P.M.C.H, Shaheed Benazirabad. The incinerator has a chimney of only 20 ft. The incinerator is manufactured locally with a capacity of 100 kg/ cycle.  
• It is a very good initiative of the Health Department to install hospital infectious waste incinerator at PMCH Shaheed Benzairabad as controlling infection should be a priority of the Government.  
• The chimney height of the incinerator should be at least 40 ft, and the temperature should cross 1000°C. This will ensure that dioxin and furans are eliminated during the incineration process.                                                                                                                                                                                                                      |
| 10:40- 11:00 am |                                                  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 02/08/2018,     | Mr Ghulam Mustafa, Male Nurse Mr Munawar Ali, Male Nurse Mrs Bashera Chachar, Nurse Superintendent | PMCH Shaheed Benazirabad | • There should be an increment of the budget.  
• In order to destroy them all the infectious hospital waste, there is an urgent need to replace the existing incinerator. The new incinerator should have high capacity.  
• Moreover, the incinerator operators and HWM team should be given a detailed briefing about the new incinerator so that the operation becomes easy.                                                                                                                                                                                                                                       |
| 11:00- 11:30 am |                                                  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 02/08/2018,     | Mr Zulfiqar Ali Bhati, Office Superintendent      | PMCH Shaheed Benazirabad | • The incineration is the best option especially for Pakistan as hospital staff/scavengers reuse the hospital waste particularly syringes if not burnt to ashes.  
• Hospital Waste Management is one of the critical tasks while managing a Hospital. Inadequate and improper handling may have serious public health consequences and a significant impact on the environment.  
• Incineration is one of the best options for destroying the infectious hospital waste as it reduces the volume of waste by manifolds plus smell and odour is also greatly reduced.  
• The old incinerator is creating problems, and we do not want to face those problems again with the new incinerator. The old one is emitting black toxic smoke, and the temperature is not enough to completely burn the infectious hospital waste.                                                                                                                                 |
<p>| 11:30- 11:40 am |                                                  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |</p>
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<th>Date &amp; Time</th>
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<th>Opinions/Concerns/Issues/Suggestions</th>
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</table>
| 02/08/2018, 11:40-11:45 am | Ms Sita, Patient Ms.Farida, Patient Ms.Radha, Patient Attendant | PMCH Shaheed Benazirabad | - It is a great initiative that the environmental examination is being carried out before installing the new incinerator.  
- Waste management of the hospital is really good. All the waste is taken to colour coding bins, and injections are being disposed of properly.  
- Wards are cleansed once a day, and all the staff is really cooperative.  
- It should be made sure that the new incinerator does not pose any kind of problem to the people. |
| 02/08/2018, 12:00-12:30 pm | Dr Mazhar Hussain Chandio, RMO, Waste management head | PMCH Shaheed Benazirabad | - It is really good that before the start of a project consultation is being carried out.  
- We already have a working incinerator with 100kg/hr. Capacity.  
- Incinerator installation is a must in PMCH Shaheed Benazirabad in order to properly destroy infectious hospital waste. Once the incinerator will be installed private sector hospitals would also be directed to dispose of their infectious hospital waste in the incinerator that will eventually lead to less infection.  
- The infectious hospital waste is a big problem for all hospitals in Pakistan. Incineration would be the best option to control infection by burning the waste at high temperatures.  
- There is a need for improvement in the solid waste management system of the city, and proper sanitary landfill site is required to avoid any infection spreading.  
- All mitigation measures should be followed that the environmental specialist will recommend.  
- Hospital existing waste management could be made even better for proper incineration. |
| 03/08/2018, 10:00-10:30 am | Dr Ali Gohar Dahri, MS Dr Insaf Bukhsi, AMS Dr Allam Ibrahim, HOD and Chairman of Department of Medician | C.M.C.H. Larkana | - Chandka Medical College Hospital Larkana was inaugurated on 20th April 1973. It is a 1400-bed hospital, and around 3,000 outpatients come daily.  
- The hospital doesn’t have a proper Hospital Waste Management Plan in action. All the duties of janitorial staff changed daily due to a shortage of staff  
- Training of staff should be must to avoid inconvenience and improper handling of infectious hospital waste.  
- Waste should be segregated properly on the source at all levels.  
- An awareness campaign should be started to inform people about the hazard of infectious hospital waste.  
- Proper treatment of infectious hospital waste must as improper disposal of infectious hospital waste increases the spread of Hepatitis C. |
<table>
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<tr>
<th>Date &amp; Time</th>
<th>Name and Designation</th>
<th>Location</th>
<th>Opinions/Concerns/Issues/Suggestions</th>
</tr>
</thead>
</table>
| 03/08/2018, 10:30-10:40 am | Dr Nagina Shaikh, Doctor of Pharmacy          | C.M.C.H. Larkana | - Waste generation rate is also increased in the last few years due to higher patient rate — that why higher capacity incinerator is needed.  
- It is HWMT responsibility to dispose of the waste properly. Infectious hospital waste if improperly disposed of can lead to spreading of infections particularly Hepatitis C. So there should be WM supervisory team in the hospital.  
- It should be made sure that the new incinerator does not pose any kind of hazards to the patients, the staff of the hospital and to the community working and living nearby.  
- The main problem faced during the hospital waste collection is that sometimes people throw their waste in the wrong basket which is difficult to segregate afterwards.  
- However, the project will bring positive impacts as well as infection control, unavailability of syringes for scavengers and will be burned. |
| 03/08/2018, 10:40-11:00 am | Dr Saeed Memon, Incharge of waste management | C.M.C.H. Larkana | - Presently, there is an incinerator which is being used to destroy infectious hospital waste being generated at C.M.C.H. Larkana. It was locally manufactured with a capacity of 100 kg/cycle. This incinerator needs to be replaced by the state of the art technology.  
- It is a very good initiative of the Health Department to install hospital infectious waste incinerators at C.M.C.H. Larkana as controlling infection should be a priority of the Government.  
- The old existing incinerator did not have a proper wet scrubber and a temperature gauge which resulted in toxic emissions from the incinerator. The new incinerator should comply with the Sindh Environmental Quality Standards for exhaust emissions.  
- During the construction phase of the project, a proper traffic management plan should be made so that our rescue vehicles do not get stuck in traffic when the contractor’s supplies come to the project site. |
| 03/08/2018, 11:00-11:30 am | Mr. Abdul Kareem, Male Staff Nurse, Mr. Manzoor Yanos, Male Nurse, Mr. Ghulam Nabi, Staff Nurse | C.M.C.H. Larkana | - Along with the improvement in the hospital waste management system, there is a need for improvement in overall hospital management and environment.  
- There should be an increment of the budget to operate the incinerator smoothly.  
- In order to destroy the infectious hospital waste, there is an urgent need to replace the existing incinerator. The new incinerator should have high capacity.  
- Moreover, the incinerator operators and HWM team should be given a detailed briefing about the new incinerator so that the operation becomes easy.  
- There should be an increase in the number of Janitorial members  
- Cleaning equipment should be provided after each month to ensure proper hygiene. |
<table>
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<th>Date &amp; Time</th>
<th>Name and Designation</th>
<th>Location</th>
<th>Opinions/Concerns/Issues/Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/08/2018,</td>
<td>Majeed Ali, Student Staff Nurse Mr Liaquat</td>
<td>C.M.C.H. Larkana</td>
<td>• Hospital Waste Management is a very serious issue in Pakistan. Proper infectious hospital waste disposal can drastically improve the environment and stop one major source of Hepatitis C infection.</td>
</tr>
<tr>
<td>11:30- 11:40 am</td>
<td>Ali, Student Staff Nurse</td>
<td></td>
<td>• Incineration is one of the best options for destroying the infectious hospital waste as it reduces the volume of waste by manifolds plus smell and odour is also greatly reduced.</td>
</tr>
<tr>
<td></td>
<td>Mr Liaquat Ali, Student Staff Nurse</td>
<td></td>
<td>• The old incinerator is creating problems, and we do not want to face those problems again with the new incinerator. The old one is emitting black toxic smoke, and the temperature is not enough to completely burn the infectious hospital waste.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• It is a great initiative that the environmental examination is being carried out before installing the new incinerator.</td>
</tr>
<tr>
<td>03/08/2018,</td>
<td>Hussain Baksh, Patient Abdul Ameen, Patient</td>
<td>C.M.C.H. Larkana</td>
<td>• Increase the number of sweeper. They only sweep wards in the morning, and sometimes they didn’t come at all.</td>
</tr>
<tr>
<td>11:40- 11:45 am</td>
<td>Attendant Muhammad Hayat, Patient Attendant</td>
<td></td>
<td>• Waste management of hospital is not good. Only 2-3 bins are present in one ward</td>
</tr>
<tr>
<td></td>
<td>Khurshid, Patient Attendant Wahid, Patient</td>
<td></td>
<td>• It should be made sure that the new incinerator does not pose any kind of problem to the people.</td>
</tr>
<tr>
<td></td>
<td>Attendant</td>
<td></td>
<td>• Washroom should be clean 3 times a day.</td>
</tr>
<tr>
<td>03/08/2018,</td>
<td>Dr Khurshid Ahmad Abbasi, Child Specialist</td>
<td>Karachi Medical</td>
<td>• It is really good that before the start of a project consultation is being carried out.</td>
</tr>
<tr>
<td>12:00- 12:30 pm</td>
<td></td>
<td>Larkana</td>
<td>• An old incinerator is working in C.M.C.H. Larkana hospital send their infectious hospital waste to them twice a week and pay 5000 per month.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• A state of art incinerator installation is a must in C.M.C.H. Larkana in order to properly destroy infectious hospital waste. Once the incinerator will be installed private hospitals should also be directed to dispose of their infectious hospital waste in the incinerator that will eventually lead to less infection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• There is a lot of need for the installation of incinerators at different hospitals of Sindh, since, there are no other proper hospital waste treatment and disposal mechanism being followed by nearby located private sector hospitals.</td>
</tr>
<tr>
<td>03/08/2018,</td>
<td>Khalid Bhutto, Lab Technician</td>
<td>Sindh lab, Larkana</td>
<td>• Hospital existing waste management could be made better by the installation of the new incinerator.</td>
</tr>
<tr>
<td>12:00- 12:30 pm</td>
<td></td>
<td></td>
<td>• Lab conduct 40-50 test per day.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• All the waste is dumped along with general waste at the dumping site.</td>
</tr>
<tr>
<td>Date &amp; Time</td>
<td>Name and Designation</td>
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<td>Opinions/Concerns/Issues/Suggestions</td>
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<tr>
<td>03/08/2018,</td>
<td>Dr. Abdul Samad S., Medical Officer</td>
<td>GMMMC Hospital Sukkur</td>
<td>• It is a very good initiative by the Health Department, Government of Sindh to install state of the art incinerator at GMMMC Hospital Sukkur.</td>
</tr>
<tr>
<td>10:00-10:30 am</td>
<td>Dr. Ahmad Mujtaba, Consultant Senior Cardiologist</td>
<td></td>
<td>• The incidences of Hepatitis C are increasing at an alarming rate in Pakistan, and particularly in Sindh.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GMMCH, Sukkur</td>
<td>• The present incinerator is not working efficiently and has only 20 – 25 ft chimney height which is very low. The incinerator while working emits black smoke which indicates that incomplete combustion is taking place.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• People from the surrounding area has also questioned the efficiency of this incinerator. Therefore, in order to protect the surrounding environment, it is imperative to install the state of the art incinerator with a proper Air Pollution Control Device.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• By installing the state of the art incinerator all step enlisted in the Sindh Hospital Waste Management Rules, 2014 will be in compliance range.</td>
</tr>
<tr>
<td>03/08/2018,</td>
<td>Mr Daniz, Student Nurse</td>
<td>GMMCH, Sukkur</td>
<td>• It is HWMT responsibility to dispose of the infectious hospital waste properly. Infectious hospital waste if improperly disposed of can lead to the spreading of infections particularly Hepatitis C.</td>
</tr>
<tr>
<td>10:30-10:40 am</td>
<td>Ms Alina, Student Nurse</td>
<td></td>
<td>• It should be made sure that the new incinerator does not pose any kind of hazards to the patients, the staff of the hospital and to the community working and living nearby</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Waste management of Cardiology ward is good as compared to other departments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The positive impacts of this project outweigh the potential negative impacts that may occur during the construction and operational phase.</td>
</tr>
<tr>
<td>03/08/2018,</td>
<td>Waqas Ahmed Khan, Admin Manager</td>
<td>GMMCH, Sukkur</td>
<td>• Presently, the incinerator is used to destroy infectious hospital waste being generated at GMMCH, Sukkur. It was locally manufactured with a capacity of 100 kg/cycle. This incinerator needs to be replaced by the state of the art technology.</td>
</tr>
<tr>
<td>10:40-11:00 am</td>
<td></td>
<td></td>
<td>• It is a very good initiative of the Health Department to install incinerator at GMMCH, Sukkur as controlling infection should be a priority of the Government.</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>• My suggestion would be that the wet scrubber should be efficient and should properly treat exhaust emissions before discharging into the air. Similarly, the technical staff should have the adequate technical training to operate the incinerator once it has been installed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Care should be taken during the construction phase of the project as ambulances and patients regularly use the main access Road to different departments of the hospital. The contractor should bring construction supply material and labour through a specific route, and it should be devised in consultation with the Hospital administration.</td>
</tr>
<tr>
<td>Date &amp; Time</td>
<td>Name and Designation</td>
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</table>
| 03/08/2018, 11:00- 11:30 | Mr Abdul Waheed, Male Nurse  
Mr Mansoor Hussain, Male Nurse  | GMMMCH, Sukkur | • There should be an increment of the budget.  
• An awareness campaign should be launched.  
• Guidelines should be provided for proper infectious hospital waste management  
• In order to destroy them all the infectious hospital waste, there is an urgent need to replace the existing incinerator. The new incinerator should have high capacity.  
• Moreover, the incinerator operators and HWM team should be given a detailed briefing about the new incinerator so that the operation becomes easy. |
| 03/08/2018, 11:40- 11:55 am | Muhammad Shaban, Patient  
Muhammad Yamin, Patient  
Ali Shar, Patient  
Najaf Ali, Patient  
Riaz Ali, Patient attendant | GMMMCH, Sukkur | • Waste management of cardiology ward is good. All the waste is taken to colour coding bins, and syringes are being disposed of properly.  
• Wards are cleansed once a day, and all the staff is really cooperative.  
• It should be made sure that the new incinerator does not pose any kind of problem to the people.  
• Drinking water should be available at each ward.  
• The washroom is in bad condition. They should clean and maintain on a daily basis to avoid foul odour |
| 03/08/2018, 12:00- 12:30 pm | Nadeem Ahmad, House Keeping Manager | GMMMCH, Sukkur | • It is really good that before a start of a project consultation is being carried out.  
• We already have a working incinerator with 100kg/hr. Capacity.  
• Incinerator installation is a must in GMMMCH, Sukkur in order to properly destroy infectious hospital infectious waste. Once the incinerator will be installed private hospitals should also be directed to dispose of their waste in the incinerator that will eventually lead to less infection.  
• The new state of the art incinerators should have their emission levels under the SEQs limits Pakistan.  
• The incinerators should also be state of the art and should burn all types of infectious hospital waste.  
• All mitigation measures should be followed that the environmental specialist will recommend.  
• Hospital existing waste management could be made even better after installation of the incinerator. |
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<tbody>
<tr>
<td>27/02/2018,</td>
<td>Majid Ali, Senior Engineer</td>
<td>NICH Karachi</td>
<td>• Sufficient land is available for construction of incineration room, yellow room, cold storage</td>
</tr>
<tr>
<td>12:00- 12:30 pm</td>
<td></td>
<td></td>
<td>room, ashpit and supervisor room</td>
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<td></td>
<td>• The construction surface is levelled, situated within the premises of NICH.</td>
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<td></td>
<td></td>
<td></td>
<td>• Basic utilities (Gas, water, electricity) are available at the project site.</td>
</tr>
<tr>
<td>27/02/2018,</td>
<td>Dr Jamal Raza, Medical Superintendent</td>
<td>NICH Karachi</td>
<td>• There would be no tree cutting involved in the project. Dismantling and demolition work of</td>
</tr>
<tr>
<td>12:30- 1:00 pm</td>
<td></td>
<td></td>
<td>existing structure at the t proposed location of incinerator will be carried out by the Public</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Works Department.</td>
</tr>
<tr>
<td>27/02/2018,</td>
<td>Manzoor Shah, Acting Incharge</td>
<td>NICH Karachi</td>
<td>• There is a need of waste treatment facility as NICH produces considerable amount of infectious</td>
</tr>
<tr>
<td>1:00- 1:30 pm</td>
<td>Sanitation</td>
<td></td>
<td>waste daily. Proper scientific disposal of infectious waste is an utmost need of NICH.</td>
</tr>
<tr>
<td></td>
<td>Nasir H. Zaidi, Horticulture Incharge</td>
<td></td>
<td>• Simple collection and disposal through KMC vehicles is carried out.</td>
</tr>
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</table>
6.9. Consultation with the Communities near project sites

The general consultation was carried out in and around hospitals where the incinerators will be installed.

During the Roadside discussion, the community adjacent to the hospital was informed about the salient features of the project, its location, and activities.

About 7% of the respondents involved in the Roadside discussion were of age less than 20. 73% of respondents were in the age group of 20 – 45 years, and 20% were of age 45 and above. Distribution of age of the respondents involved in the Roadside discussion is shown in Figure 6.1.

**Figure 6.1**: Age distribution of people involved in the public consultation of the provision of incinerators in different hospitals of Sindh

![Age Distribution Chart](image)

The respondents were both male and female, and the distribution of gender of the respondents involved in the Roadside discussion is shown in Figure 6.2. 75% of the people consulted belong to the male group while 25% of respondents were females.
Figure 6.2: Gender Distribution of People Involved in Public Consultation on the Provision of Incinerator in Different Hospitals of Sindh

25% of the respondents were illiterate, 29% had done matric, 14% had done matric, and 32% were graduate. Distribution of education of the respondents involved in the Roadside discussion is shown in Figure 6.3.

Figure 6.3: Educational Distribution of People Involved in Public Consultation of the Provision of Incinerators in Different Hospitals of Sindh
The viewpoints of respondents are as follows:

- The hospital waste is very infectious. Hospital waste should be burned properly in the incinerator, and the ashes should be disposed of in a proper way.
- Other hospitals particularly private hospitals should also send their waste to for incineration, and it should be used at its optimum.
- There should be a monitoring system for the private hospital as well. As sometimes it is observed that private hospital dump or burn their infectious waste in the open which is very harmful to the environment.
- The community should not be disturbed in any way by the operation of the incinerator.
- Proper plantation should be done along the incinerator as it may cause smoke or other gaseous emissions.
- Pre-operative screening of patients for Hepatitis B or C is not performed routinely even if the patient is admitted for the first time.
- There is a need to control infection caused by unhygienic tools being used by Barbers.
- There is a need to regulate the healthcare practices of un-qualified doctors and Hakeem’s.
- It is good to know that the existing old incinerator is being replaced by a new one which meets the pollution control standards of the Environmental Protection Department of Sindh.
- It will have positive health impacts on the surrounding communities, hospital employees, patients and sanitary workers.
EIA of Provision of Incinerators (Procurement, Installation, Commissioning & Operations) In Different Hospitals of Sindh

Health Department, Government of Sindh

Exhibit 6.1: Consultation with a Juice Court Owner
Exhibit 6.2: Public consultation with Rickshaw Driver
Exhibit 6.3: Consultation with an Admin
Exhibit 6.4: Consultation with a Shopkeeper
Exhibit 6.5: Public Consultation with a Lab technician
Exhibit 6.6: Consultation with Plant operators
Pictorial Presentation of Public and Stakeholders Consultation for incinerator installation Project of Dr Ruth Pfau Civil Hospital Karachi

Exhibit 6.7: Consultation with a shopkeeper

Exhibit 6.8: Public consultation with Rickshaw Driver

Exhibit 6.9: Consultation with a Public

Exhibit 6.10: Consultation with a Patient

Exhibit 6.11: Public Consultation with a Nurse

Exhibit 6.12: Consultation with AMS Officer.
Pictorial Presentation of Public and Stakeholders Consultation for Incinerator installation Project at Sindh Government Lyari General Hospital Karachi

Exhibit 6.13: Consultation with a Juice Court Owner
Exhibit 6.14: Public consultation with Rickshaw Driver

Exhibit 6.15: Consultation with a school teacher
Exhibit 6.16: Consultation with a Ward Labor

Exhibit 6.17: Public Consultation with a Heath Officer
Exhibit 6.18: Consultation with GMS and DMS Officer.
Pictorial Presentation of Public and Stakeholders Consultation for Incinerator Installation Project of Liaquat University Hospital Jamshoro/Jamshoro

Exhibit 6.19: Consultation with a Patient

Exhibit 6.20: Public consultation with visitors

Exhibit 6.21: Consultation with RMO

Exhibit 6.22: Consultation with House Officers

Exhibit 6.23: Public Consultation with Labor

Exhibit 6.24: Consultation with AHS Additional MS
Pictorial Presentation of Public and Stakeholders Consultation for incinerator installation Project at Peoples Medical University College Hospital, Shaheed Benazirabad

Exhibit 6.25: Consultation with an AMS

Exhibit 6.26: Public consultation with Rickshaw Driver

Exhibit 6.27: Consultation with Private hospital

Exhibit 6.28: Consultation with admin

Pictorial Presentation of Public and Stakeholders Consultation for incinerator installation Project of Ghulam Muhammad Mahar Medical College Hospital Sukkur

Exhibit 6.29: Consultation with a Shopkeeper

Exhibit 6.30: Public consultation with Labor
EIA of Provision of Incinerators (Procurement, Installation, Commissioning & Operations) In Different Hospitals of Sindh
Health Department, Government of Sindh

Pictorial Presentation of Public and Stakeholders Consultation for Incinerator installation Project of Chandka Medical College Hospital Larkana

Exhibit 6.31: Consultation with a Blood Bank Incharge
Exhibit 6.32: Consultation with Hospital employee

Exhibit 6.33: Consultation with Medical Superintendent
Exhibit 6.34: Public consultation with School teacher

Exhibit 6.35: Consultation with a Headmaster
Exhibit 6.36: Consultation with a Rickshaw Driver
7 Impact Assessment and Mitigation Measures

7.1 Introduction
This chapter provides screening of potential environmental impacts of the proposed project, discusses the stakeholders’ views, assesses the significance of the potential impacts, and recommends mitigation measures to minimize if not eliminate the potentially adverse impacts of the proposed activities.

7.2 Environmental Screening of the Proposed Project
An Environmental Screening Matrix has been developed as part of the present EIA study focusing on the potential environmental impacts of the project during pre-construction/design, construction and operational phases.

The matrix examines the intersection of project activities with various components of the environment. The impacts are broadly classified as physical, biological and social, and then each of these broad categories further divided into different aspects. The potential impacts have been predicted and are characterized as follows:

- High negative (adverse) impact,
- Low negative impact,
- Insignificant impact,
- High Positive (beneficial) impact,
- Low positive impact, and
- No impact.

The environmental screening matrix (unmitigated) of the provision of incinerators in different hospitals of Sindh is provided in Table 7.1.

The negative impacts predicted in this manner are the “unmitigated” impacts. Appropriate mitigation measures have been recommended as part of this EIA.

The occurrence possibility and severity of the potentially adverse impacts identified in Table 7.1 will be reduced as a consequence of the incorporation of these mitigation measures into the project design/management. The negative impacts screened through this process are discussed in the chapter.
Table 7.1: Environmental Screening Matrix (un-mitigated) of EIA of Provision of Incinerators in Different Hospitals of Sindh

<table>
<thead>
<tr>
<th>Description</th>
<th>Physical</th>
<th>Biological</th>
<th>Social and Socio-economic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soil Contamination</td>
<td>Air Quality</td>
<td>Surface and Ground Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Siting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Site, Land Use and Design</td>
<td>-1</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Visual Impacts</td>
<td>-1</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Acquisition</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Contractor Mobilization</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>Construction Camp Establishment</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Construction Camp Operation</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Site Preparation</td>
<td>-2</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Construction Works</td>
<td>-2</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Laying of Services</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Construction of Buildings</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Construction Materials Supply</td>
<td>-1</td>
<td>-1</td>
<td>N</td>
</tr>
<tr>
<td>Description</td>
<td>Physical</td>
<td>Biological</td>
<td>Social and Socio-economic</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Soil Contamination</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Air Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Surface and Ground Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flora</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fauna</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Noise and Vibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Land Acquisition and</td>
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<td></td>
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<td></td>
<td>Compensation Issues</td>
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<td></td>
<td></td>
<td></td>
<td>Safety, Public Health and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nuisance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Employment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Historical or Archeological Sites</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construction Crew Transportation</th>
<th>-1</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste Disposal</td>
<td>-2</td>
<td>-1</td>
<td>N</td>
</tr>
<tr>
<td>Waste Effluent Disposal</td>
<td>-1</td>
<td>0</td>
<td>N</td>
</tr>
<tr>
<td>Demobilization of Contractor</td>
<td>-1</td>
<td>0</td>
<td>N</td>
</tr>
</tbody>
</table>

**Key:** -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible negative; +1: low positive impact; +2: High positive impact, N: no impact.

Operation Phase

| Operation of Incinerator facility | -1       | -2         | -1                        | -1         | -2         | -2         | N           | -2         | +1         | N          |
7.2.1 Community and Stakeholders’ View

As discussed in chapter 6, a public consultation was held with the community and stakeholders regarding their comments and suggestion on the installation of incinerators at eight different districts of Sindh Province. The views of the stakeholders are listed below:

- The incidences of Hepatitis C are increasing at an alarming rate in Pakistan, and particularly in Sindh.
- The existing incinerators are out of work and emit black smoke when operated.
- The incineration is the best option especially for Pakistan as hospital staff/scavengers reuse the hospital waste particularly syringes if not burnt to ashes.
- The new state of the art incinerators should have their emission levels under the SEQs limits Pakistan.
- The incinerators should also be state of the art and should burn all types of infectious hospital waste.
- The selected incinerators are the best option for hospital waste disposal as thorough as this all infections can be controlled effectively.
- There is a need for improvement in the solid waste management system of the city, and proper sanitary landfill site is required to avoid any infection spreading.
- The main problem faced during the hospital waste collection is that sometimes people throw their waste in the wrong basket which is difficult to segregate afterwards.
- There is a lot of need for the installation of incinerators at different hospitals of Sindh, since, there are no other proper hospital waste treatment and disposal mechanism being followed by nearby located private sector hospitals.
- Recycling of syringes is commonly practised in different hospitals of Sindh. Therefore, proper awareness is required in the community to deal with this problem.
- The operators of the incinerators should be equipped with PPEs, and they should be properly trained for its operation and maintenance.

7.2.2 Environmental Impact Characterization

During the environmental impact assessment process, the predicted impacts are characterized as follow:

- Nature (direct/indirect)
- Duration of impact (short term, medium term, long-term)
- Geographical extent (local, regional)
- Timing (project phase: before, during and after construction)
- Reversibility of impact (reversible/irreversible)
- Likelihood of the impact (certain, likely, unlikely, rare)
- Impact consequence severity (severe, moderate, mild)
- The significance of impact (high, medium, low)

The above aspects of impact characterization are defined in Table 7.2.
Table 7.2: Impact characterization of installation of incinerators in different hospitals of Sindh

<table>
<thead>
<tr>
<th>Categories</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature</td>
<td>Direct: The environmental parameter is directly changed by the project.</td>
</tr>
<tr>
<td></td>
<td>Indirect: The environmental parameter changes as a result of a change in another parameter.</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short-term: Lasting only for the duration of the project such as noise from the construction activities.</td>
</tr>
<tr>
<td></td>
<td>Medium-term: Lasting for a period of few months to a year the project before naturally reverting to the original condition such as loss of vegetation due to the clearing of the construction site, contamination of soil or water by fuels or oil.</td>
</tr>
<tr>
<td></td>
<td>Long-term: Lasting for a period much greater than medium-term impact before naturally reverting to the original condition such as loss of soil due to soil erosion and air emissions.</td>
</tr>
<tr>
<td>Geographical extent</td>
<td>Local, regional (spatial dimension)</td>
</tr>
<tr>
<td>Timing</td>
<td>Construction and operation</td>
</tr>
<tr>
<td>Reversibility of impact</td>
<td>Reversible: When a receptor resumes its pre-project condition.</td>
</tr>
<tr>
<td></td>
<td>Irreversible: When a receptor does not or cannot resume its pre-project condition.</td>
</tr>
<tr>
<td>Likelihood of the impact</td>
<td>Almost Certain: Impact expected to occur under most circumstances</td>
</tr>
<tr>
<td></td>
<td>Likely: Impact will probably occur under most circumstances</td>
</tr>
<tr>
<td></td>
<td>Possibly: Impact may possibly occur at some time</td>
</tr>
<tr>
<td></td>
<td>Unlikely: Impact could occur at some time</td>
</tr>
<tr>
<td></td>
<td>Rare: Impact may occur but only under exceptional circumstances</td>
</tr>
<tr>
<td>Impact consequence severity</td>
<td>Major: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora or fauna; has long-term effects (period of years) on socio-economic activities of significance or regional level.</td>
</tr>
<tr>
<td></td>
<td>Moderate: When an activity causes long-term (period of years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one generation of a population of flora or fauna; has short-term effects (period of months) on socioeconomic activities of significance on a regional level.</td>
</tr>
<tr>
<td></td>
<td>Minor: When an activity causes short-term (period of few months) reversible damage to an environmental feature; sight reversible damage to a few species of flora or fauna within a population over a short period; has short-term (period of months) effects on socioeconomic activities of local significance.</td>
</tr>
<tr>
<td></td>
<td>Negligible: When no measurable damage to the physical, socio-economic, or biological environment above the existing level of public concern; and conformance with legislative of statutory requirements.</td>
</tr>
<tr>
<td>Significance of impact</td>
<td>Categorized as High, Medium, or Low</td>
</tr>
<tr>
<td></td>
<td>Based on the consequence, likelihood, reversibility, geographical extent, and duration; the level of public concern; and conformance with legislative of statutory requirements.</td>
</tr>
</tbody>
</table>
Subsequent to the characterization, appropriate mitigation measures were identified, in order to minimize, if not completely eliminate, the adverse impacts associated with project activities. Finally, residual impacts were identified.

The impact characterization of the predicted impacts, mitigation measures and residual impacts are discussed below:

7.3 Pre-Construction/Design Phase Impacts

7.3.1 Project Location Impacts

The impacts associated with the project location (sitting) are those which relate to its location at the designated site. These impacts are different from those which are associated with the project’s construction and operational phases. The construction and operational impacts are associated with the activities such as land clearing, waste disposal, whereas the sitting impacts relate to the mere presence of a facility at the given location.

For the proposed project, the aspect of the project site, land use and design have been considered.

7.3.2 Project Location, land use and design

The incinerators are being installed within the premises of the said hospitals and will be the replacement of the existing old incinerators at an adjacent piece of land. The project will not have any impact on demographic patterns and disruption of social and cultural values. The socio-economic impacts of the setting up of the incinerator are anticipated as being positive.

The unmitigated impacts associated with the Project sitting, land use and design are characterized as follows:

<table>
<thead>
<tr>
<th>Nature:</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration:</td>
<td>Long-term</td>
</tr>
<tr>
<td>Geo extent:</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility:</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood:</td>
<td>Possibly</td>
</tr>
<tr>
<td>Consequence:</td>
<td>Moderate</td>
</tr>
<tr>
<td>Impact significance:</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Mitigation Measures

- The specific project sites at the selected hospitals cannot be categorized, as being ecologically or environmentally sensitive.
- The project will be located near the source of infectious hospital waste which must be treated within 24 hours of its generation. The land use and layout plan of the project site will be designed in accordance with the instruction of manufacture of the incinerator. The buildings of the incinerator facility will blend with the overall landscape and natural settings of the hospital.
- The new incinerator will cause no specific adverse effect on the existing landscape.
7.4 Construction Phase Impacts

Various construction activities will invariably create environmental disturbances, which may have temporary impacts on the physical, biological and social environment of the area and nearby communities during the construction phase. Such impacts include the following:

- **Physical Environment**
  - Soil erosion and degradation
  - Air quality deterioration
  - Water Quality (Surface and groundwater)

- **Biological Environment**
  - Loss of Vegetation
  - Damage to wildlife

- **Socio-economic Environment**
  - Noise and vibration
  - Safety hazards, Public health and nuisance issues
  - Sites of Archaeological or Historical Significance

7.4.1 Soil Erosion and Degradation

The soil related issues include soil erosion, slope stability, and soil contamination. These may be caused by land clearing, levelling and grading, excavation and filling, construction activities and maintenance of equipment/vehicles.

The soil may be contaminated as a result of improper handling of fuel, oil, chemical and solid waste or untreated wastewater from the construction site. Extraction of stone or gravel and removal of topsoil from the project site may potentially lead to soil erosion.

This contaminated soil may adversely affect the natural vegetation in the area.

<table>
<thead>
<tr>
<th>Nature</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Long-term</td>
</tr>
<tr>
<td>Geo extent</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Certain</td>
</tr>
<tr>
<td>Consequence</td>
<td>Moderate</td>
</tr>
<tr>
<td>The significance of Impact</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

**Mitigation Measures**

- Good management of topsoil will be done to prevent the loss of soil fertility.
- Construction activities carried out in a manner to minimize soil erosion.
- Land clearing, levelling and grading be minimized.
- Excavated slopes will not be left untreated/unattended for long durations. Appropriate slope stabilization measures will be taken as per the design (i.e. Stone pitching).
- Temporary measures, such as the construction of temporary walls reinforced with brick lining bordering the construction areas to contain debris and spoil, will also be undertaken to avoid soil erosion and water contamination.
The stone and gravel will not be extracted from the project area.

Vehicles and equipment will not be repaired at the project site. If unavoidable, impervious shield will be used to avoid any soil contamination.

Waste oils (if any) will be collected in drums and sold to the recycling contractor.

The recyclable waste from the project site (such as cardboard, drums, broken/used parts, etc.) will be used as appropriate or to be sold to recycling contractor.

All temporary structures established during the construction phase for the temporary purpose will be demolished, land levelled and re-contoured to the original condition or better. All debris and any other material will be removed from the site.

### 7.4.2 Air Quality Deterioration

The construction machinery and project vehicles will release exhaust emissions, containing Carbon Monoxide (CO), Oxides of Sulfur (SOx), Oxides of Nitrogen (NOx) and Particulate Matter (PM).

Impacts of air emissions may be carried over long distances depending upon the wind speed, direction, temperature of the surrounding air and atmospheric stability.

These emissions can deteriorate the ambient air quality in the immediate vicinity of the project site. Furthermore, construction activities such as excavation, land levelling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.

The unmitigated impacts related to air quality deterioration are characterized below:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Temporary</td>
</tr>
<tr>
<td>Geo extent</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Certain</td>
</tr>
<tr>
<td>Consequence</td>
<td>Moderate</td>
</tr>
<tr>
<td>Significance of Impact</td>
<td>High Negative</td>
</tr>
</tbody>
</table>

**Measures and Mitigation**

- Construction machinery and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions.
- Fugitive dust emissions will be minimized by spraying water on soil, where required and appropriate.
- Vehicular traffic on unpaved track will be avoided as far as possible.
- To minimize the occupational health hazard, proper personal protective gears, i.e. masks shall be provided to the workers who are engaged in dust generation activity.

**Residual Impacts**

The above measures will reduce the magnitude of the adverse impacts on the ambient air quality. The significance of the residual impacts on the air quality is expected to be low.
7.4.3 Water Quality (Surface and Groundwater)

During construction, water will be used for various construction activities, but the impact found to be of minor significance.

The unmitigated impact associated with the water quality of the area is characterized as follows:

Nature: Direct
Duration: Long-term
Geo extent: Local
Reversibility: Irreversible
Likelihood: Possibly
Consequence: Severe
Impact significance: Moderate
Timing: Design Phase

Measures and Mitigation

- During construction, the wastewater generated from the septic tank which will be properly drained into the sewerage line of the hospital.
- The solid waste generated will be reused where possible, if not reused, they will be disposed at the solid waste disposal site of the respective district Metropolitan Corporation.

7.4.4 Loss of Vegetation

The project site preparation and construction activities may necessitate removal of the natural vegetation, but no tree will be cut during any phase of the project.

The unmitigated impacts of the proposed activities on the loss of vegetation of the area are characterized below.

Nature: Direct
Duration: Long Term
Geo extent: Local
Reversibility: Irreversible
Likelihood: Certain
Consequence: Moderate
Significance of Impact: Insignificant Impact

Mitigation Measures

- The selected hospitals will maintain existing plantation cover and aesthetic beauty of the area.
- Endeavours will be made to enhance the environment, through a plantation of trees.
\begin{itemize}
\item All preventive measures will be adopted to control the spill-over of chemicals and other effluents on the ground to protect the soil.
\item The construction workforce will be provided with LPG as cooking and heating (if required) fuel. The burning of fuelwood will be strictly prohibited.
\end{itemize}

Residual Impact

The trees planted under the plantation plan will take some time to grow and mature. This impact cannot be fully mitigated, and all other residual impacts would be medium; at least in the medium term. In the longer run, however, the planted trees and vegetation will enhance the environment of the selected Hospitals.

7.4.5 Damage to Wildlife

The project site is small and inhibits no wildlife, while smoke, chemicals, dust particles, and noise generated by construction machinery during the construction period are a scaring factor for biota. Rodents and insects would lose their abode.

Impacts on wildlife may arise from the following project activities:

\begin{itemize}
\item Noise generated from project activities;
\item Movement of personnel and vehicles;
\item Lights used at the project facilities;
\item Clearing of vegetation; and
\item Improper disposal of wastes
\end{itemize}

The unmitigated impacts of the proposed activities on the faunal resources of the area are characterized below:

\begin{tabular}{|l|l|}
\hline
Nature: & Direct \\
\hline
Duration: & Medium to long-term \\
\hline
Geo extent: & Local \\
\hline
Reversibility: & Irreversible \\
\hline
Likelihood & Certain \\
\hline
Consequence & Moderate \\
\hline
Significance of Impact: & Insignificant Impact \\
\hline
\end{tabular}

Mitigation Measures

\begin{itemize}
\item The measures to prevent soil and water contamination will forestall any adverse impact on the faunal resources of the area.
\item Special measures will be adopted to minimize impacts on birds, such as avoiding noise-generating activities.
\item The measures to enhance natural vegetation in the area will benefit the area’s fauna as well.
\end{itemize}
The designated project staff will not be allowed to indulge in any hunting or trapping activities.

Appropriate diffusers will be used to restrict the illumination within all the designated project sites.

Night time construction works will not be undertaken.

Residual Impact
Despite the above mitigation measures, there will be some residual impacts of the project on the faunal resources of all the project areas. The significance of these residual impacts is expected to be medium.

7.4.6 Noise and Vibration
Due to the movement of heavy machinery and vehicles, there would be excessive noise and vibration. Other construction activities which may result in intermittent noise and vibration include excavation for foundation, lifting and unloading of the incinerators, use of air compressors, concrete mixing plants, generators and light towers.

The unmitigated impacts related to the noise and vibration caused by the project are characterized below:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Temporary</td>
</tr>
<tr>
<td>Geo extent</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Certain</td>
</tr>
<tr>
<td>Consequence</td>
<td>Moderate</td>
</tr>
<tr>
<td>Significance of Impact</td>
<td>Moderate negative</td>
</tr>
</tbody>
</table>

Mitigation Measures
- To mitigate these impacts noise barriers will be constructed in sensitive areas.
- Construction equipment and vehicles will have exhaust mufflers (silencers) to minimize noise generation.
- Nighttime traffic and construction activities will be avoided.

Residual Impact
Despite the above mitigation measures, there will be some residual impacts of the project on the noise and vibration of the area. The significance of these residual impacts is expected to be low.

7.4.7 Safety Hazards, Public Health and Nuisance
The project may pose some safety hazards to the hospital staff, patients and visitors.

The public health issues related to the project site include the possibility of contamination of local drinking water resources and dust emissions during the construction phase. The anticipated health impacts are classified into the following categories:
Dust and Pollen Allergy: One of the main problem people may face in dust and pollen allergy.

Eye and Respiratory Diseases: Construction workers may be susceptible to eye and respiratory diseases due to their routine exposure to dust and exhaust emissions on the project site.

Accidents: During the construction phase, as the traffic will increase, it may cause accidents and become a safety problem.

Physical Injuries: Injuries could happen primarily by occupational-related accidents, animal bites, etc. Activities such as land clearing, tree felling, earthworks, and construction present various occupational hazards to the workers on site.

Psychological Disorders: Some workers may suffer from depression and anxiety disorders due to working and accommodation conditions, and their relationship with fellow workers. The psychological wellbeing of some members of the community may be affected due to disturbances created by the project activities.

Excessive illumination at the construction site may potentially cause light pollution, creating a public nuisance.

The unmitigated impacts related to the safety hazards; public health and nuisance are characterized as follows:

Nature: Direct and indirect
Duration: Short to medium term
Geo extent: Local
Reversibility: Reversible
Likelihood: Likely
Consequence: Major
Impact significance: High.

Mitigation Measures

- Protected fencing will be fixed around the construction site. Unauthorized access to the construction area will not be allowed.
- The local community, hospital staff, patients and visitors will be educated regarding the safety hazards at the project site.
- Defensive driving practices will be inculcated in the project drivers through training, posters and other similar measures.
- Vehicle speeds of 5 km/hr at the project site will be implemented.
- Appropriate light diffusers and reflectors will be used, if required, to minimize the public nuisance caused by light pollution.
- Personnel injuries risks can be mitigated through the provision of appropriate training and emergency response procedures.
- The contractor will ensure better working conditions for its employees.
- Regular routine health screening of the contractor staff will be carried out.
- Firefighting equipment will be made available at the construction site.
- The construction site office will have first-aid kits.
- The construction crew will be provided with an awareness of the transmissible diseases (such as HIV/AIDS, Hepatitis B and C).
- All safety precautions will be taken to transport, handle and store hazardous substances such as fuel.

**Residual Impacts**

There will be a moderate level of residual impact of safety hazard associated with the vehicular traffic and construction activities.

The residual public health and nuisance issues will be quite negligible after the effective implementation of the mitigation measures.

7.4.8 **Sites of Archaeological or Historical Significance**

There are no such archaeological and historical sites near the selected hospitals.

7.5 **Operational Phase Impacts**

The operation of the incinerator facility in all hospitals will interact with different components of the environment. For the successful operation of the incinerator facility, proper planning is required in order to minimize the environmental impacts as well as public awareness is also very important.

For smooth operation and less environmental and health impacts, training of the incinerator operator is quite important.

The impact of the operation of the proposed incinerator facility on the surrounding environment will be associated with the issue of infectious waste storage and emissions. The interaction of the incinerator with the various compartment of the environment may result in the following adverse impacts.

- Soil Contamination
- Air quality deterioration
- Safety Hazards, Public Health and Nuisance

7.5.1 **Soil Contamination**

The soil may be contaminated as a consequence of infectious waste (solid as well as liquid) and ash disposal at the project site. Improper wastewater disposal at the healthcare facility can also contaminate soil.

The unmitigated impacts of incinerator facility operation on the soil of the area are characterized as follows:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Long-term</td>
</tr>
<tr>
<td>Geo extent</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Certain</td>
</tr>
<tr>
<td>Consequence</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Significance of Impact: High

Mitigation Measures

- The infectious hospital waste will be segregated from the other non-risk waste and will not be sent to the municipal waste dumping site/landfill. Solid and infectious hospital waste generated by each selected hospital shall be collected, and the waste bins will be placed at various wards/locations.
- All the yellow bags will be stored in the yellow room where the 4°C temperature will be maintained.
- Fly ash and other incineration residuals will be disposed at Ashpit.
- Oils and grease from moving machine parts and other sources will be handled as hazardous wastes.

Residual Impacts

The residual impacts after the implementation of the above-mentioned mitigation measures will be negligible.

7.5.2 Air quality deterioration

Incineration of infectious waste can also pollute the air. Of particular concern are dioxins which are produced by burning of the plastic and polyethene products. The dioxins are carcinogenic and can affect the healthcare of the facility staff carrying out the waste burning, nearby staff, patients, and communities.

Stack emissions

Burning of any substance leads to emissions which could be released into the air, and the emissions contain particulates, Sulfur oxides (SOx), Nitrogen oxides (NOx), Volatile Organic Compounds (VOCs) dioxins/furans and acidic gases.

The particulates generated as a result of the burning process of infectious waste also contain heavy metals which could cause serious health and environmental impacts.

Primary attention needs to be focused on gaseous emissions of particulate less than 10 microns in size, dioxins, furans, sulfur oxides and nitrogen oxides which are associated with immediate health and environmental concerns. However, it is anticipated that the incinerator stack emissions are low, and the incinerator has a 15 m stack height which is enough to disperse and dilute the plume coming out of the installed incinerators.

Air emissions as result of the incinerator facilities can have major impacts on the local and regional air quality if not controlled properly. These air pollutants could seriously affect human health, vegetation, agriculture and other entities.

The unmitigated impact associated with the stack emission from the incinerator is characterized as follows:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Long-term</td>
</tr>
<tr>
<td>Geo extent</td>
<td>Local/Regional</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
</tr>
</tbody>
</table>
Likelihood: Possibly  
Consequence: Severe  
Impact significance: High  
Timing: Operation Phase  

**Mitigation Measures**

In order to ensure a safe and healthy environment, the incinerator facilities need to carry out the following measures:

- The incinerators are specifically designed for infectious hospital Waste which will be burned.
- Properly trained staff operate the incinerators according to standard operating procedures
- In order to limit the emissions, the incinerator facilities will be operated and maintained as per the manufacturer’s operational manual.
- The temperature in the primary chamber will be around 600-800°C, and in the secondary chamber, it will be 1100°C ± 50°C.
- To lessen the health and ecological impacts higher chimney height of the facilities (15m) will be designed to minimize the ground level concentration of pollutants.
- Latest pollution control equipment has been provided in the incinerators to remove air emissions in order to meet environmental standards.
- If properly operated the best air pollution control equipment can potentially remove up to 99% of dioxins and furans, more than 99% of heavy metals, 99% of PM, more than 99% of hydrogen chloride, more than 90% of Sulfur dioxide and up to 65% of Nitrogen Oxides.
- Exhaust gas from an incinerator can be forced through a wet scrubber to remove toxic gases. Scrubbers are used primarily to control acid gases, but they remove some heavy metals as well. Wet scrubbers use a moving alkaline liquid solution to neutralize acids.
  
Dry scrubbers either a file alkaline spray or powder to neutralize the acid and it could control maximum pollution followed by a baghouse.
- Primary pollutants emitted from the installed incinerator facilities will be monitored continuously.
- Production of Carbon-monoxide (CO) and Hydrogen Chloride (HCl) are directly related to the combustion efficiency. Therefore, the optimum conditions must be ensured to prevent their production. The reason could be the incomplete burning of waste overloading of the furnace and insufficient temperature caused by the high moisture content of the waste.
- Regular and thorough cleaning of the incinerators would be done, including ash removal is absolutely essential for efficient operation. An accumulation of ash/unburnt material/incombustible matter will cause the excessive temperature to be generated and should, therefore, be avoided.
  
The incinerators will be cleaned, and all ash removed regularly. Free passage of air is essential for combustion as well as for the cooling process. Therefore, the removal of deposits from within as well as underneath the combustion chamber is critical.
- Good combustion practices can control emissions by ensuring that the temperature in the combustion chamber and the time the waste remain in the combustion chamber
are kept at optimal levels. Major variations in these or other incineration operation could lead to a limited but significant belch of contaminated air emissions.

**Residual Impacts of stack emissions**

There will be a moderate level of residual impact of air contamination associated with the operational activities. The significance of these residual impacts is expected to be low after taking the above-mentioned mitigation measures.

**Residual Incinerator Ash**

The ash generated in the incinerator facilities contains a concentration of heavy metals, such as lead, cadmium, mercury, arsenic, copper and zinc.

The principal environmental concern regarding incinerator ash is that when ash is disposed of in a landfill, the metals and organic compounds can leach and migrate into groundwater or nearby surface water.

In addition to possibly contaminating water supplies, incinerator ash could also affect human health through direct inhalation or ingestion of airborne or settled ash.

The unmitigated impacts associated with the residual ash is characterized as follows:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Long-term</td>
</tr>
<tr>
<td>Geo extent</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Possibly</td>
</tr>
<tr>
<td>Consequence</td>
<td>Severe</td>
</tr>
<tr>
<td>Impact significance</td>
<td>High</td>
</tr>
<tr>
<td>Timing</td>
<td>Operation Phase</td>
</tr>
</tbody>
</table>

**Mitigation Measures**

- An ash pit will be constructed in the vicinity of the incinerator area 5.95 Sq. m as a part of the project where the ash residue will be buried deep. Approximately 2kg of ash will be produced by burning 100 Kg of waste per hour.
- The ash pit will be constructed of concrete lining and will be watertight so that no water enters the ash pit. This will ensure that soil and groundwater are not contaminated.
- Ash produced by the proposed incinerators will be collected in ash bins which will be conveyed to the ash pit for its final disposal.
- Bottom ash and fly ash are often managed together and referred to as “Combined ash”. Incinerator ash is usually disposed of in a Hazardous Waste (HW) landfill or an ash-only landfill known as an Ash Monofill. Ash Monofill are specially designed to reduce the ability of heavy metals to migrate from the ash into the environment. Monofill is often co-located with hospital waste incinerators or existing landfills to reduce transportation distances and sitting difficulties.
If the ash has to be landfilled, it can be stabilized and solidified by encasing in concrete prior to disposal, thereby significantly reducing the potential for the contaminant to migrate.

Residual Impact

The above measures will reduce the magnitude of the adverse impacts on the environment. The significance of the residual impacts on the air quality is expected to be low.

7.5.3 Water Contamination

During operation, water will be used for the wet scrubber system, and wastewater will contain dissolved gases and suspended particles in it. If the wastewater gets to the wastewater stream in the untreated form, it may pose a serious threat to the community.

The unmitigated impact associated with the water quality of the area is characterized as follows:

<table>
<thead>
<tr>
<th>Nature:</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration:</td>
<td>Long-term</td>
</tr>
<tr>
<td>Geo extent:</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility:</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Likelihood:</td>
<td>Possibly</td>
</tr>
<tr>
<td>Consequence:</td>
<td>Severe</td>
</tr>
<tr>
<td>Impact significance:</td>
<td>Moderate</td>
</tr>
<tr>
<td>Timing:</td>
<td>Operational Phase</td>
</tr>
</tbody>
</table>

Measures and Mitigation

- The incinerators come with water treatment technology, and an auto recycles unit. The water used for the operational purpose will be treated in the water treatment facility and reused.
- The sludge created by the treatment will be settled in the settling tank. The settled sludge will be basically gypsum which has commercial value. Thus, water consumption of the incinerator will be reduced.
- 500-liter tank for a wet scrubber is available where 25% Caustic Soda and 75% Water slurry will be sprayed over the exhaust gases. The resulting wastewater will be directed to 690 litres settling tank to reuse the cleared water after settling of sludge. The water is reused as much as possible approximately 4-5 cycles are easily carried out by 500 litres.
- Sludge will be minimum, and it will be deposited in the ash pit.

Residual Impact

The above measures will reduce the magnitude of the adverse impacts on the environment. The significance of the residual impacts on the wastewater quality is expected to be low.
7.5.4 Public Health and Safety Hazards

The proposed project is for the sake of handling infectious hospital waste. There will be infectious waste storage. The incinerator could lead to major health and environmental impacts if not handled and supervised properly.

The workers who are in direct contact with the infectious hospital waste could be affected if the personal safety measures are not ensured.

The health hazards for staff are by far the most significant potential risk associated with the healthcare facility operation.

Safety hazards in the healthcare facilities are generally associated with the handling of sharps (needles, cutters), gases, and other similar equipment. Open burning of hospital waste also poses safety risks for the staff carrying out this activity. These hazards include the risk of cuts, pricks, gas poisoning, burning, and other bodily injuries. The healthcare facility staff, as well as the patients, are susceptible to these safety hazards.

The unmitigated impacts related to the safety hazards; public health and nuisance are characterized as follows:

<table>
<thead>
<tr>
<th>Nature:</th>
<th>Direct and indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration:</td>
<td>Short to medium term</td>
</tr>
<tr>
<td>Geo extent:</td>
<td>Local</td>
</tr>
<tr>
<td>Reversibility:</td>
<td>Reversible</td>
</tr>
<tr>
<td>Likelihood:</td>
<td>Likely</td>
</tr>
<tr>
<td>Consequence:</td>
<td>Major</td>
</tr>
<tr>
<td>Impact significance:</td>
<td>High</td>
</tr>
</tbody>
</table>

Measures and Mitigation

In order to ensure a safe and healthy environment, the infectious hospital waste storage facilities need to carry out the following measures:

- The infection control protocol will be strictly implemented to minimize health risks for the staff and patients.
- Proper management of hospital waste 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, infectious and non-infectious components.
- Other important steps are the institution of a sharps management system, waste reduction, avoidance of infectious substances whenever possible. Ensuring worker safety, providing secure methods of waste collection and transportation, and installing safe treatment and disposal mechanisms.
- Strict compliance with the procedures specified in the Sindh Hospital Waste Management Rules of 2014 (and other similar standards), in close coordination with the infection control protocol mentioned above.
- Infectious Hospital waste will be incinerated on a daily basis, if not, the infectious hospital waste (yellow bag) will not be stored for more than 24 hours.
- The infectious waste storage facilities will be marked properly, and unauthorized personals will not be allowed there.
While dealing with the storage facilities, workers will wear personal protective equipment like a gas mask, gloves, safety shoes etc.

Housekeeping around and inside the incinerator facilities area will be ensured

Vaccination of the staff particularly for Hepatitis A and B and tetanus.

It will be ensured that a reliable and safe drinking water source is available at the facility. Water will be periodically tested against the national standards for drinking water.

Thick/puncture resistant plastic bags to collect Hospital Waste and rigid/puncture proof boxes to dispose of needles/other sharps will be used.

Accidental events will be reported and recorded to avoid future accidents.

Residual Impacts

There will be a moderate level of residual impact of safety hazard associated with the operational activities.

The residual public health and nuisance issues will be quite negligible after the effective implementation of the mitigation measures.

7.6 Case Studies

The purpose of the provision of incinerators (procurement, installation, commissioning & operations) in different hospitals of Sindh Project is to ensure compliance of Sindh Hospital Waste Management Rules 2014 in the selected hospitals which will reduce the prevalence of Hepatitis C in Sindh.

In order to better understand the current status of hospital waste management practices and the spread of Hepatitis B and C in Sindh, two case studies were considered during the EIA process as described hereunder:

7.6.1 Current Hospital Waste Management Practices in Pakistan

A case study regarding the Current Hospital Waste Management Practices in Pakistan: Case Study and Curative Measures was carried out by the Ali. S et al., 2015.14

The main objective of the study was to visit private and public-sector hospitals in Rawalpindi and Islamabad region in order to investigate current hospital waste management practices and to check their compliance with the national and international standards.

This study is conducted at two tertiary care teaching hospitals of good credibility in Rawalpindi/Islamabad city from 15th April 2014 to 25th May 2014. One tertiary care hospital from the Government sector and one from the private sector were selected.

Both hospitals have good cleanliness and hygiene maintained on their premises. The atmosphere, in general, is healthy and periodic mopping is functional. The operation theatre has a high standard of cleanliness and sterilization system in both hospitals.

The private sector hospital has no waste management department/committee contrary to the other. However, none of them has any standard operating procedures or written protocols for

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the waste handling. Both the hospitals observe primary segregation of waste inside the wards. The public-sector hospital has somewhat reasonable procedure to treat waste from the point of generation to the point of dumping.

Conversely, the private sector is rated below the satisfactory level on the basis of certain indicators decided in our research methodology. The used syringes, drug ampoules and sharps are being disposed of properly in both hospitals. The waste is being segregated, but the colour coding for waste bags are not followed as suggested by Hospital Waste Management Rules 2005.

Instead, the practice is the use of red and blue tapes on the local polythene bags which are liable to tear damage easily. Moreover, the collection and transportation from wards to the dumping site are not being carried out as per international standards in both the hospitals.

The staff does not follow proper protection during collection, segregation and transportation in both hospitals. No Storage place exists in a private hospital, and the waste is eventually dumped in a pit situated in the backyard of hospital premises which by all means is an improper practice.

Both hospitals neither have their own incinerator nor have any alternative method of treatment of wastes at the local level. The waste is transported to another faraway place for Incineration twice a week on the minimum in both hospitals.

The analysis of this study shows that segregation of various medical wastes in the hospitals is not being conducted properly. Furthermore, the need for training and capacity building programs for all employees involved in the medical waste management is required.

The Hospital waste management policy and standard operating procedures need to be implemented in accordance with the local and international legislation in true spirit. Overlooking this aspect can lead to potential health hazards for inmates and people living nearby. The severity of this problem can only be addressed by massive awareness drives at all levels.

**7.6.2 Wide prevalence of hepatitis C in Sindh**

There are approximately 1.5 million chronic carriers of hepatitis B and 1.8 million chronic carriers of hepatitis C in Sindh. Hepatitis C symptoms appear in 80% of the population after 10-20 years after infection that’s why the majority of patients are even unaware that they have contracted the disease.

Unfortunately, by the time symptoms appear it’s too late. However, in 20% of population symptoms do appear after 10-12 weeks which includes flu that eventually leads to nausea, vomiting, diarrhoea, loss of appetite, loss of weight and dark-coloured urine etc. Chronic hepatitis C causes severe damage to Liver.

There is currently no vaccination available against hepatitis C. Reusing needles, and unsterile syringes, dental equipment, razors and unsafe blood transfusions have said to be major reasons for transmission of hepatitis in Pakistan. However, it can be prevented by not sharing items that may be contaminated.

The PCR test, which is done to ascertain the existence of hepatitis, costs Rs. 3,000 to 4,000 in the private sector, which the poor cannot afford. The Federal Government has prepared PC-I to control hepatitis in Sindh province. This plan was worth over four billion rupees. The
7.7 Positive Impacts of the Project

The project will greatly enhance the environment as it will destroy infectious waste produced by the hospital.

7.7.1 Infection Control

The installation of incinerator facilities is a very important step towards the improvement of a health condition in Sindh Province, which aims to control the infectious diseases caused by inappropriate disposal of infectious hospital waste.

Hospitals are important sites for the generation of infectious waste. Healthcare waste includes infectious, chemical, expired pharmaceutical and radioactive items and sharps. These items can be pathogenic and environmentally adverse. They are referred to infectious healthcare waste or hospital waste. Incinerator burns all the infectious hospital waste and hence reduce the spread of infectious diseases.

7.7.2 Reduction of Waste

Incineration process is one of the best hospital waste management method. Two of the primary advantages of incineration is that:

- Waste volumes are reduced by an estimated of 80-95%.
- The need for land and landfill space is greatly reduced. For urban areas, this can be especially important, as urban land is often at a premium.

7.7.3 Socio-Economical benefits

Incineration is a practical method of disposal of hospital waste that saves a lot of money on the transport of waste to landfills and thus also the carbon footprint that such transport leaves behind. The sheer reduction in the space required to dispose of the 10 per cent of waste that it does produce relieves pressure on land, which in urban areas can constitute a big saving.

7.7.4 Employment

The operation of Incinerator facilities at all the selected hospitals in five districts of Sindh will improve the employment opportunities in all the respective project areas. It is anticipated that the local community will get direct or indirect employment due to the commencement of the project. The employment will have a positive impact on the local economy.

For the operation, supervision and maintenance of the incinerator facilities, skilled staff is needed. In this way, the local community could get job opportunities.

7.7.5 Business Opportunity

With the startup of operation of Incinerators facilities, business opportunities in the area will be enhanced thus, boosting up the local economy.

Other private hospital and clinics in the selected project areas will also submit their infectious hospital waste to the incineration facilities and will pay a charge for the service. For this
purpose local transportation company and workers will be consulted, this way the proposed project will be a good source of business opportunity in the area.
8 Environmental Management Plan

8.1 Introduction

The EIA report has identified the potential impacts that are likely to arise during the construction and operational phase of the project. The EIA report has identified both positive and negative impacts at each stage of the project.

To minimize the effects of adverse impacts, the EIA has recommended the mitigation measures. These mitigation measures include the use of alternative technologies, management and physical control or compensation in monetary terms.

The proposed mitigation measures have been based on the understanding of the sensitivity and behaviour of environmental receptors in the project area. The legislation controls that apply to the project and a review of good industry practices while operating in sensitive environments.

For residual impacts (impacts remaining after applying the recommended mitigation measures) and for impacts in which there can be a level of uncertainty in prediction at the EIA stage, monitoring measures have been recommended to ascertain these impacts during the course of the project.

For the effective implementation and management of mitigation measures, an environmental management plan (EMP) has been prepared. The EMP satisfies the requirement of the Sindh Environmental Protection Act, 2014.

This chapter outlines the implementation mechanism for the EMP and defines the institutional arrangements required for the implementation of the plan. The EMP provides the implementation mechanism for the mitigation measures identified during the EIA.

8.2 Purpose and Objectives of EMP

An Environmental Management Plan (EMP) provides a delivery mechanism to address the adverse environmental impacts of a project during its execution, to enhance project benefits, and to introduce standards of best practices to be adopted for all phases of the project.

The primary objectives of the EMP are to:

- Facilitate the implementation of identified mitigation measures.
- Develop a proper monitoring mechanism and identify the requisite monitoring parameters to confirm the effectiveness of the proposed mitigation measures.
- Define the responsibilities of the project proponent, design and supervision consultant and contractor, and provide a means of effectively communicating environmental issues among themselves.

8.3 Management Approach/ Institutional Capacity

8.3.1 Pre-Construction and Construction Phase

The organizational roles and responsibilities are summarized below:

a) Health Department, Government of Sindh.
The overall responsibility of supervision of all the project activities rests with the project proponent, Health Department, Government of Sindh. The Additional Director Development, Office of Additional Secretary Development, Health Department, and Government of Sindh will be responsible for supervising the project activities.

b) M/s Vertex Medical (Pvt) Ltd., Lahore

M/s Vertex Medical (Pvt) Ltd., Lahore (VMPL) will be responsible for installation, commissioning and operation of the Incinerator at eight districts of Sindh Province for three years.

Vertex Medical will be responsible for compliance of with the Environmental Department procedures, conducting the Environmental Impact Assessment, submitting the environmental report and acquiring NOC for the project from Environmental Protection Department, Government of Sindh.

c) Contractor

Vertex Medical will engage a contractor to carry out civil works. The site engineer of the contractor will carry out field activities as part of their contract agreement. The site engineer will be responsible for implementing various mitigation actions prescribed in the EIA report relevant to the contract. He will also be subject to certain liabilities under the environmental laws of Sindh/Pakistan.

d) Sindh EPA

The Sindh Environmental Protection Agency will periodically visit the project site to monitor the compliance of environmental protection measures detailed in the EIA report.

8.3.2 Organizational Structure and Responsibilities

The organisational structure for the construction phase EMP is described as follows:

Primary Responsibilities: The primary responsibilities for the environmental performance of the project proponent, Additional Director Development, Office of Additional Secretary Development, Health Department, and Government of Sindh will be assumed by their respective highest-ranking officers during the construction phase.

The Project Coordinator, Vertex Medical Pvt. Ltd., will be responsible for the compliance with the EMP of the project.

The Project Coordinator will be responsible for monitoring and ensuring the implementation of the EMP and EIA of the project.

The Contractor, civil work will be responsible for the implementation of the EMP and EIA on the ground.

Field Management and Quality Control: The construction and installation activities will be carried out in an environmentally sound manner during the construction, installation and commissioning phase of the project and will be the responsibility of the project coordinator of Vertex Medical. He will be responsible for implementing EMP and EIA recommendations.

The Additional Director Development, Office of Additional Secretary Development, Health Department, and Government of Sindh will be responsible for ensuring the overall
environmental soundness of all construction activities. He will ensure the implementation of EMP and EIA.

**Environmental Monitoring:** Project Coordinator, Vertex Medical (Pvt) Ltd, will make the necessary arrangements to monitor the key environmental data during the construction phase.

These will include a quantity of water used, a record of waste produced, a record of waste disposal and project related vehicular traffic.

### 8.3.3 Operation Phase

During the operational phase of the project, environmental management will become a routine function.

a) **Health Department, Sindh**

The overall responsibility for supervising all the activities carried by operation and maintenance contractor Medical Vertex rest with the project proponent, Health Department, Lahore.

b) **Vertex Medical (Pvt) Ltd., Lahore**

Overall, the Vertex Medical Lahore will be responsible for operating and maintaining the incinerators for three years. Meanwhile, the staff of the discussed Hospitals will also be trained to operate and maintain the incinerators so that the hospitals do not face issues after the incinerators are handed over. The executing agency, i.e. the selected Hospitals will be responsible onwards.

An environmental monitoring plan has been developed as part of Vertex Medical (Pvt) Ltd, management system. The key environmental parameters, such as water consumption, waste disposal, water quality, traffic count, noise, and status of implementation of plantation plan will be monitored on a regular basis. The environmental monitoring reports will be produced and shared with the EPA, Sindh and the respective hospital management.

The Project Coordinator of Vertex Medical (Pvt) Ltd will be the focal point for all environmental matters associated with the operation of the facilities. He will coordinate with the EPA, Sindh for any monitoring and/or reporting requirements.

c) **Selected Hospitals**

After three years of operational phase, the Medical Superintendents of the selected hospitals will take our operation and maintenance of the incinerators. Then the Medical Superintendents of the selected hospitals will assume the main responsibility for the environmental performance of the incinerator facilities.

### 8.4 Legislation and Guidelines

The EIA of Installation of the incinerator project has discussed provincial, national and international legislation and guidelines that are relevant. The Vertex Medical will ensure that his staff and civil work contractor are aware of this legislation and guidelines prior to the start of the project activities.

The Sindh Environmental Protection Act, 2014 is the basic environmental legislation in Sindh. The act also requires that no person shall emit pollutants or noise in amount, concentration or
level that exceeds the Sindh Environmental Quality Standards (SEQS). The SEQS will be followed throughout the construction and operational phases of the project.

8.5 Environmental Improvement Cell and Responsibilities

Health Department, Government of Sindh, will form up an Environmental Improvement Cell, which will be responsible for the environmental management and supervisory affairs during the construction and operational phases of the project.

The responsibilities of the Environmental Improvement Cell are as follows:

- To ensure the implementation of all the proposed mitigation measures during Installation, commissioning and operational phase of the project.
- Capacity building of the staff regarding environmental improvement and awareness.
- To develop operational guidelines and implementation schedule.
- Receiving complaints from the community. To ensure that the proposed project is implemented in an environmentally friendly manner, causing least harm to the existing environment.

8.6 Approvals

Vertex Medical Pvt Ltd. will obtain environmental approvals from Environmental Protection Agency, Government of Sindh and other regularity agencies.

8.7 Contractual Provisions

Adherence to the requirements of the EMP and EIA in terms of environmental mitigation will be required from the civil works contractor, and thus EMP will form part of their contract agreements signed.

The contractor shall be responsible for implementing the mitigation measures and monitoring of various environmental parameters. The VMPL Coordinator shall monitor the contractor’s performance with respect to EMP implementation.

8.8 Environmental Mitigation Matrix

An Environmental Management Matrix has been developed which is given in Table 8.1.

This Environmental mitigation matrix provides details about potential environmental impacts, where the impact will happen, where the impact will occur, mitigation measures, responsibility and parameters for monitoring.
Table 8.1: Environmental Mitigation Matrix of Provision of Incinerator Project in Different Hospitals of Sindh

<table>
<thead>
<tr>
<th>Potential Environmental Impact</th>
<th>Where the impact is likely to happen</th>
<th>When the impact likely to occur</th>
<th>Mitigation Measures</th>
<th>Responsibility</th>
<th>Parameters for Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-construction Phase Impacts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The project site, land use, and design</td>
<td>At the project site.</td>
<td>During the detailed design of construction works.</td>
<td>The incinerators will be located near the source of infection hospital waste which must be treated within 24 hours of its generation. The land use and layout plan of all the project sites will be designed in accordance with the instruction of manufacture of the incinerators. The buildings of the incinerator facilities will blend with the overall landscape and natural settings of the hospital. Preservation and use of natural drainage pattern.</td>
<td>M/s Vertex Medical Pvt. Ltd.</td>
<td>Health Department and Design of construction works.</td>
</tr>
<tr>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contamination of soil and groundwater</td>
<td>At the project site.</td>
<td>Construction of campsite and buildings.</td>
<td>Septic tank with a soakage pit will be constructed for domestic wastewater from the construction camp. The outflow from the septic tank will be connected with the sanitary sewerage system of the hospital to prevent contamination of soil and groundwater. Vehicles and equipment will not be repaired at the project site. If unavoidable, impervious shield will be used to avoid any soil contamination. Waste oils (if any) will be collected in drums and sold to the recycling contractor. Solid waste will not be disposed of in the open, and on-site burning of solid waste will be not allowed. Waste bins/containers will be placed at appropriate locations. The recyclable waste from the project site (such as cardboard, drums, broken/used parts,</td>
<td>Contractor</td>
<td>Water and Soil</td>
</tr>
<tr>
<td>Potential Environmental Impact</td>
<td>Where the impact is likely to happen</td>
<td>When the impact likely to occur</td>
<td>Mitigation Measures</td>
<td></td>
<td></td>
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<td>-------------------------------</td>
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</tbody>
</table>
| Soil Erosion                  | At the project site.                | Construction of campsite and land levelling for construction activities. | - Campsite area to be kept to the minimum.  
- The construction of a campsite in the levelled area will minimize disturbance to the soil.  
- Construction activities carried out in a manner to minimize soil erosion.  
- Land clearing, levelling and grading be minimized.  
- Exposed surface will be re-surfaced and stabilized as soon as possible.  
- Existing pathways and access Roads will be used as much as possible.  
- Appropriate slope stabilization measures will be taken as per the design (i.e. Stone pitching).  
- Temporary measures, such as the construction of temporary walls reinforced with brick lining bordering the construction areas to contain debris and spoil, will also be undertaken to avoid soil erosion and water contamination.  
- The hazardous waste will be kept separate and handled according to the nature of the waste. While storing, hazardous waste will be marked. |
| Air Quality Deterioration     | At the project site.                | Construction of campsite and buildings | - Construction machinery and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions. |

Responsibility: Contractor  
M/s Vertex Medical Pvt. Ltd.  

Parameters for Monitoring: Land  
Air Quality Report
<table>
<thead>
<tr>
<th>Potential Environmental Impact</th>
<th>Where the impact is likely to happen</th>
<th>When the impact likely to occur</th>
<th>Mitigation Measures</th>
<th>Responsibility</th>
<th>Parameters for Monitoring</th>
</tr>
</thead>
</table>
| Ground Water Quality            | At the project site                 | Construction of campsite and buildings | - Fugitive dust emissions will be minimized by spraying water on soil, where required and appropriate.  
- Vehicular traffic on unpaved track will be avoided as far as possible. | Contractor M/s Vertex Medical Pvt. Ltd. | Water Quality Report |
| Loss of Vegetation              | At the project site                 | Construction of campsite and buildings | - The solid waste generated will be reused where possible, if not reused, they will be disposed at the respective hospitals designated solid waste disposal site from where the municipal committee will take it.  
- Removal of vegetative cover will be kept to the minimum.  
- Un-necessary clearing will be avoided.  
- Tree plantation will be carried out after completion of construction activities.  
- The construction workforce will be provided with LPG as cooking and heating (if required) fuel. The burning of fuelwood will be strictly prohibited. | Contractor M/s Vertex Medical Pvt. Ltd. | Plantation plan implementation |
| Damage to Wildlife              | At the project site                 | Construction of campsite and buildings | - The measures to prevent soil and water contamination will forestall any adverse impact on the faunal resources of the area.  
- The measures to enhance natural vegetation in the area will benefit the area’s fauna as well.  
- Movement of construction machinery and equipment will be restricted to work areas only to avoid necessary disturbance of the wildlife. | Contractor M/s Vertex Medical Pvt. Ltd. | Ambient Air and Noise Monitoring |
| Noise and Vibration             | At the project site                 | Construction of campsite and buildings | - Construction equipment and machinery will have exhaust mufflers (silencers) to minimize noise generation.  
- Noise construction activities will be carried out only during normal working hours. | Contractor M/s Vertex Medical Pvt. Ltd. | Noise Monitoring |
<table>
<thead>
<tr>
<th>Potential Environmental Impact</th>
<th>Where the impact is likely to happen</th>
<th>When the impact likely to occur</th>
<th>Mitigation Measures</th>
<th>Responsibility</th>
<th>Parameters for Monitoring</th>
</tr>
</thead>
</table>
| Health and Safety of the workforce | At the project site | Construction of campsite and buildings | - It will be ensured that the generator, vehicles and other potentially noisy equipment used are in good condition.  
- The use of pressure horns will not be allowed inside each hospital premises.  
- Nighttime traffic and construction activities will be avoided. Medical Superintendent of the selected hospitals will be taken in confidence if such work is unavoidable. | Contractor | M/s Vertex Medical Pvt. Ltd. | Health and Safety Environment Report |
| Public Health, Safety and Nuisance | At the project site | Construction of campsite and buildings | - All occupational and health and safety requirement for workforce will be adhered to.  
- Special safety measures will be adopted during the lifting and unloading of the incinerator to the respective incinerator room.  
- Protected sheet/fencing will be fixed around the construction site. Unauthorized access to the construction area will not be allowed.  
- To minimize the occupational health hazard, proper personal protective gears, i.e. masks shall be provided to the workers who are engaged in dust generation activity. | Contractor | M/s Vertex Medical Pvt. Ltd. | Public Health and Safety |
<p>| Site Restoration | At the project site | Upon completion of construction activities | - All equipment and machinery previously used at the incinerator installation site will be dismantled. | Contractor | M/s Vertex Medical Pvt. Ltd. | Demobilization of contractor |</p>
<table>
<thead>
<tr>
<th>Potential Environmental Impact</th>
<th>Where the impact is likely to happen</th>
<th>When the impact likely to occur</th>
<th>Mitigation Measures</th>
<th>Responsibility</th>
<th>Parameters for Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Soil Contamination              | At Incinerator facilities           | During Operation and maintenance period | • Fly ash and other incineration residuals will not be disposed on land but rather will be disposed of in Ashpit  
• Oils and grease from moving machine parts and other sources will be handled as hazardous wastes in accordance with regulations of hazardous waste regulation. | M/s Vertex Medical Pvt. Ltd. | Soil |
| Air Quality Deterioration (Stack Emissions) | At Incinerator facilities | During Operation and maintenance period | • Duly trained staff will operate the incinerators in accordance with standard operating procedures  
• The temperature in the primary chamber will be kept around 600-800°C, and in the secondary chamber, should be 1150°C + 50°C.  
• Regular and thorough cleaning of the incinerators, including ash removal, is absolutely essential for their efficient operation.  
• An accumulation of ash/unburnt material/incombustible matter will cause the excessive temperature to be generated and should, therefore, be avoided.  
• The incinerator will be cleaned, and all ash would be removed regularly. Free passage of air is essential for combustion as well as for the cooling process. Therefore, the removal of deposits from within as well as underneath the combustion chamber is critical. | M/s Vertex Medical Pvt. Ltd. | Bi-annual Stake emission monitoring report |
<p>| Public Health and Safety hazards | At Incinerator facilities           | During Operation and maintenance period | • The infection control protocol will be strictly implemented to minimize health risks for the staff and patients. | M/s Vertex Medical Pvt. Ltd. | Public Health and Safety Hazard |</p>
<table>
<thead>
<tr>
<th>Potential Environmental Impact</th>
<th>Where the impact is likely to happen</th>
<th>When the impact likely to occur</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Proper management of hospital waste can minimize the risks both within and outside healthcare facilities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Strict compliance with the procedures specified in the Sindh Hospital Waste Management Rules of 2014 (and other similar standards), in close coordination with the infection control protocols mentioned above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Infectious Hospital waste will be incinerated on a daily basis, if not, the infectious hospital waste (yellow bag) will not be stored for more than 24 hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The infectious waste storage facilities will be marked properly, and unauthorized personals will not be allowed there.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• While dealing with the storage facilities, workers will wear personal protective equipment like a gas mask, gloves, safety shoes etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Housekeeping around and inside the incinerator facilities area will be ensured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Vaccination of the staff particularly for Hepatitis A and B and tetanus.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Thick/puncture resistant plastic bags to collect Hospital Waste and rigid/puncture proof boxes to dispose of needles/other sharps will be used.</td>
</tr>
</tbody>
</table>
8.9 Solid Waste Management Plan

Construction Phase: A number of solid waste bins will be placed at the construction site for the collection of solid waste.

The civil work contractor will be responsible for disposal of solid waste generated by the project.

Empty chemical drums, iron cuttings, etc. will be collected separately at the project site within an area marked as "Scrap Yard". After a suitable time frame, scrap will be sold to a recycling contractor.

The construction waste generated will be recycled to the extent possible. Open burning of solid waste will not be allowed.

Operational Phase: Two categories of solid waste will be generated by the incinerator project.

- Municipal Solid Waste: The municipal solid waste generated by the hospital will be dumped at the hospital waste storage area from where the municipal committee will collect it.
- Ash residue: The ash produced will be collected in ash bins, and it will be buried in the Ashpit.

8.10 HSE Management Plan

- Health Safety and Environment (HSE) induction/orientation will be provided to all workforce at the project site.
- Assembly point will be established for the gathering of workforce regarding daily HSE Toolbox Talk at the project site.
- HSE Toolbox Meeting will be held by the HSE Manager on a weekly basis.
- Special education sessions will be conducted properly at the project site.
- The daily walkthrough will be conducted at the project site.
- All the Mandatory PPE’s (Safety Helmet, Safety Jacket, Safety Shoes, Coverall, Full body Harness, Safety Goggles, Earplug, Earmuff, Dust mask/Special, Safety Gloves, Masks etc.).
- Proper and safe scaffolding will be provided at the site for safe work at height.
- All the construction machinery will be inspected properly at the site.
- All cranes and lifting gears will be inspected/checked on a regular basis.
- Inspection and Tagging system will be maintained at the project site.
- Safety signage will be provided at the project site.
- Fire posts will be established at the project site at easy approach location.
- HSE Sign board will be installed at the project site for an emergency response.
- Regular First Aid Center along with all required medicines 24/7 will be available at the project site.
The civil work contractor will develop his HSE policy, roles and responsibilities of HSE Manager and staff. It also provides information about HSE objectives, Personal Protective Equipment (PPE’s) to be used at the site, first aid training and communication and documentation regarding HSE.

- **First Aid Boxes:** First aid boxes will be provided at the construction sites to cope up the emergency situations. Usually, a typical first aid box mainly contains antibiotics, basic medicines, cotton, bandages, sunny plst, healing balms, pyodine, spirit, painkiller, etc.

- **Dispensaries:** Medical facilities will be established by the contractor. A dedicated room will be established as a dispensary and first aid services at the construction site.

- **PPEs:** Site Engineer and HSE Manager will be responsible for providing PPEs to all workers.

- **Safety Signs:** Relevant safety sign boards will be displayed on the work sites to make aware / train workers about safety rules. Mainly safety signs include signs of speed limits, electric spark, etc.

- **TBTs:** Tool Box Talks (TBTs) will be delivered on a regular basis and when a new team of workers start a new activity like shuttering, steel fixing, steel cutting, steel bending, scaffolding, concrete pouring, mechanical works, electrical works, etc. at sites to promote safety culture.

- **Barricading:** The contractor will put up barricade tape at all the active work sites. Hard barricading (scaffolding pipes) will be used to cover exposed areas where excavation is more than 10 feet.

- **Training:** Safety training will be delivered by the HSE Manager to achieve its objectives. Training will be conducted for capacity building of employees / workers / labour / sub-contractors to make them well effective to respond in any kind of emergency situation.

The overall cost of EMP for all eight selected hospitals namely, Jinnah Postgraduate Medical Center Karachi, National Institute of Child Health Karachi, Dr. Ruth Pfau Civil Hospital Karachi, Sindh Government Lyari General Hospital Karachi, Liaquat University Hospital Jamshoro, Ghulam Muhammad Mahar Medical College Hospital Sukkur, Chandka Medical College Hospital Larkana, and Peoples Medical College Hospital Shaheed Benazirabad will be Rs. 546,000/-. However, breakup cost for the safety of workers of a single hospital is described in **Table 8.2**.

**Table 8.2:** Estimated Cost for the Implementation of Environmental Monitoring Plan for Provision of Incinerators in Different Hospital of Sindh for a single hospital

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Quantity</th>
<th>Unit Cost (Rs.)</th>
<th>Total Cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dust Masks</td>
<td>150</td>
<td>10</td>
<td>1,500</td>
</tr>
<tr>
<td>2</td>
<td>Safety Shoes</td>
<td>5</td>
<td>2000</td>
<td>10,000</td>
</tr>
<tr>
<td>3</td>
<td>Gloves</td>
<td>120</td>
<td>200</td>
<td>24,000</td>
</tr>
<tr>
<td>4</td>
<td>First Aid Box</td>
<td>1</td>
<td>3000</td>
<td>3,000</td>
</tr>
<tr>
<td>5</td>
<td>Ear Plugs</td>
<td>40</td>
<td>50</td>
<td>2,000</td>
</tr>
<tr>
<td>6</td>
<td>Safety Helmets</td>
<td>10</td>
<td>1000</td>
<td>10,000</td>
</tr>
</tbody>
</table>
### Table

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Quantity</th>
<th>Unit Cost (Rs.)</th>
<th>Total Cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Safety Jackets (Hi Vis)</td>
<td>10</td>
<td>500</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Others (B)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Provision of Dust Bins</td>
<td>2</td>
<td>1000</td>
<td>2,000</td>
</tr>
<tr>
<td>10</td>
<td>Safety Cones</td>
<td>3</td>
<td>1000</td>
<td>3,000</td>
</tr>
<tr>
<td>11</td>
<td>Safety Sign Boards</td>
<td>5</td>
<td>1500</td>
<td>7,500</td>
</tr>
<tr>
<td>12</td>
<td>Rain Coat</td>
<td>10</td>
<td>1000</td>
<td>10,000</td>
</tr>
<tr>
<td><strong>Total (A + B)</strong></td>
<td></td>
<td></td>
<td></td>
<td>78,000</td>
</tr>
</tbody>
</table>

- Time Required for Construction Period = 4 Months
- Number of Labor Required for Construction = 10
- Personal Protective Equipment PPEs
- Dust Musk: 1 Dust Mask to be used in a week by each labourer
- Safety Shoes: 1 Safety shoe for six months for each labourer
- Gloves: 2 pairs of gloves for each labourer for a month
- First Aid Box: 1 first aid box for every 10 labourers
- Ear Plug: 1 set of the earplug to be used for 1 month for each labourer
- Safety Helmet: 1 safety helmet for each labourer for 4 months
- Safety Jackets: 2 safety Jackets (Hi-Vis) for each labourer for 4 months
- Dust Bin: Rough estimate
- Water Sprinkling the whole construction period
- Rain Cost: 1 Rain Coat for each labourer

**8.11 Traffic Management and Construction Material Transportation Plan.**

- 5 km speed limited will be being maintained at the project site.
- All the light vehicles cars, jeep etc. are being parked in a designated area.
- Speed breakers will be followed properly.
- The experienced and license holders (drivers and operators) will be hired for transportation.
- All the heavy machinery will be checked properly and inspected on a regular basis.
- Speed limit sign boards have been installed at the project site.
- All the headlights, backlights, Indicator etc. of vehicles and machines will be checked and maintained regularly.
- All the warning light, reverse back alarms will be maintained properly.
8.12 Emergency Preparedness, Response and Site Evacuation Plan

- The contractor will always be ready for response in any kind of emergency at each incinerator installation site.
- Special assembly points will be established at the project site (offices and site).
- The emergency siren will be installed at assembly points.
- Contact numbers of emergency response team will be circulated at the project site.
- Close coordination will be carried out in 1122 in the case of any serious injury/accident.
- Close coordination will be carried out with all law enforcement agencies (police) in case of an aggressive mob of people in the shape of any kind of protest.
- Emergency response drill will be carried out once in a month for provision of awareness to the workforce at the project site.
- First Aid Box will be available at the project site around the clock.
- Experienced and qualified paramedic staff will be available at First Aid Post at the site under the command of the designated HSE Manager’s.
- All the new entrants will be oriented by HSE Manager’s regarding the required awareness towards the infectious and risky situation and control.
- The entire workforce will be provided with the all mandatory PPEs for the risk-free environment.
- Special in-house training (TBT) will be conducted by HSE Manager’s regarding the awareness towards any emergency condition and control.
- Proper water sprinkling will be carried out on the service Road along with the project site for dust control to avoid any hazardous and risky situation which a cause of transport emergency can be.

8.13 Fire Fighting Plan

All the designated construction sites will be equipped with fire extinguishers as well as communication equipment for contacting the appropriate emergency response teams.

At all the project site, emergency alarms will be installed. Individuals will be nominated to ring the emergency alarm in case of an emergency situation or any emergency risk.

All the workers will be trained and well communicated on how to respond to the emergency alarm and reach assembly point immediately. Workers will be trained to respond to an emergency alarm as discussed below:

- If the alarm rings for 20 seconds, only once, then it is a less severe emergency;
- If it rings for 20 seconds thrice after intervals, then it is medium to a severe high emergency, but it can be much severe; and
- If it rings for 60 seconds or more continuously, then the emergency situation is most severe so, everyone should respond to it immediately, evacuate the workplace and move towards the assembly point.

Proper evacuation routes will be designated, nominated and well communicated to all. All the workers will be trained to follow the particular evacuation routes and reach the assembly point in case of an emergency situation.
The layout of firefighting arrangements (number and point of installation) and emergency evacuation route is highlighted in Figure 8.1.

Figure 8.1: Layout of firefighting arrangements (number and point of installation) and emergency evacuation route

Addfield MP-500 Medical Disposal System

8.14 Plantation Plan

A proper plantation plan has been prepared after consultation with the Horticulture Management at all eight hospitals in Sindh.

The plantation plan recommends planting 100 mature plants having 4-5 feet height and 1.0 to 1.5 inches stem diameter at the discussed hospitals of Sindh.

The hospital management will ensure the provision of staff and budget for the implementation of the plantation plan.

The practice of plantation of mature plants will be an effective compensation for carbon sequestration against the expected damages to the environment during the operational phase.
The plantation of recommended indigenous species will be carried out whereby the distance of 8-10 feet among rows in case of multiple rows, will be kept.

The plantation plan consists of trees, shrubs and flowering plants which are recommended for all eight hospitals.

Trees (20 ft. and above): A total of 10 trees comprising of shady, flowering, fruit trees have been recommended for plantation at all the selected hospitals.

**Table 8.3:** Recommended Trees for plantation in all the incinerator installation sites of Sindh

<table>
<thead>
<tr>
<th>Sr.#</th>
<th>Name</th>
<th>Description</th>
<th>Estimated Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Azadirachta indica</td>
<td>Commonly known as neem it has medicinal value</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>Khujoor (date)</td>
<td>A fruiting plant which can easily be grown in the region</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>Gulmohar (Flame of the forest)</td>
<td>A flowering plant which can easily be grown in Karachi</td>
<td>500</td>
</tr>
<tr>
<td>4</td>
<td>Laal Badaam (Indian almond)</td>
<td>A fruiting plant which can easily be grown in the region</td>
<td>500</td>
</tr>
<tr>
<td>5</td>
<td>Jaamun (Syzygium cumini /jambolan)</td>
<td>A fruiting plant which can easily be grown in the region</td>
<td>100</td>
</tr>
</tbody>
</table>

Flowering Plants: A total of 3 flowering plants having positive psychological effects have been recommended.

**Table 8.4:** Recommended Flowering Plants for plantation in all the incinerator installation sites of Sindh

<table>
<thead>
<tr>
<th>No.</th>
<th>Scientific Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Meri gold</td>
<td>An evergreen flowering vine</td>
</tr>
<tr>
<td>2</td>
<td>Petunia</td>
<td>An evergreen flowering vine</td>
</tr>
<tr>
<td>3</td>
<td>Pansy</td>
<td>An evergreen flowering vine</td>
</tr>
<tr>
<td>4</td>
<td>Calendula</td>
<td>An evergreen flowering vine</td>
</tr>
<tr>
<td>5</td>
<td>Nausturcium</td>
<td>An evergreen flowering vine</td>
</tr>
<tr>
<td>6</td>
<td>Rose</td>
<td>Perennial flowering plant</td>
</tr>
</tbody>
</table>

**Plantation Plan Cost**

A total number of 100 trees will be planted. The procurement of 100 trees for a single hospital will cost around Rs. 26,000/- whereas the cumulative plantation cost for all eight selected hospitals is Rs.182, 000/-
8.15 Restoration and Rehabilitation Plan

Restoration of the project site and associated facilities including access tracks is of utmost importance. Improper disposal of waste left at the end of the construction activities would lead to extensive disturbance to the environment.

Following measures will be adopted for site restoration and rehabilitation:

- All equipment and machinery at the incinerator installation sites will be de-mobilized.
- All waste at the project site will be disposed of according to the requirement of EIA.
- Septic tank with soakage pit will be properly dismantled.
- All temporary concrete structures at the project site will be dismantled, and construction and demolition material will be handed over to the concerned contractor for reuse or disposal.
- All the un-necessary pits at the project site will be backfilled.

8.16 Project Monitoring

Vertex Medical will make necessary arrangements to monitor the key environmental data during the construction and operational phases for the first three years after the operational phase. These will include the quantity of water used, a record of waste produced, a record of waste disposal, and project-related vehicular traffic.

The Project coordinator Vertex Medical will monitor project activities while working in the project area. He will keep a record of all non-conformance observed and report these along with actions to HD for further action. He will also have to report any impacts anticipated along with his recommendations for further action.

8.17 Environmental Monitoring Plan

Environmental Monitoring is normally undertaken during both the construction and operational phases of the project to ensure the effectiveness of the proposed mitigation measures.

In order to respond to unanticipated environmental concerns at an early stage and to determine the accuracy of impact, predictions are also required. Specific monitoring programs are outlined below as well as responsibilities for the collection and analysis of data and the reporting requirements.

The various purposes of the environmental monitoring plan are:

- To evaluate, the effectiveness of mitigation measures.
- To respond to the unanticipated environmental impacts when the project is under implementation.
- To make regulations and improve management and environmental controls based on the monitoring data. Environmental Protection Department, Sindh is entrusted with the overall responsibilities of monitoring the environment in Sindh.

An Environmental Monitoring Plan for Installation of Incinerators Projects in different districts of Sindh province has been provided in Table 8.5. The plan will be used as a management and monitoring tool for the implementation of the mitigation measures required by the EIA. The plan entails the required mitigation measures recommended in the EIA.
### Table 8.5: Environmental Monitoring Plan for Provision of incinerator in different hospitals of Sindh

<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Project Phase</th>
<th>Parameters</th>
<th>Locations</th>
<th>Frequency</th>
<th>Standards</th>
<th>Implementing</th>
<th>Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Quality</td>
<td>Construction</td>
<td>SO₂, NO, NO₂, O₃, SPM, PM₁₀, PM₂.₅, Pb and CO</td>
<td>Designated hospital incinerator installation site</td>
<td>PM₁₀, for continuous 8 hours, on a quarterly basis</td>
<td>WHO/USEPA guidelines, SEQS</td>
<td>Civil Work Contractor</td>
<td>Vertex Medical (Pvt)Ltd., Lahore</td>
</tr>
</tbody>
</table>
| Roadside Plantation     | Construction  | Visual inspection of plant species survival rate and status of maintenance | At the selected sites where plantation was carried out | (1) One month after plantation 
(2) One year after plantation | 75% survival rate | Civil Work Contractor | Vertex Medical (Pvt)Ltd., Lahore |
| Noise Levels            | Construction  | dB (A)     | At a central location in the Designated hospital incinerator installation site | Twice in 8 hours at a selected site on a quarterly basis. | EPA Ambient Noise standards | Civil Work Contractor | Vertex Medical (Pvt)Ltd., Lahore |
| Water Quality           | Construction  | pH, BOD, COD, TDS, TSS, DO, coliforms, hardness, nitrate, chloride, sulphate, hydrocarbon, | At Designated hospital incinerator installation site, i.e., start and end of Project site | Quarterly | WHO and SEQS | Civil Work Contractor | Vertex Medical (Pvt)Ltd., Lahore |
| **Operational Phase**   |               |            |           |           |           |              |             |
| Plantation              | Operation (First three years) | Visual inspection of plant species survival rate and status of maintenance | At sites where plantation was carried out | (1) 2.5 years after plantation | 75% survival rate | Project Coordinator | Medical Superintendents of the selected hospitals |
### Environmental Component

<table>
<thead>
<tr>
<th>Stack Emissions Operation (First three years)</th>
<th>Parameters</th>
<th>Locations</th>
<th>Frequency</th>
<th>Standards</th>
<th>Implementing Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack Emissions</td>
<td>Particulate matter, Nitrogen Oxides expressed as NO2, HCL, Hg and its compounds, Total Dioxins and Furans</td>
<td>Near the Stack of the Incinerators</td>
<td>Quarterly</td>
<td>SEQS</td>
<td>Project Manager</td>
</tr>
</tbody>
</table>

### Key:

- **dBA** = decibels (measured in the audible range)
- **EPA** = Environmental Protection Authority
- **PM10** = Particulate Matter smaller than about 10 micrometres
- **ROW** = Right-of-Way
- **SEQS** = Sindh Environmental Quality Standards
- **SPM** = Suspended Particulate Matter
- **TSS** = Total Suspended Solids
- **USEPA** = United States Environmental Protection Agency
- **WHO** = World Health Organization

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**EIA of Provision of Incinerators (Procurement, Installation, Commissioning & Operations) In Different Hospitals of Sindh**

**Health Department, Government of Sindh**

**Environmental Management Plan**

**Project Procurement International**

Page – 303
Table 8.6 shows the estimated cost for the EMP.

Table 8.6: Estimated Cost for the Implementation of Environmental Monitoring Plan for Provision of Incinerators Project in different hospitals of Sindh

<table>
<thead>
<tr>
<th>Environmental Monitoring Activities</th>
<th>Units/ No. of Samples</th>
<th>Unit Cost specification</th>
<th>Cost (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient air quality monitoring</td>
<td>2 (4 months project)</td>
<td>@ 50,000 per sample for 24 hr monitoring</td>
<td>100,000</td>
</tr>
<tr>
<td>Ambient water quality monitoring Quarterly basis on one location for 0.5 years</td>
<td>2</td>
<td>@ 20,000 per sample</td>
<td>40,000</td>
</tr>
<tr>
<td>Noise levels, quarterly basis for 0.5 years</td>
<td>2</td>
<td>@ 10,000 per sample</td>
<td>20,000</td>
</tr>
<tr>
<td>Environment, Health and Safety Specialist/third-party environmental consultant visit</td>
<td>4 months</td>
<td>@ 50,000</td>
<td>200,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>360,000</td>
</tr>
<tr>
<td><strong>Operational phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stack emission monitoring quarterly basis for 3 years</td>
<td>12</td>
<td>@ 30,000 per sample</td>
<td>1,080,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>1,800,000</td>
</tr>
</tbody>
</table>

*Source: PPI Estimates, 2018*

8.18 Training Schedule

Training programs are a necessary agenda that has to be implemented to implement the Environmental Management and Monitoring Plan effectively. The Environment, Health and Safety Officer will impart training to the contractor’s staff. The key objective of the training program is to ensure that the requirement of EMP is clearly understood and followed throughout the project. The training shall cover the following areas:

- Environmental sensitivity of the project area.
- EMP communication and documentation requirement.
- Vegetation and community issues and their mitigation measures.
- Safe construction practices
- Use of personal protective equipment’s (PPEs)
- Environmentally sound construction practices
- Vehicular safety.
- Site restoration requirement.
- Solid Waste Disposal

Vertex Medical (Pvt) Ltd will be primarily responsible for providing training to all project personnel. A lump sum fees of Rs. 100,000/= should be kept for the training management plan. Framework for the environmental and social training program is being provided in Table 8.7.
### Table 8.7: Framework for Environmental & Social Training Program for the provision of incinerators in different hospitals of Sindh

<table>
<thead>
<tr>
<th>Type of Training</th>
<th>Training Description</th>
<th>Period</th>
<th>Duration</th>
<th>Training By</th>
<th>Trainee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational Health and Safety staff</td>
<td>Training should be provided to aware staff to conform to safety codes</td>
<td>Before Commencement of Project Activities</td>
<td>Full day</td>
<td>External Sources</td>
<td>EHS Manager</td>
</tr>
<tr>
<td>Environment and Social Laws, Regulations, procedure and guidelines of the Government</td>
<td>The training should detail the laws and regulations concerning the environment, Labour laws and compliance with Government regulation.</td>
<td>Before Commencement of Project Activities</td>
<td>Full day</td>
<td>External Sources</td>
<td>EHS Staff, Site Supervisors, Site Engineers.</td>
</tr>
<tr>
<td>Occupational Health and Safety for workers</td>
<td>Health, safety and hygiene. Proper usage of Personal Protective Equipment (PPE’s), Precautions to be taken for working in confined areas.</td>
<td>Before Construction Activities</td>
<td>Full Day</td>
<td>EHS Manager</td>
<td>Workers</td>
</tr>
<tr>
<td>Solid Waste Management</td>
<td>Waste segregation, identification of infectious Waste, Use of PPEs and waste Handling</td>
<td>Before Commencement of Project Activities</td>
<td>Full Day</td>
<td>External Sources</td>
<td>Relevant workers and staff</td>
</tr>
<tr>
<td>Vehicular safety</td>
<td>Safe operation and maintenance of all vehicles, insurance in accordance with the applicable local and federal laws</td>
<td>Before Commencement of Project Activities</td>
<td>Full Day</td>
<td>EHS Manager</td>
<td>Relevant workers and staff</td>
</tr>
<tr>
<td>Vegetation and community issues and their mitigation measures</td>
<td>To analyze the community problems and how to cater serious issues relevant to vegetation and agricultural land of the community</td>
<td>Before Commencement of Project Activities</td>
<td>Full Day</td>
<td>EHS Manager</td>
<td>Relevant workers and staff</td>
</tr>
<tr>
<td>Safe construction practices</td>
<td>To upgrade local craftsmen’s skill in quality construction and develop skilful working human resources in hazard-resistant construction</td>
<td>Before Commencement of Project Activities</td>
<td>Full Day</td>
<td>EHS Manager</td>
<td>Relevant workers and staff</td>
</tr>
<tr>
<td>Health Safety and Environmental Auditing</td>
<td>Health Safety and Environmental Audits, Reporting Requirements</td>
<td>Before Commencement of Project Activities</td>
<td>Full Day</td>
<td>External Sources</td>
<td>Relevant Department</td>
</tr>
<tr>
<td>Implementation of environmental management and monitoring plan</td>
<td>Explanation of Environment Management and Monitoring Program</td>
<td>Quarterly. As soon as the project activities start</td>
<td>Full Day</td>
<td>External Sources</td>
<td>EHS Staff</td>
</tr>
</tbody>
</table>
8.19 Environmental Budget

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

The cost of a wet scrubber, ash pit and water treatment and recycling unit has already been added to the project cost. The summary of the cost of monitoring environment and mitigation cost for a single hospital is shown in Table 8.8.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Basis</th>
<th>Cost (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Monitoring Cost</td>
<td>Ambient Air, Noise and Water Quality Monitoring and Cost of Hiring Environmental Engineer for 40 Months</td>
<td>1,800,000</td>
</tr>
<tr>
<td>Plantation Plan</td>
<td>Implementation of plantation plan</td>
<td>26,000</td>
</tr>
<tr>
<td>Health and Safety of Workers</td>
<td>For 10 employees for the provision of dust masks, safety shoes, gloves, first aid box, ear plugs, safety helmets and safety jackets (Hi-Vis) And Provision of dustbins, warning tap, safety cones, safety sign boards and water sprinkling</td>
<td>78,000</td>
</tr>
<tr>
<td>Cost of Environmental Training</td>
<td>For the whole construction period</td>
<td>100,000</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>2,004,000</td>
</tr>
</tbody>
</table>

However, the cumulative cost required to implement the mitigation measures of all eight hospitals in Sindh will be Rs. 16,032,000/-.

8.20 Communication and Documentation

An effective program for storing and communicating environment information during the project is an essential requirement of an EMP. This activity will be done by an independent monitoring consultant. The key features of such a mechanism are:

- Precise recording and maintenance of all information generated during the monitoring in a predetermined format.
- Communicating the information to a central location
- Storing the raw information in a central database
- Processing the information to produce periodic reports

Data recording and maintenance: All forms will be numbered, and a tracking system will be developed for each. Whenever a form is released for use in the field, its number will be
recorded. The monitors will be required to account for each form after completion. In this manner, it will be ensured that all forms are returned to the office, be they filled, unused or discarded.

Storage of information: A database for information collected during the project will be prepared. The database may include information on training programs, staff deployment, non-compliance, corrective actions, water resources, results of effects monitoring.

Meeting: For effective monitoring, management and documentation, of the environmental performance during the operation, environmental matters will be discussed during a daily meeting held on-site. Environmental concerns raised during the meetings will be mitigated after discussions with all the proponent sites and their representatives.

Reporting: Monitoring body will produce daily, weekly, monthly and another periodic report, as well as a final report of the project based on the information collected. All the proponent sites, their representatives and the contractors will also prepare weekly environmental reports. Copies of the proponents will be provided to the proponent and contractor’s higher management.

8.21 Equipment Maintenance Detail

The equipment of the contractor will be regularly maintained. Proper logbooks will be maintained in which record of the equipment, its working and inspection schedule will be noted.

The civil works contractor will be responsible for the maintenance of his equipment during the construction phase.

Preventive Part Maintenance Plan (PPMP) will be carried out quarterly. The whole machine will be analyzed, and if there are any problems, it will be rectified.

8.22 Change Management

An environmental assessment of the proposed project has been made on the basis of project description available at the time the EIA was conducted. However, it is possible that changes in the project design will be required when the project is implemented. This section provides the mechanism that will be put in place to manage changes that might affect the project’s environmental impact.

Changes to the Operation: The changes in the project design have been categorized as first-order, second-order and third-order. These are defined below:

First-Order Change: A First order change is one that leads to a significant departure from the project described in the EIA and consequently requires a reassessment of the environmental impact associated with the change. In such an instance, Vertex Medical (Pvt) Ltd will be required to reassess the environmental impact of the proposed change, the results of which will then be sent to the EPA, Sindh for approval.

Second-Order Change: A second order change is the one that may entail the project activities not significantly different from those described in the EIA, which may result in project effects whose overall magnitude would be similar to the assessment made in this report. In case of such changes, Vertex Medical Pvt. (Pvt) Ltd will be required to reassess the impact of the activity on the environment, specify additional mitigation measures, if necessary and report the changes to the EPA, Sindh.
The EPD will review the change management statement and communicate if any concerns. If EPA agrees with the assessment of Installation of Incinerator Project in different hospitals of Sindh, it does not need formal approval. Seven days after submission of the change management statement, the change will be implemented unless a communication to the contrary has been received from EPA, Sindh.

**Third-Order Change:** A third-order change is the one that is of little consequence to EIA findings. This type of change doesn’t result in effects beyond those already assessed in the EIA; rather it may be made on site to minimize the impact of an activity such as realigning a particular section is to avoid cutting a tree, to minimize clearing vegetation, etc. The only action required for such changes would be to record the change in the Change Record Register.

### 8.23 Quarterly Environmental Monitoring Report

The contractor will prepare a Quarterly Environmental Monitoring Report of project activities carried out during the specified period to Installation of Incinerator Project in different hospitals of Sindh via Vertex Medical (Pvt.) Ltd.

The Vertex Medical (Pvt) Ltd, Lahore will submit the Quarterly Environmental Monitoring Report of the project to Environmental Protection Agency, Government of Sindh. A format of the Quarterly Environmental Monitoring Report has been provided at Annexure 7.

### 8.24 Post Project Monitoring

The Managing Director of Vertex (Pvt) Ltd or his representative shall prepare a brief post-project report describing the conduct of the actual operation, any changes from the operation for which approval was obtained, the degree to which the recommendations of the EIA were adhered to, any damages to the environment and the mitigation or compensation provided, and monitoring information of scientific or environmental interest that is not propriety in nature. This report should be submitted to the Environmental Protection Agency, Government of Sindh.
9 Conclusion and Recommendations

9.1 Introduction
This chapter presents the assessment of the possible environmental impacts of Installation of Incinerator Projects in different hospitals of Sindh namely, Jinnah postgraduate medical college Karachi, National Institute of Child Health Karachi, Dr. Ruth Pfau civil hospital Karachi, Sindh Government Lyari general hospital Karachi, Peoples medical hospital, Shaheed Benazirabad, Liaquat medical hospital Jamshoro, Chandka Medical College Larkana and Ghulam Muhammad Mahar Medical College Hospital Sukkur.

The study presents the purpose of the EIA as to the description of the site, the impact of the project during and after implementation, the mitigation measures and residual impacts.

The EIA also includes the justification and detailed description of the project, with an evaluation of the potential impacts and effects on the environment including economic and social consequences. This chapter describes the conclusion and recommendation of the EIA study of the project.

9.2 Conclusions
The major conclusions of the EIA are:

- Health Department intends to install a new incinerator of capacity 100kg/hr at five different districts of province Sindh namely, Karachi, Jamshoro, Sukkur, Larkana and Benazirabad, while keeping in view the alarming situation of waste management in the province. Under this program, 8 incinerators would be installed in eight hospitals.
- The objective of the project is to install the incinerators at the said hospitals to promote cleaner practices and complete combustion of hazardous wastes. It will help overcome the hazardous waste management and disposal problems.
- The infectious waste in the said hospitals was being destroyed by an existing incinerator which is not in working condition anymore and no more efficient. It emits black smoke while functioning which is unhealthy for the environment and people living around. Presently it is non-operational and is out of order.
- The project consists of installation, commissioning and operation of 100 kg/hr incinerator (MP 500, Addfield Environmental Systems Limited, UK).
- There will be an incineration room, one supervisor room, furniture, washroom, cold storage room, Ashpit and boundary wall of 6 ft. with steel gate.
- The utilities to be provided are a single phase 220 V, 50 Hz, 13-16 Ampere electricity connection with distribution box, electric cable from main to the distribution box and to the incinerator. The gas connection with the pressure of 22 bar with 4.32 m3/hr with GI pipe, further pressure gauge, shut off valves, pressure regulator and bypass scheme. The water connection with 2-3 bar, water pipes and shut off valve. There will be standby Liquefied Petroleum Gas (LPG) Fuel with 2 large cylinders to run the incinerator for 12 hours having 6 mm gauge, pressure gauge, regulator, safety value and 4 wheels.
- The incinerator comes with wastewater treatment technology, and an auto recycles unit. The water used for the operational purpose will be treated in the water treatment facilities and reused. The sludge created by the treatment will be settled in a settling tank. The settled sludge will be basically gypsum which has commercial value.
The potential impacts during the construction phase include loss of flora, increased threat to fauna, soil erosion and contamination, water contamination, deterioration of ambient air quality caused by the construction activities.

The significant environmental management issues during operational phase include air pollution, sewage disposal, solid waste and noise pollutions, and ash disposal.

The project construction and operational activities can potentially affect the community of the area. These adverse impacts can be largely reduced by implementing the appropriate mitigation measures, which has been discussed in this report.

The mitigation measures have been identified for impacts expected during the different phases of the project.

The installation of incinerator facilities is a very important step towards the infection control program which aims to control the infectious diseases caused by inappropriate disposal of infectious hospital waste.

Based on the recommended mitigation measures in chapter 7, the impacts identified will be reduced with residual impacts having insignificant levels. Table 9.1 presents the assessment of the residual impacts (mitigated).

9.3 Recommendations

- All public and private sector hospitals must comply with the Sindh hospital waste management rules, 2014.
- There are no guidelines for hospital waste management in Sindh. Proper formulation and implementation of the hospital waste management plan is required to deal with all the epidemics arising from hazardous hospital waste generation in the province.
- There is a dire need of the formulation, establishment and implementation of Sindh Environmental Quality Standards for Treatment of Liquid and Disposal of Bio-Medical Waste by Incineration, Autoclaving, Microwaving and Deep Burial, by the Sindh Environmental Protection Agency.
- Hazardous hospital waste Incineration must be carried out in all public and private sector hospitals to deal with the spread of infectious diseases. Health Department must take serious steps to initiate and strictly implement incineration provision programmes in private sector hospitals as well.
- A plantation plan has been proposed in the EIA report, which will be developed and implemented for Installation of Incinerator Project at different hospitals in Karachi, Hyderabad, Larkana, Sukkur and Shaheed Benazirabad.
- Air quality monitoring should be done as proposed in this EIA report.
- The operators and waste collectors working at the incinerator site should wear proper PPEs and should be trained properly for their safety and proper operation of the incinerator.

On the basis of the overall impact assessment, more specifically, nature and magnitude of the residual environmental impacts identified during present EIA, it is concluded that Installation of Incinerator Project in different hospitals of Sindh is likely to cause environmental impacts mainly during its operational phase. However, these impacts can be mitigated by the implementation of proposed mitigation measures. Health Department will ensure the effective implementation of mitigation measures.
The project will positively contribute to the reduction of infectious diseases spreading among the community, given a platform for proper disposal of infectious waste.

There are no remaining issues that warrant further investigation. This EIA is considered adequate for the environmental and social justification of the project.
Table 9.1: Impact Matrix – Residual Impacts of the project Provision of an incinerator in different hospitals of Sindh (Mitigated)

<table>
<thead>
<tr>
<th>Description</th>
<th>Physical</th>
<th>Biological</th>
<th>Social and Socio-economic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soil</td>
<td>Air Quality</td>
<td>Surface and Ground Water</td>
</tr>
<tr>
<td>Project Siting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Site, Land Use and Design</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Visual Impacts</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Acquisition</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Contractor Mobilization</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction Camp Establishment</td>
<td>-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction Camp Operation</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Site Preparation</td>
<td>-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction Works</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Laying of Services</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction of Buildings</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Description</td>
<td>Physical</td>
<td>Biological</td>
<td>Social and Socio-economic</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------</td>
<td>--------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>Air Quality</td>
<td>Surface and Ground Water</td>
</tr>
<tr>
<td>Construction Materials Supply</td>
<td>0</td>
<td>0</td>
<td>N</td>
</tr>
<tr>
<td>Construction Crew Transportation</td>
<td>0</td>
<td>0</td>
<td>N</td>
</tr>
<tr>
<td>Solid Waste Disposal</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Waste Effluent Disposal</td>
<td>0</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Demobilization of Contractor</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Operation Phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of Installation of Incinerator Project</td>
<td>N</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Key:** -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible negative; +1: low positive impact; +2: High positive impact, N: no impact.
# Annexure-1: List of Names, Qualification and Roles of EIA Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Project Position</th>
<th>Qualification and Experience</th>
<th>Tasks Assigned</th>
</tr>
</thead>
</table>
| Mr Saadat Ali         | Team Leader/ Environmental Engineer | Postgraduate Diploma in Sanitary Engineering, International Institute for Hydraulic and Environmental Engineering, 1984  
B. Sc. Civil Engineering, Engineering College, University of Peshawar, 1978                                                                                   | - Overall management of the project (Supervision, site visits, guidance, inputs and suggestion, recommendation and discussion and report presentations).  
- To review the overall environmental issues and mitigation measures.  
- To prepare draft and final study reports.                                                                                                                     |
| Mr Ali Abdullah       | Enviro-Civil Engineer        | M. Sc. Environmental Engineering, Newcastle University (2016)  
B. Sc. Civil Engineering, The University of Lahore, Lahore (2010-1014)                                                                                           | - Suggest mitigation measures for impacts that affect the environment.  
- Identification of site for baseline data collection for water, wastewater, noise, soil, traffic and ambient air quality. |
| Ms Noor Ul Ain        | Environmental Scientist/ Energy Engineer | MS in Energy system Engineering, United States Pakistan Center for Advanced Studies in Energy, NUST, 2018  
Bachelor's in Environmental Science, International Islamic University, Islamabad, 2016                                                                      | - Secondary data collection for desk review  
- Research tools preparation for field study  
- Fieldwork for baseline data collection in the area under study  
- Public Consultation  
- Draft preparation and Report Compilation                                                                                                                   |
| Mr M. Wajahat Saeed   | Environmental Engineer       | Bachelor's in environmental engineering, National University of Sciences and Technology (NUST) Islamabad, 2016                                                                                           | - Fieldwork for baseline data collection in the area under study  
- Stakeholders consultation  
- Secondary data collection                                                                                                                                    |
| Mr Zohaib Alam        | Baseline data collector      | Bachelors of Mining Engineering, Mehran University of Engineering Technology, Jamshoro, 2014  
Master in Environmental Management, S pecilaztion Environment, 2018  
IOSH, 2016                                                                                                                                                    | - Baseline Data Collection for all the eight hospitals  
- Stakeholder consultation  
- Secondary data collection                                                                                                                                     |
<table>
<thead>
<tr>
<th>Name</th>
<th>Project Position</th>
<th>Qualification and Experience</th>
<th>Tasks Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mariam Iftikhar</td>
<td>Environmental Scientist</td>
<td>M.Phil. in Environmental Sciences, Fatima Jinnah Women University Rawalpindi, 2015 Bachelor’s in Chemistry, GC University Faisalabad, 2013</td>
<td>Primary data collection · Secondary data collection for desk review · Research tools preparation for field study · Fieldwork for baseline data collection in the area under study · Public Consultation · Draft preparation and Report Compilation</td>
</tr>
<tr>
<td>Mr Tariq Khan</td>
<td>Plant Taxonomist</td>
<td>M.Phil. (Environmental Sciences) From PMAS University of Arid Agriculture, Rawalpindi. M.Sc. Botany (Specialization in Plant Taxonomy) From Islamia University Bahawalpur.</td>
<td>Biological Environment of the Project Area</td>
</tr>
<tr>
<td>Mr Azam Ali</td>
<td>Civil Engineer</td>
<td>Bachelor’s in Civil Engineering, National University of Sciences and Technology (NUST) Islamabad, 2018</td>
<td>Primary data collection · Secondary data collection for desk review · Research tools preparation for field study · Fieldwork for baseline data collection in the area under study · Public Consultation · Draft preparation and Report Compilation</td>
</tr>
<tr>
<td>Ms Shabila Parveen</td>
<td>Environmental Scientist</td>
<td>Masters in Environmental Sciences, National University of Sciences and Technology (NUST) Islamabad, 2018 Bachelors in Environmental Sciences, Fatima Jinnah Women University Rawalpindi, 2014</td>
<td>Secondary data collection for desk review · Research tools preparation for field study · Draft preparation and Report Compilation</td>
</tr>
</tbody>
</table>
Annexure-2: Terms of Reference

An EIA will be carried out for all stages of the projects, i.e. preconstruction, construction and post construction with the following objectives:

- Establishing the environmental baseline in the study area and identifying any significant environmental issue.
- Assessing these impacts and providing for the requisite avoidance, mitigation and compensation measures.
- Integrating the identified environmental issues in the project planning and design.
- Developing appropriate management plans for implementing, monitoring and reporting of the environmental mitigation and enhancement measures suggested.
- Give presentation during a public hearing of the EIA of the Installation of the Incinerator Project and respond to queries generated by Sindh EPA until issuance of the NOC.
Annexure-3: References

- M. Ahmad et al., Assessment of the aquifer system in the city of Lahore, Pakistan using isotopic techniques, Pakistan Institute of Nuclear Science & Technology.


### Annexure-4: Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air pollution</td>
<td>Air is made up of a number of gases, mostly nitrogen and oxygen and, in smaller amounts, water vapour, carbon dioxide and argon and other trace gases. Air pollution occurs when harmful chemicals and particles are emitted to the air – due to human activity or natural forces – at a concentration that interferes with human health or welfare or that harms the environment in other ways.</td>
</tr>
<tr>
<td>Ambient air quality</td>
<td>Ambient air quality refers to the quality of outdoor air in our surrounding environment. It is typically measured near ground level, away from direct sources of pollution.</td>
</tr>
<tr>
<td>Archaeology</td>
<td>The study of human history and prehistory through the excavation of sites and the analysis of artefacts and other physical remains.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.</td>
</tr>
<tr>
<td>Bye-law</td>
<td>A rule made by a local authority to govern activities within the area it controls. Examples include bye-laws covering waste disposal, traffic or public events or signs.</td>
</tr>
<tr>
<td>Carbon dioxide (CO₂)</td>
<td>A colourless gas that is naturally produced by animals and people in the exhaled air and the decay of plants.</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>A highly poisonous, odourless, tasteless and colourless gas that is formed when carbon material burns without enough oxygen.</td>
</tr>
<tr>
<td>Climate</td>
<td>The pattern of weather in a particular region over a set period of time, usually 30 years.</td>
</tr>
<tr>
<td>Compost</td>
<td>A rich soil-like material produced from decayed plants and other organic matter, such as food and animal waste, that decomposes (breaks down) naturally.</td>
</tr>
<tr>
<td>Composting</td>
<td>The process of deliberately allowing food, garden and other suitable organic wastes to break down naturally over time to produce compost.</td>
</tr>
<tr>
<td>Conservation</td>
<td>Preserving or protecting animals and resources such as minerals, water and plants through planned action (such as breeding endangered species) or non-action (such as not letting taps run unnecessarily).</td>
</tr>
<tr>
<td>Deforestation</td>
<td>The reduction of trees in a wood or forest due to natural forces or human activity such as burning or logging.</td>
</tr>
<tr>
<td>Effluent</td>
<td>Liquid wastes such as sewage and liquid waste from industries.</td>
</tr>
<tr>
<td>Energy efficiency</td>
<td>Actions to save fuels, for example, better building design, changing production processes, developing better transport policies, using better Road vehicles and using insulation and double glazing in homes.</td>
</tr>
<tr>
<td>EIA</td>
<td>An environmental impact assessment (EIA) is an analytical process that systematically examines the possible environmental consequences of the implementation of projects, programs and policies.</td>
</tr>
<tr>
<td>EMP</td>
<td>An environmental management plan (EMP) is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation.</td>
</tr>
<tr>
<td>Fauna</td>
<td>The animals of a particular region, habitat, or geological period.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Flora</td>
<td>The plants of a particular region, habitat, or geological period.</td>
</tr>
<tr>
<td>Genotoxic waste</td>
<td>Waste derived from drugs generally used in oncology or radiotherapy units that have a high hazardous mutagenic or cytotoxic effect. Faeces, vomit or urine from patients treated with cytotoxic drugs or chemicals should be considered as genotoxic.</td>
</tr>
<tr>
<td>Habitat</td>
<td>The area occupied by a community or species (a group of animals or plants), such as a forest floor, desert or seashore.</td>
</tr>
<tr>
<td>Hospital waste</td>
<td>All kinds of waste arising from healthcare establishments.</td>
</tr>
<tr>
<td>Initial Environmental Examination</td>
<td>Initial environmental examinations describe the environmental condition of a project, including potential impact, formulation of mitigation measures, and preparation of institutional requirements and environmental monitoring.</td>
</tr>
<tr>
<td>Landfill</td>
<td>A site that is specially designed to dispose of waste and operates with a license granted by the Environmental Protection Agency (EPA).</td>
</tr>
<tr>
<td>Radioactive Medical Waste</td>
<td>This waste is generated by nuclear medicines &amp; radiation oncology. This waste includes contaminated materials and syringes generated from Nuclear Medicine procedures, unused radioactive seeds from implants in Radiation Oncology as well as sealed sources used for calibration purposes, which are no longer useful.</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>A systematic process of evaluating the potential risks that may be involved in a projected activity or undertaking.</td>
</tr>
<tr>
<td>Risk waste</td>
<td>It is that hazardous portion of healthcare waste that includes wastes from natal care, diagnosis, treatment or prevention of disease in humans, infectious waste, infectious sharps and pharmaceutical waste</td>
</tr>
<tr>
<td>Segregation</td>
<td>The action or state of setting risk, i.e. hazardous and non-risk, i.e. nonhazardous wastes apart from others.</td>
</tr>
<tr>
<td>SEQS</td>
<td>The Sindh Environmental Quality Standards (SEQS) are quality standards to regulate the air emissions and effluents of industry and other big polluters.</td>
</tr>
<tr>
<td>Sharps</td>
<td>A long sharply pointed needle used for general sewing.</td>
</tr>
<tr>
<td>Noise Pollution</td>
<td>Noises that disturb the environment and people’s ability to enjoy it, for example continually sounding house alarms, loud music, air conditioning or other electrical units and aircraft or motor engines.</td>
</tr>
<tr>
<td>Seismology</td>
<td>The branch of science concerned with earthquakes and related phenomena.</td>
</tr>
<tr>
<td>Topography</td>
<td>The arrangement of the natural and artificial physical features of an area.</td>
</tr>
</tbody>
</table>
Annexure-5: List of Person Met During Field Visit

List of Stakeholder contacted during the EIA of Provision of Incinerators Project in Different Hospitals of Sindh

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Person</th>
<th>Designation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><strong>Public and Private Organizations</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mr Ramzan Arif</td>
<td>Director, Vertex Medical Pvt. Ltd., Lahore</td>
</tr>
<tr>
<td>2</td>
<td>Mr Farhan Lodhi</td>
<td>Director of Operations, Hangzhou Jinjiang Group, Karachi</td>
</tr>
<tr>
<td>3</td>
<td>Engr. Syed Haq</td>
<td>Managing Director, Ceres Associate Gulf, Karachi</td>
</tr>
<tr>
<td>4</td>
<td>Mr Imran Sabir,</td>
<td>Assistant Director, Sindh Environmental Protection Agency, Karachi</td>
</tr>
<tr>
<td>5</td>
<td>Mr Naveed Larik</td>
<td>Deputy Director, Sindh Solid Waste Management Board</td>
</tr>
<tr>
<td>6</td>
<td>Dr Abdual Jabbar Memon,</td>
<td>Additional Director, Development, Health Department, Government of Sindh</td>
</tr>
<tr>
<td>7</td>
<td>Mr Shahid Lutfi,</td>
<td>Environmental Consultant, Karachi</td>
</tr>
<tr>
<td>8</td>
<td>Dr Tariq Mehmood</td>
<td>HOD of Radiology</td>
</tr>
<tr>
<td>9</td>
<td>Dr Shaista Nizami</td>
<td>Doctor in Radiology</td>
</tr>
<tr>
<td>10</td>
<td>Dr Muhammad Ali</td>
<td>Doctor in Medicine Ward</td>
</tr>
<tr>
<td>11</td>
<td>Mr Riaz Gill</td>
<td>Director of Admin</td>
</tr>
<tr>
<td>12</td>
<td>Mr Bisharat Ali,</td>
<td>Computer operator Admin</td>
</tr>
<tr>
<td>13</td>
<td>Dr. Seemin Jamili,</td>
<td>Executive Director</td>
</tr>
<tr>
<td>14</td>
<td>Mr. Shahid Hussain Arain</td>
<td>National Sales Manager</td>
</tr>
<tr>
<td>15</td>
<td>Mr Zahid Kundan</td>
<td>Assistant</td>
</tr>
<tr>
<td>16</td>
<td>Mr. Muhammad Amen</td>
<td>Assistant Maintenance Manager</td>
</tr>
<tr>
<td>17</td>
<td>Mr. Sayed Tariq</td>
<td>Electrical Supervisor</td>
</tr>
<tr>
<td>18</td>
<td>Dr. Tariq Mehmood</td>
<td>Computer Operator Admin</td>
</tr>
<tr>
<td></td>
<td><strong>Jinnah Postgraduate Medical Centre, Karachi</strong></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Dr Jawad Memon</td>
<td>Administration Kitchen Sterilization</td>
</tr>
<tr>
<td>20</td>
<td>Dr Ameer Memon</td>
<td>GMS paramedics</td>
</tr>
<tr>
<td>21</td>
<td>Dr Naveed Ahmad</td>
<td>DMS acting charge</td>
</tr>
<tr>
<td>22</td>
<td>Ms Muniba Kanwal</td>
<td>House Officer</td>
</tr>
<tr>
<td>23</td>
<td>Ms Toba Akbar</td>
<td>House Officer</td>
</tr>
<tr>
<td></td>
<td><strong>Sindh Government Lyari General Hospital Karachi</strong></td>
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</tr>
<tr>
<td>24</td>
<td>Dr. Arif</td>
<td>Assistant Medical Superintend</td>
</tr>
<tr>
<td>25</td>
<td>Prof. Dr Shahla Baki</td>
<td>AMS</td>
</tr>
<tr>
<td>26</td>
<td>Dr Saeed</td>
<td>Senior Medical Officer</td>
</tr>
<tr>
<td>27</td>
<td>Dr Ramallah Shahzad</td>
<td>House In-charge</td>
</tr>
<tr>
<td>28</td>
<td>Dr Asad</td>
<td>Chief Executive</td>
</tr>
<tr>
<td></td>
<td><strong>Dr Ruth Phau Civil Hospital, Karachi</strong></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Name of Person</td>
<td>Designation</td>
</tr>
<tr>
<td>-----</td>
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<td>-------------</td>
</tr>
<tr>
<td>29</td>
<td>Mr. Abdul Sattar Jatoi</td>
<td>Director, Planning, Procurement &amp; Development</td>
</tr>
<tr>
<td>30</td>
<td>Dr. Naeem Raza Memon</td>
<td>AHS Additional MS General</td>
</tr>
<tr>
<td>31</td>
<td>Dr Niaz Hussain Babar</td>
<td>RMO</td>
</tr>
<tr>
<td>32</td>
<td>Dr Asma Kfeel</td>
<td>House Officer</td>
</tr>
<tr>
<td>33</td>
<td>Dr Anosha Jamani</td>
<td>House Officer</td>
</tr>
<tr>
<td>34</td>
<td>Dr Zubaida Kkashkeli</td>
<td>House Officer</td>
</tr>
<tr>
<td></td>
<td><strong>Liaquat University Hospital, Hyderabad / Jamshoro</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>People Medical College Hospital, Nawabshah</strong></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Dr Saida Rashida</td>
<td>AMS</td>
</tr>
<tr>
<td>36</td>
<td>Dr Muhammad Hanif Bhangwar</td>
<td>AMS</td>
</tr>
<tr>
<td>37</td>
<td>Dr Abdul Aziz Sahito</td>
<td>HOD and Chairman of the Department of Medicine</td>
</tr>
<tr>
<td>38</td>
<td>Dr Samina</td>
<td>Women Medical Officer</td>
</tr>
<tr>
<td>39</td>
<td>Dr Nazish Akhtar, HO</td>
<td>House officer</td>
</tr>
<tr>
<td>40</td>
<td>Dr Shahzad Memon</td>
<td>Admin</td>
</tr>
<tr>
<td>41</td>
<td>Mr Zulfiqar Ali Bhati</td>
<td>Office Superintendent</td>
</tr>
<tr>
<td></td>
<td><strong>Chandka Medical College, Larkana</strong></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Dr. Ali Gohar Dahri</td>
<td>Medical Superintendent</td>
</tr>
<tr>
<td>43</td>
<td>Dr. Insaif Bukhsi</td>
<td>Assistant Medical Superintendent</td>
</tr>
<tr>
<td>44</td>
<td>Dr Allam Ibrahim</td>
<td>HOD and Chairman of the Department of Medicine</td>
</tr>
<tr>
<td>45</td>
<td>Dr Nagina Shaikh</td>
<td>Doctor of Pharmacy</td>
</tr>
<tr>
<td>46</td>
<td>Dr Saeed Memon</td>
<td>In-charge of waste management</td>
</tr>
<tr>
<td></td>
<td><strong>Ghulam Muhammad Mahar Medical College Hospital Sukkur</strong></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Dr Abdul Samad S.</td>
<td>Medical Officer</td>
</tr>
<tr>
<td>48</td>
<td>Dr. Ahmad Mujtaba</td>
<td>Consultant Senior Cardiologist</td>
</tr>
<tr>
<td>49</td>
<td>Mr Waqas Ahmed Khan</td>
<td>Admin Manager</td>
</tr>
<tr>
<td></td>
<td><strong>National Institute of Child Health Karachi</strong></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Majid Ali</td>
<td>Senior Engineer</td>
</tr>
<tr>
<td>51</td>
<td>Manzoor Shah</td>
<td>Acting Incharge Sanitation</td>
</tr>
<tr>
<td>52</td>
<td>Nasir H. Zaidi</td>
<td>Horticulture Incharge</td>
</tr>
<tr>
<td>53</td>
<td>Dr Jamal Raza</td>
<td>Medical Superintendent</td>
</tr>
</tbody>
</table>
### List of People met during the Public Consultation

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Age</th>
<th>Gender</th>
<th>Education</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Ms Khalida Parveen</td>
<td>45</td>
<td>Female</td>
<td>BS Nursing</td>
<td>Head Nurse</td>
</tr>
<tr>
<td>51</td>
<td>Bagh Ali</td>
<td>55</td>
<td>Male</td>
<td>Middle</td>
<td>Patient</td>
</tr>
<tr>
<td>52</td>
<td>Mr. Mehoob Alam</td>
<td>40</td>
<td>Male</td>
<td>Engineer</td>
<td>Plant Operator</td>
</tr>
<tr>
<td>53</td>
<td>Bashir Shah</td>
<td>50</td>
<td>Male</td>
<td>NIL</td>
<td>Senior Manager, Head of waste management</td>
</tr>
<tr>
<td>54</td>
<td>Asif Majeed</td>
<td>35</td>
<td>Male</td>
<td>Engineer</td>
<td>Manager of Engineering and Maintenance</td>
</tr>
<tr>
<td>55</td>
<td>Mr Murad Ali</td>
<td>44</td>
<td>Male</td>
<td>8th Class</td>
<td>Nil</td>
</tr>
<tr>
<td>56</td>
<td>Mr. Zahoor Ahmed</td>
<td>45</td>
<td>Male</td>
<td>Nil</td>
<td>Daily wages</td>
</tr>
<tr>
<td>57</td>
<td>Mr. Noman</td>
<td>36</td>
<td>Male</td>
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<td>Private Employee</td>
</tr>
<tr>
<td>58</td>
<td>Mr. Shahroze Sajjad</td>
<td>18</td>
<td>Male</td>
<td>Student</td>
<td>Lab Technician</td>
</tr>
<tr>
<td>59</td>
<td>Ms Aqsa</td>
<td>21</td>
<td>Female</td>
<td>Student</td>
<td>Nil</td>
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<tr>
<td>60</td>
<td>Ms. Saba</td>
<td>18</td>
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<td>Student</td>
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<tr>
<td>61</td>
<td>Ms. Nadeem</td>
<td>40</td>
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<td>AC Technician</td>
</tr>
<tr>
<td>62</td>
<td>Mr. Muhammad Furqan</td>
<td>23</td>
<td>Male</td>
<td>Inter</td>
<td>Ac Technician</td>
</tr>
<tr>
<td>63</td>
<td>Mr Talha</td>
<td>17</td>
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<td>Nil</td>
</tr>
<tr>
<td>64</td>
<td>Mr Kashif</td>
<td>43</td>
<td>Male</td>
<td>Inter</td>
<td>Rikshaw Driver</td>
</tr>
</tbody>
</table>

**Jinnah Postgraduate Medical Centre, Karachi**

<p>| 65   | Ms Shazia Abdul Rashid              | 35  | Female | BS Nursing | Staff Nurse                                |
| 66   | Mr Raja Natho                       | 25  | Male   | Illiterate | Sweeper                                    |
| 67   | Mr Diyal                            | 30  | Male   | Illiterate | Sweeper                                    |
| 68   | Mr Manzoor Ahmad                    | 40  | Male   | Illiterate | Ward Labor                                 |
| 69   | Mr Aman Bakash                      | 40  | Male   | Illiterate | Ward boy                                   |
| 70   | Ms An Bibi                          | 35  | Female | Illiterate | Patient                                    |
| 71   | Ms Zaib-Un Nisa                     | 45  | Female | Illiterate | Patient                                    |
| 72   | Ms Sameena                          | 35  | Female | Illiterate | House Wife                                 |
| 73   | Ms Farida                           | 24  | Female | Middle     | House Wife                                 |
| 74   | Mr Hazeem                           | 40  | Male   | Illiterate | NIL                                        |
| 75   | Mr Tarique                          | 33  | Male   | Bachelor   | Book Stall                                 |
| 76   | Mr Ghulam Qadir                     | 48  | Male   | Matric     | NIL                                        |
| 77   | Mr Imam Bux                         | 55  | Male   | Illiterate | Rikshaw Driver                             |
| 78   | Mr Perwaiz                          | 35  | Male   | Middle     | Juice Court Owner                          |
| 79   | Mr Najid Ali                        | 42  | Male   | Middle     | Worker                                     |
| 80   | Mr Abdul Hammad                     | 24  | Male   | Illiterate | Pan Shop Owner                             |
| 81   | Mr Muhammad Shokat                  | 40  | Male   | Matric     | Nil                                        |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Age</th>
<th>Gender</th>
<th>Education</th>
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<tr>
<td>82</td>
<td>Ms Abda</td>
<td>35</td>
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<td>Middle</td>
<td>House Wife</td>
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<tr>
<td>83</td>
<td>Ms Haji Abdul Jabbar</td>
<td>47</td>
<td>Male</td>
<td>Illiterate</td>
<td>Nil</td>
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<tr>
<td>84</td>
<td>Mr Pir Bux</td>
<td>65</td>
<td>Male</td>
<td>Matric</td>
<td>Watchman</td>
</tr>
<tr>
<td>85</td>
<td>Ms Shamim Qadir, Dr Ruth Phau Civil, Karachi</td>
<td>35</td>
<td>Female</td>
<td>Graduate</td>
<td>Staff Incharge</td>
</tr>
<tr>
<td>86</td>
<td>Mr Ameen,</td>
<td>25</td>
<td>Male</td>
<td>Uneducated</td>
<td>Patient Attendant</td>
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<tr>
<td>87</td>
<td>Mr Muhammad Anayat</td>
<td>30</td>
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<td>Patient Attendant</td>
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<tr>
<td>88</td>
<td>Mr Khurshid,</td>
<td>40</td>
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<tr>
<td>89</td>
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<td>Patient</td>
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<tr>
<td>90</td>
<td>Mr Wali Bhai Khan</td>
<td>42</td>
<td>Male</td>
<td>Matric</td>
<td>Security Guard</td>
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<tr>
<td>91</td>
<td>Mr Ali Mehmood</td>
<td>23</td>
<td>Male</td>
<td>Intermediate</td>
<td>Rickshaw Driver</td>
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<tr>
<td>92</td>
<td>Mrs Rehmat Bibi</td>
<td>50</td>
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<td>Middle</td>
<td>House Wife</td>
</tr>
<tr>
<td>93</td>
<td>Mr Mohmmad Khalid</td>
<td>60</td>
<td>Male</td>
<td>Graduate</td>
<td>Retired</td>
</tr>
<tr>
<td>94</td>
<td>Mr Sorajudon Khan</td>
<td>47</td>
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<td>Private employee</td>
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<tr>
<td>95</td>
<td>Mr Rizwan Ahmed</td>
<td>35</td>
<td>Male</td>
<td>Matric</td>
<td>Govt. Servant</td>
</tr>
<tr>
<td>96</td>
<td>Mr Ahmad Khan</td>
<td>22</td>
<td>Male</td>
<td>Bachelor</td>
<td>Student</td>
</tr>
<tr>
<td>97</td>
<td>Mr. Patras Masih</td>
<td>35</td>
<td>Male</td>
<td>Intermediate</td>
<td>Incinerator operator</td>
</tr>
<tr>
<td>98</td>
<td>Ms Khushnooud Bashir Shafique</td>
<td>37</td>
<td>Female</td>
<td>B.S Nursing</td>
<td>Nurse</td>
</tr>
<tr>
<td>99</td>
<td>Mr Muhammad Shafique</td>
<td>32</td>
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<td>Matric</td>
<td>Ward boy</td>
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<tr>
<td>100</td>
<td>Mr Aslam Hussain</td>
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<td>Male</td>
<td>Middle</td>
<td>Patient</td>
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<tr>
<td>101</td>
<td>Mr Ghulam Ali</td>
<td>43</td>
<td>Male</td>
<td>Illiterate</td>
<td>Patient</td>
</tr>
<tr>
<td>102</td>
<td>Mr Naveed</td>
<td>50</td>
<td>Male</td>
<td>Illiterate</td>
<td>Patient</td>
</tr>
<tr>
<td>103</td>
<td>Mr Basit Ali</td>
<td>29</td>
<td>Male</td>
<td>Graduate</td>
<td>Patient</td>
</tr>
<tr>
<td>104</td>
<td>Mr Ali Noor</td>
<td>26</td>
<td>Male</td>
<td>Middle</td>
<td>Patient attendant</td>
</tr>
<tr>
<td>105</td>
<td>Mr Masood</td>
<td>47</td>
<td>Male</td>
<td>Middle</td>
<td>Patient attendant</td>
</tr>
<tr>
<td>106</td>
<td>Ms Samreen M. Hussain</td>
<td>44</td>
<td>Female</td>
<td>Middle</td>
<td>Patient</td>
</tr>
<tr>
<td>107</td>
<td>Ms Tahmina</td>
<td>25</td>
<td>Female</td>
<td>Middle</td>
<td>Patient</td>
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<tr>
<td>108</td>
<td>Ms Shazia</td>
<td>23</td>
<td>Female</td>
<td>Illiterate</td>
<td>Patient</td>
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<tr>
<td>109</td>
<td>Mr Mola buksh</td>
<td>55</td>
<td>Male</td>
<td>Illiterate</td>
<td>Patient</td>
</tr>
<tr>
<td>110</td>
<td>Mr Essa</td>
<td>50</td>
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Liaquat University Hospital Hyderabad / Jamshoro
### EIA of Provision of Incinerators (Procurement, Installation, Commissioning & Operations) In Different Hospitals of Sindh

**Health Department, Government of Sindh**

**Annexure-5: List of Person Met During Field Visit**

<table>
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<th>No.</th>
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**Ghulam Muhammad Mahar Medical College Hospital Sukkur**

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**National Institute of Child Health Karachi**

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Annexure-6: Stack Emission Report of MP 200 Series

STACK EMISSION MONITORING

REPORT

OF

MEDICAL WASTE INCINERTOR
(ADD FIELD-UK MP 200)

AT

DHQ HOSPITAL SAMUNDRI FAISALABAD

FOR

VERTEX MEDICAL PVT. LTD.

Prepared By: Green Crescent Environmental Consultancy Pvt. Ltd.
DETAILED REPORT

Stack Emission monitoring was conducted on Tuesday 10-04-2017 at DHQ Samundri, Faisalabad by Mr. Rashid Sultan, Executive field officer, Green Crescent Environmental consultants Pvt. Ltd.

SCOPE OF SERVICES

Scope of services covered following main components:

• Stack Emission

METHODOLOGY STACK EMISSIONS MONITORING

Stack emission monitoring was conducted at mutually agreed monitoring point. Lancom-4 was used for the detection of gaseous emissions from generator.

RESULT AND DISCUSSION

The activity for monitoring the air conditions around generator was carried out at the proposed generators on 10-04-2017. To assess the current quality of ambient air Carbon Monoxide, Oxides of Nitrogen, Sulphur Dioxide, and carbon dioxide were monitored.

Discussion of CO Measurements

The readings of CO are within the permissible limit of PEQS.

Discussion of NOx Measurements

The readings of NO, NO2 and NOx for the project site and its surroundings comply with the Punjab Environmental Quality Standard.

Discussion of SO2 Measurements

The SO2 readings for the monitoring location depicts that the monitoring results are within the prescribed limits of PEQS.

Discussion of CO2 Measurements

The values for Carbon Dioxide recorded were within the prescribed limits of PEQS for CO2.
Stack Emission Monitoring Report

Client Name: Verris Medical Pvt. Ltd.
Job Number: G2224-P-502-2017
Reporting Date: June 17

Monitoring Point Details & Monitoring Results

<table>
<thead>
<tr>
<th>Monitoring Date</th>
<th>Monitoring Location</th>
<th>Monitoring Time</th>
<th>Model</th>
<th>Instrument</th>
<th>Sample Size</th>
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<tbody>
<tr>
<td>10/Sept/97</td>
<td>DRI Hospital, Karachi</td>
<td>11:00</td>
<td>MP 200</td>
<td>300x300</td>
<td>30x30x30</td>
</tr>
</tbody>
</table>

Parameters | Unit | Reading 01 | Reading 02 | Reading 03 | Reading 04 | Limit as per PEQI
---|---|---|---|---|---|---
Carbon Dioxide (CO2) | % | 5.73 | 5.75 | 5.73 | 5.81 | 5.81 |
Oxygen (O2) | % | 19.71 | 19.59 | 19.47 | 19.50 | 19.60 |
Carbon Monoxide (CO) | mg/Nm³ | 30.69 | 31.21 | 31.44 | 31.41 | 800 |
Sulphur Dioxide (SO2) | mg/Nm³ | 0.00 | 0.00 | 0.00 | 0.00 | 1700 |
Nitrogen Dioxide (NO2) | mg/Nm³ | 86.52 | 88.21 | 88.49 | 88.21 | 800 |
Nitrogen Oxides (NOx) | mg/Nm³ | 64.11 | 65.51 | 65.17 | 65.52 | 800 |
Soot | mg/Nm³ | 116.82 | 118.42 | 116.78 | 117.34 | <0.05 |
Particulate Matter | mg/Nm³ | 0.66 | 0.66 | 0.66 | 0.66 | 2.00 |

*Level of Exposure of Nitrogen according to Part type as per PEQI

Abbreviations:
PEQI: Public Environmental Quality Standard
ng/Nm³: Milligram Normal cubic meter

Project Procurement International
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## Annexure-7: Quarterly Environmental Report

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<th>Description</th>
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<td>Executive Summary</td>
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<tr>
<td>Chapter 1.0</td>
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<tr>
<td>Chapter 2.0</td>
<td>Construction Summary</td>
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<tr>
<td>Chapter 3.0</td>
<td>Project’s Progress Up to date.</td>
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<tr>
<td>Chapter 4.0</td>
<td>Environmental Monitoring</td>
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<td></td>
<td>External Environmental Monitoring</td>
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<td>Internal Environmental Monitoring</td>
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<td>Communicable Disease Testing</td>
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<tr>
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<td>Environmental Audit</td>
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<td>Monthly Progress</td>
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<td>Safeguard Plans and their Implementation Status</td>
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<td>HSE Management Plan</td>
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<td>Fire Fighting Plan</td>
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<td>Solid Waste Management</td>
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<td>Borrow Area Management Plan</td>
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<td>Site Restoration Plan</td>
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<td>Emergency Preparedness, Response and Site Evacuation Plan</td>
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<td></td>
<td>Traffic Management &amp; Construction Material transportation</td>
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<td></td>
<td>Implementation of Social Safeguard Policies</td>
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<td></td>
<td>Local Employment</td>
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<tr>
<td>Annex</td>
<td>Pictorial Presentation of Environmental Monitoring Plan</td>
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</tbody>
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