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Environmental & Social Impact Assessment (ESIA) - Construction of New Sanitary Landfill Cell at Jam Chakro (Package 02)



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ABBREVIATIONS & ACRONYMS

AOI	Area of Influence
C&D	Construction and Demolition
CBOs	Community Based Organizations
CHS	Community Health and Safety
CLICK	Competitive and Liveable City of Karachi
COVID-19	Corona Virus Disease of 2019
CPESMP	Construction Phase Environmental & Social Mitigation Plan
dBA	Decibel A-Weighted
DMC	District Municipal Corporation
E&S	Environmental and Social
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standard
GBV	Gender Based Violence
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GoS	Government of Sindh
GRM	Grievance Redress Mechanism
GTS	Garbage Transfer Station
HDPE	High Density Polyethylene
IBRD	The International Bank for Reconstruction and Development
IDA	International Development Association
IEE	Initial Environmental Examination
KSDP	Karachi Strategic Development Plan
KWSB	Karachi Water and Sewerage Board
LGD	Local Government Department
LGHTPD	The Local Government Housing, and Town Planning Department
LMP	Labor Management Procedures
M&E	Monitoring and Evaluation
MGD	Million Gallons Per Day
MIS	Management Information system
MRF	Material Recovery Facility
MW	Mega Watt
NGOs	Non-Governmental Organization
NOC	No Objection Certificate
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
P&D	Planning and Development
PAPs	Project Affected Persons
PIU	Project Implementation Unit
PM	Particulate Matter
POM	Project Operational Manual
PPE	Personal Protection Equipment
RF	Resettlement Framework
RFID	Radio Frequency Identification

RP	Resettlement Plan
SBCA	Sindh Building Control Authority
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SEQS	Sindh Environmental Quality Standards
SITE	Sindh Industrial Trading Estate
SOPs	Standard Operating Procedures
SSWMB	Sindh Solid Waste Management Board
SWEEP	Solid Waste Emergency and Efficiency Project
SWM	Solid Waste Management
TMP	Traffic management Plan
TPV	Third Party Validation
UN	United Nations
VAC	Violence against Children
WB	World Bank
WHO	World Health Organization

Executive Summary

The Government of Sindh (GoS) through the Sindh Solid Waste Management Board (SSWMB) is planning to construct a sanitary, engineered, landfill cell in Karachi within the premises of the Jam Chakro Landfill site (specific works described ahead in the document). The proposed sub-project will be implemented under the umbrella of the Solid Waste Emergency & Efficiency Project (SWEEP), which is funded by the World Bank (WB), focuses on prioritized interventions and improvements in the Solid Waste Management (SWM) sector. To address the potential environmental and social impacts of this proposed sub-project, this Environmental and Social Impact Assessment (ESIA) has been prepared in accordance with the guidelines and requirements of the Sindh Environmental Protection Agency (SEPA) and the World Bank's Environmental and Social Framework (ESF).

Solid Waste Emergency & Efficiency Project (SWEEP)

SWEEP aims to mitigate the impacts of flooding and COVID-19 emergencies, and to improve solid waste management services in Karachi. To alleviate this situation, the SWEEP project was planned with 3 components:

1. Component 1 – Immediate Emergency Response Interventions
2. Component 2 – Development of SWM Backbone Infrastructure
3. Component 3 – Project Management & Implementation Support

The project supports the Government of Sindh (GoS) to improve solid waste management services in Karachi, through the incremental upgrading of infrastructure for collection, transfer, final disposal, and treatment of solid waste in Karachi. The Sindh Solid Waste Management Board (SSWMB) is the implementing agency for SWEEP and has established a Project Implementation Unit (PIU) under a government-appointed Project Director, with technical resources for engineering, environmental and social management, procurement, financial management and other key functions.

Proposed Sub-Project – Development of Sanitary Engineered Landfill Cell

Currently, Sub-Component 2.2 is planned for implementation under SWEEP, where a sanitary landfill cell (in line with international standards and best practices) is planned to be developed alongside the existing dumpsite at the Jam Chakro dump site.
Currently, the boundaries of Jam Chakro comprise of unutilized (vacant) land immediately to the north of the existing open dump site, where a small area of the existing dump site also falls within the boundary of the land allocated for the new cells. The total extent of the area allocated for the new landfill cells is roughly 145 acres of unutilized land, of which 10 acres lies on the existing dumpsite from where waste must be removed prior to site works. Access to the site will be provided through a road which will be developed through the existing dumpsite. A depiction of this is provided below in Figure ES-1.

Other Environmental & Social Studies

In tandem with the ESIA, a separate Livelihood Restoration Plan (LRP) adhering under to Environmental and Social Standard I (ESS1) have been developed for the proposed sub-project, specifically addressing potential impacts on waste pickers at the Jam Chakro site and the 04 Garbage Transfer Stations proposed for upgradation (Dinga Morr, Gutter Baghicha, Sharafi Goth, Imtiaz) as there is no involuntary resettlement involved at any of these sites. Furthermore, the following documents have also been prepared for the SWEEP Project:

- Environmental & Social Management Framework (ESMF)
- Resettlement Framework (RF)
- Stakeholder Engagement Plan (SEP)
- Labor Management Procedures (LMP)
- Gender Action Plan (GAP)
- Grievance Redress Mechanism (GRM)

These documents are disclosed on SWEEP website[1].

Objectives of ESIA

The objectives of the E&S study are to ensure that the proposed project is planned and implemented in an environmentally and social sustainable manner with effective stakeholder involvement, and compliance with relevant laws and policies of the Islamic Republic of Pakistan, the Provincial GoS, the City of Karachi and the applicable World Bank's ESF requirements.

Methodology

The methodology adopted to prepare this ESIA was in accordance with SEPA Initial Environmental Examination (IEE)/ Environmental Impact Assessment (EIA) Regulations, 2021 and WB's ESF. The methodology included desktop studies, delineation of the Area of Impact (AoI), carrying out field surveys for establishing baseline conditions, analysis of alternatives, stakeholder consultations and public disclosure, assessing the potential environmental and social impacts and proposing appropriate control and mitigation measures to eliminate the adverse impacts. and finally, preparation of Environmental and Social Management Plan (ESMP).

ES-2 RELEVANT LEGISLATIVE REQUIREMENTS AND FRAMEWORK

Under Section 17 of the Sindh Environmental Protection Act - 2014, it is mandatory for the proponents of the projects[2] to execute the IEE and/ or EIA, where warranted, and get the approval from SEPA. The SEPA (Review of IEE and EIA) Regulations, 2021 provide screening categories of projects for which IEE or EIA need to be conducted. The development of the landfill cells falls under Schedule III (Category 'H' of "Waste Disposal and Treatment") and requires an EIA for obtaining the No Objection Certificate (NOC)/environmental approval from SEPA.

Moreover, as per World Bank Environmental and Social Framework (ESF), the proposed project has been classified as "High Risk" for which ESIA is prepared under ESS1 is prepared.
This ESIA will be submitted to SEPA to obtain NOC before start of civil works on site. The ESIA will be reviewed and cleared by WB and will be disclosed by the SSWB and the bank.

Other applicable laws, acts, legislations, standards, and guidelines considered while carrying out this EISA include : Sindh Strategy for Sustainable Development - 2007, Sindh Drinking Water Policy - 2017, National Action Plan for COVID-19, Karachi Strategic Development Plan (KSDP) 2020, Pakistan Climate Change Act - 2016, Karachi Water and Sewerage Board Act 1996 (amendment 2015), Sindh Occupational Safety & Health Act - 2017, Protection against Harassment of Women at the Workplace Act - 2010, Sindh Prohibition of Child Employment Act, 2017, Sindh Differently Able Persons (Employment, Rehabilitation and Welfare (Amendment) Act, 2017, Gender Equality as part of Constitution of Pakistan, 1973, and World Bank Group's Environment Health and Safety Guidelines.

[1] https://sweep.gos.pk/downloads/

[2] *No proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment and has obtained from the Agency approval in respect thereof.*

ES-3 PROJECT DESCRIPTION

As part of funding received from the World Bank under the SWEEP Project, the SSWMB aims to develop a sanitary landfill cell within the premises of the Jam Chakro site. This will allow for incoming waste to be dealt in a manner that is environmentally friendly and produces minimal impacts. The Jam Chakro site with respect to its location in the city of Karachi is briefly described below:

Table ES-1: Location of Jam Chakro Site with respect to Karachi

Site	Co-ordinates	District	Zone	Description of Location
Jam Chakro Site	25°2'24.78" N 67°1'42.54" E	West	Manghopir	Located along the Surjani Town Link Road

Currently, the existing dump site at Jam Chakro is operating as an un-engineered manner, where gaseous emissions and effluents are continuously being released into the environment.

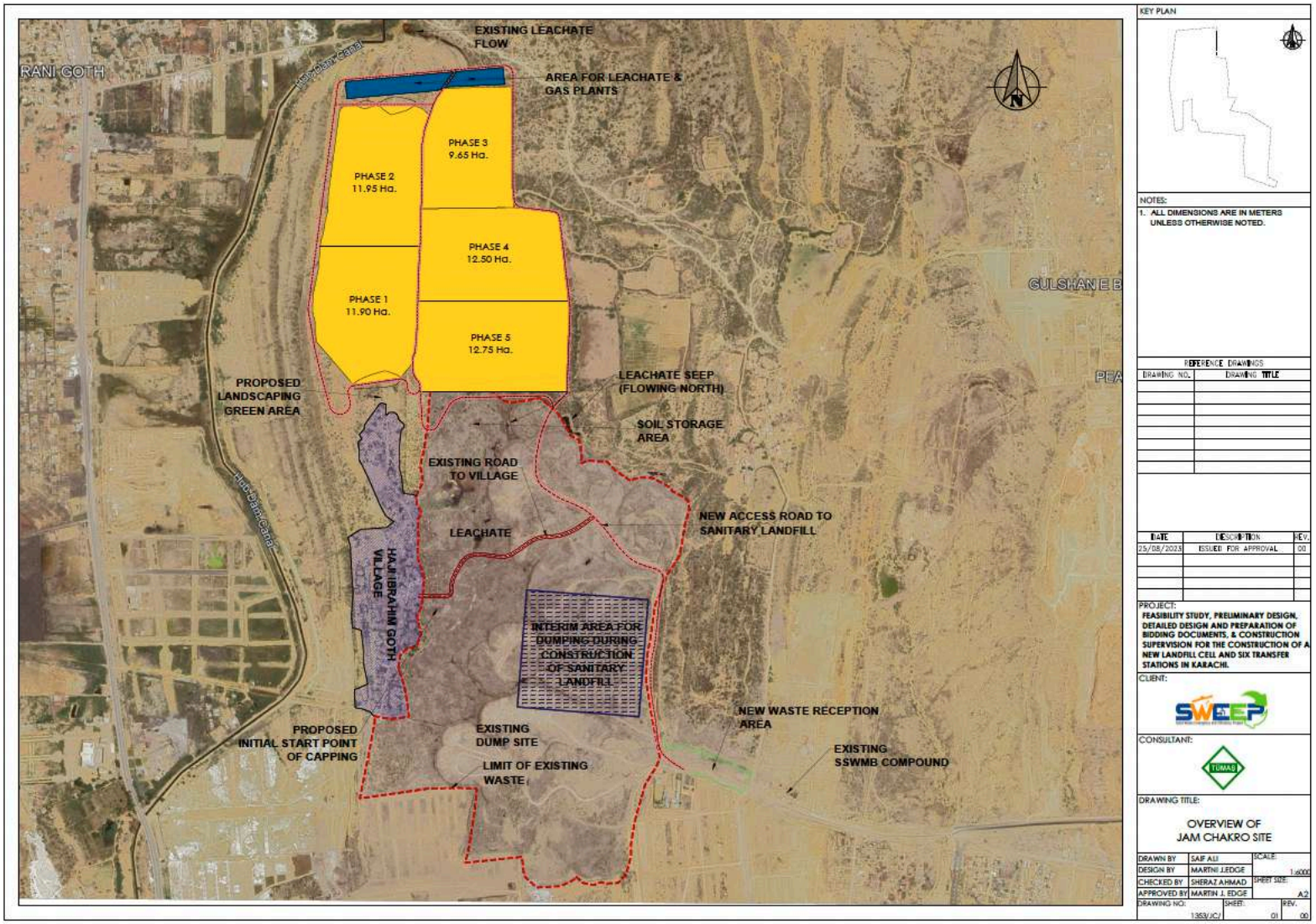


Figure ES1 – Overview of Site Development at Jam Chakro

The receptors within the AOI of 500 m from the boundaries of the Jam Chakro site are identified and their distances between the existing dumpsite and the sanitary cells proposed are given below:

Table ES-2: Proximity of Receptors to Jam Chakro Site

S. No.	Settlement/ Receptor	Nature of Receptor	Sensitivity of Receptor	Proximity to Boundary of Old Dump Site	Proximity to Boundary of New Cells
1	Haji Ibrahim Goth	Informal Settlement residing next to the Jam Chakro site.	Sensitive	Approximately 900 m of the settlement is immediately adjacent to the existing dump site	Approximately 130 m from the Northern side of the settlement.
2	Al Zainab Residency	A proposed residential development next to the Jam Chakro site,	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 300 m from the old dumpsite.	Approximately 1.3 km from the proposed cells.
3	North Town Residency	A proposed residential development near the Jam Chakro site	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 263 m from the old dumpsite	Approximately 1.5 km from the proposed cells
4	North Town Residency Phase II	A proposed residential development near the Jam Chakro site	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 210 m from the old dumpsite.	Approximately 1.6 km from the proposed cells
5	Hope Medical Facility	A makeshift medical center to cater to the people of Haji Ibrahim Goth	Sensitive	Immediately adjacent to existing dumpsite	Approximately 1.03 km from the proposed cells.
6	Ali Town Residency	A proposed residential development across from the Jam Chakro site	Non-sensitive as it is currently in the process of construction	Approximately 750 m from the old dump site	Approximately 310 m from the proposed cells where the settlement is located across the Hub Dam Canal, still under construction, and sheltered from the proposed development due to the ridges that encapsulate the cells.
7	Haji Abdul Rehman Goth	A proposed residential development, North of the Jam Chakro site.	Non-sensitive as it is currently in the process of construction. There is an imposing natural ridge and a surface water channel between the landfill cells and the residential development	Approximately 1,150 m from the old dumpsite	Approximately 300 m from the proposed cells, where the settlement is located across the Hub Dam Canal, is sparsely populated, and sheltered from the proposed development due to the ridges that encapsulate the cells.
8	Gul Muhammad Qalandri Goth	A settlement on the North of the Jam Chakro site.	Relatively non-sensitive as it is not in the wind direction and away from the dump site	Approximately 1,200 m from the old dump site	Approximately 500 m from the proposed cells where the settlement is sheltered from the proposed development due to the ridges that encapsulate the cells.
9	Idara Al Khair Campus 3	A school for the children of Haji Ibrahim Goth	Sensitive	Immediately on the border of the old dumpsite	Approximately 1.3 km from the proposed cells

10	Hamdard Industrial Complex	An industry operating in the area	Non-sensitive	Approximately 560 m from the old dumpsite	Approximately 1.7 km from the proposed cells
11	Sumayya Northern Industrial Zone	A proposed industrial zone across the Hub Dam Canal from the Jam Chakro site.	Non-sensitive as it is currently under development	Approximately 300 m from the old dumpsite	Approximately 579 m from the proposed cells, where the proposed industrial zone is across the hub dam canal, and sheltered from the proposed development due to the ridges that encapsulate the cells.
12	Al Ghafoor Industrial Zone	A proposed industrial zone to the Southwest of the Jam Chakro site.	Non-Sensitive as it is currently under development	Approximately 100 m from the old dumpsite	Approximately 1,320 m from the proposed cells

ES-4 BASELINE OF PROJECT AREA

The data presented in the baseline section has been collected from primary and secondary sources. For the primary data acquisition, the ESIA team conducted reconnaissance and detailed field visits.

Physical Environment

Physical site surveys were carried out which aided in the development of E&S measures for the proposed engineered cells:

The topography of the site dictated numerous aspects that have gone into the design considerations to reduce overall E&S impact:

- The topography of the area is hilly, where, using 10-year flood data and the hydrological patterns of the area, the flood risk for the site was calculated. The assessment indicated that the flood risk in the area is low. This was confirmed as no flooding has been observed on site despite the increased intensity in rainfall patterns in recent years starting from 2019.
- The overall site topography has been used to finalize the type of landfill to be developed, i.e., in the Western valley, using the natural ridge on the East & West, a semi aerobic bio-reactor landfill has been proposed where minimal excavation shall be used, and the natural slope of the area will be used to drain out the leachate. Similarly, on the eastern valley, using the topography of the area and using minimal excavation, a conventional landfill shall be developed.

The strata determined through investigation determines the different types of controls that must be introduced at the design stage to curb E&S impacts as:

- Limestone and sandstone being porous rocks in the area may have allowed for percolation of leachate from the old dumpsite to the groundwater present below, contaminating it.
- Limestone and sandstone being porous rocks in the area require for proper engineering controls to be established in the form of a composite lining system that will prevent leachate generated at the landfill cells from percolating into the ground and contaminating the groundwater. This has been taken into account in line with ESS 4 – Community Health & Safety.
- The geological strata found also dictates the stability of the area in the case of any seismic events, where the results obtained dictate that the site won materials have high frictional strength with an adequate factor of safety to be constructed at slopes of 1V:3H under both operational and seismic loads. This also fulfils requirements of any engineering controls to be required in line with ESS 4 – Community Health & Safety.

The climatic conditions of the area determine various factors in the development and operation of the landfill cells that would contribute towards its E&S impacts, such as:

- The amount of leachate generated will be impacted by the rainfall events and intensities, where its evaporation from the site would be determined by the temperature and the wind speed. Given the high humidity in the city, low rainfall, and mid to high temperatures, leachate recirculation has been sought out as an option to expedite the process of decomposition, and to also naturally allow for the leachate to evaporate rather than having to treat it.
- The wind direction and speed would determine the direction and dispersion of any landfill gases that are allowed to escape into the atmosphere. Given that most of the year wind blows from Southwest to Northeast, any landfill gas released into the atmosphere would be dispersed in that direction, mostly away from the immediately situated Haji Ibrahim goth.

The nearest freshwater source to the site is the Hub Lake/Hub Dam which is 26 km away from the site.

Environmental Monitoring was conducted at different points inside the AOI for ambient air, noise, drinking water quality, groundwater quality, leachate, municipal wastewater quality, and soil. A map of the locations at which monitoring was conducted is provided below:

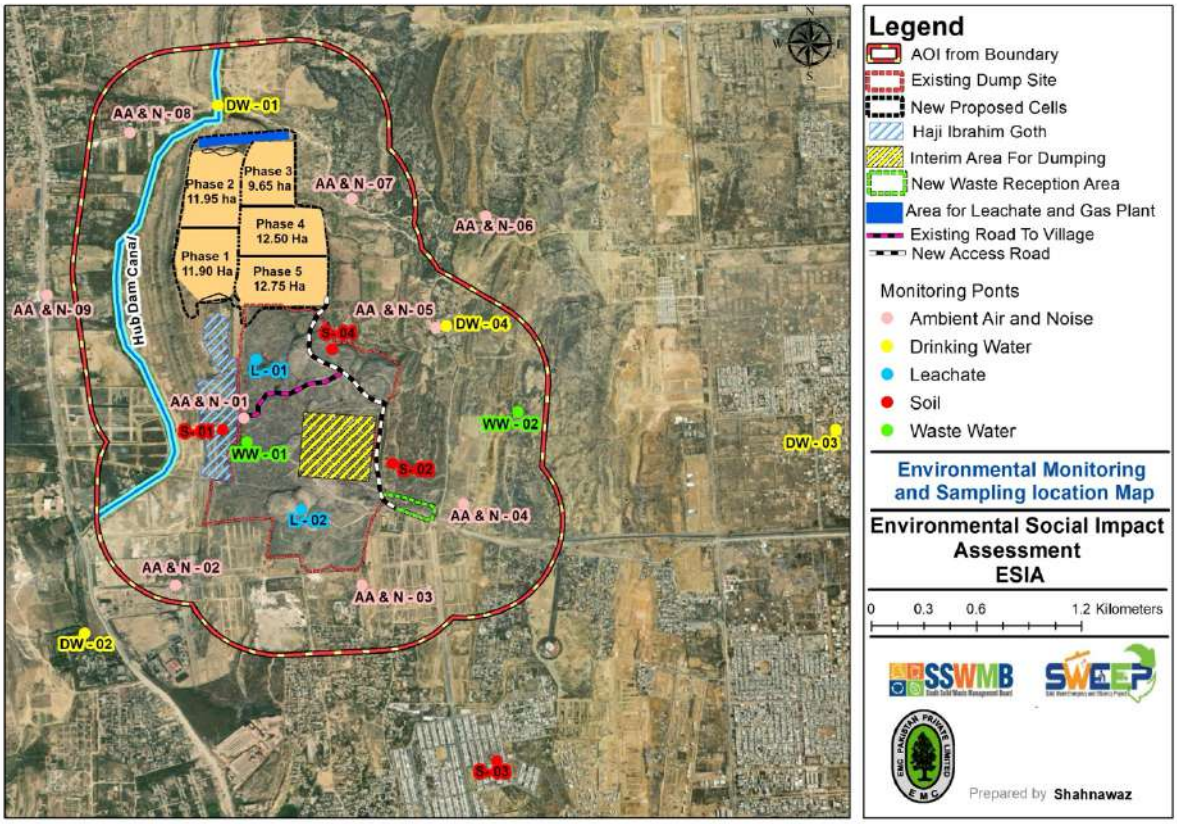


Figure ES 2 – Locations of Environmental Monitoring Conducted

The ambient air and noise monitoring was conducted at 9 different locations corresponding to different receptors (residential, industrial etc.) within and outside the AOI to understand the existing conditions. As such, the airshed in the area was fond to be deteriorated with high levels of NO_2, $PM_{2.5}$, and PM_{10}, which can be attributed to the commercial construction activities and the movement of heavy vehicles in the area. Noise levels were also found to be elevated for the most part due to the presence of these activities.

Drinking water sources in the area was also studied within the AOI at 04 different points, including samples from the nearby Hub Dam Canal (upstream and downstream from the Jam Chakro site), the water connection and Haji Ibrahim goth, and a mosque at another village in the AOI, Hassan Brohi Goth. All water samples were found to be relatively unpolluted (i.e. the samples had 1-2 pollutants that slightly exceeded the acceptable threshold levels for drinking water) and as such fit for human consumption, with the exception of the water at the mosque which presented bacterial contamination. This pointed towards the drinking water sources at the site being relatively undistributed by the activities of the dump site next to it.

The leachate being generated at the site exhibited high levels of Biological Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solids, Total Dissolved Solids, Phenolic Compounds, Chlorides, Sulfate, Ammonia, Silver, Barium, Iron, Boron, Total Nitrogen, Total Phosphorus, and p-Cresol. These results and their concentrations were used to calculate the method of leachate treatment to be utilized on site for the development of the landfill cells. Furthermore, the groundwater quality and soil were also studied to check whether there were any elevated levels of the same compounds, exhibiting contamination from the leachates at the site.

Groundwater at the site was encountered fairly below the ground (almost 250 feet below ground level), where samples were taken from 07 boreholes, corresponding to residential receptors in and around the AOI. The groundwater obtained showed contamination of barium, chloride, and lead, with some samples also exhibiting high levels of fluorides, chlorides, and chromium. As such, the groundwater is unfit for consumption as is, where it will require treatment prior to human consumption. Groundwater is however not being used for consumption by the people.

Nevertheless, the contamination of the groundwater at the site cannot be directly linked back to the activities of the dump site without further detailed investigations of the legacy waste, as during geotechnical investigations, there was no visible sign of leachate percolation into the ground observed. Furthermore, given the overall nature of Karachi city where industrial and municipal effluents are discharged into unlined drains throughout the city and solid waste is found everywhere, the groundwater of the city is already polluted, where parameters such cyanide, lead, and chromium are found to be in excess in the groundwater as is[3].

Soil investigations were also conducted where, out of the 4 soil samples taken, 3 were taken from the Jam Chakro site, and 1 from an area outside of the AOI. Given that chromium was found exceeding the stringent standards in all 4 samples, it can be attributed to the anthropogenic footprint in the area as a whole and the subsequent deterioration of the environment.

All monitoring and testing were conducted by a SEPA approved Environmental Laboratory (EL).

Ecological Environment

In order to study the project area, all available literature, and data regarding the tract, its habitat, flora, and fauna was thoroughly reviewed to have a better understanding of the project area. Field survey was also carried out covering ecosystem sensitivities, vegetation/flora, and fauna. A variety of mammals, reptiles, amphibians, and bird species reported in the AOI as mentioned in Chapter 4.

Social Environment

Adjacent to the boundaries of Jam Chakro lies Haji Ibrahim Goth, an informal settlement that is home to a significant population of waste pickers. These individuals frequently visit the existing dump site for waste picking and to engage in various livelihood activities.

[3] PCRWR (Pakistan Council of Research in Water Resources). 2002. Water Quality Status in Pakistan. Pakistan Council of Research in Water Resources, Ministry of Science & Technology, Government of Pakistan, Islamabad

To understand the social baseline of the area, a census survey was conducted of Haji Ibrahim Goth, where the results are summarized below:

Table ES3 – Findings of Census Survey

Entities	No and % age
Total Residential Households	723
Total Commercial Structures	63
Total Population	3,448
Total No. of Adult Males (Above 15)	949
Total No. of Adult Females (Above 15)	963
Total No. of Male Children (Below 15)	808
Total No. of Female Children (Below 15)	726
Total No. of Transgenders	02
Literacy Rate (% of total population)	77% Illiterate (74% of overall Males & 80% of overall Females)
Livelihood Practices*	
Waste Pickers in the family	1,067 (31%) i.e., 841 Males, (48%) and 226 Females (13%).
Non-working women staying at home	838 (24%)
Jobless	78 (2%)
Labourer	42 (1%)
Other Occupations	1425 (42%)

*Note: Percentage may vary due to multiple answers being received against one field

No physical resettlement or relocation of these persons or their assets will take place at the Jam Chakro site under the subproject, where only livelihood loss is expected, for which a dedicated LRP has been developed. Details on the findings obtained from these surveys are further elaborated upon in chapter 5.

ES-5 POTENTIAL IMPACTS & MITIGATION MEASURES

The proposed project is likely to have both positive and negative impacts during the construction and operational phases, for which proper mitigation measures will be necessary. The identification of these impacts has been conducted on the basis of literature review, site surveys, and expert opinion on prevailing site conditions and sensitive receptors, where mitigation measures have been proposed in line with the Bank's mitigation hierarchy.

Positive Impacts: the sub-project will reduce if not totally eliminate some of the prevailing problems pertaining to the informal operation of the site, i.e., insufficient capacity, poor working conditions, community health & safety issues, etc. the proposed sub-project will uplift the aesthetics of the areas also. The operations of SSWMB along with the HSE improvements to workers on site will also be manifold, which in turn will boost, the performing capacity of SSWMB in terms of waste handling. The livelihoods of those previously associated with waste picking in the area and residing at Haji Ibrahim Goth will also be improved through interventions planned under the LRP.

Adverse Impacts: The potentially significant adverse impacts associated with the construction activities under the different stages of the project (pre-construction, construction, operation) are presented below, where the detailed

Table ES4 – Summary of E&S Risk Assessment for the Existing Dumpsite

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
ESS 1: Assessment & Management of Environmental Risks & Impacts					
Adequate Coverage of Project Risks & Impacts along with definition of mitigation measures	Operations (Current Conditions) & Closure/ Capping	High	Currently, the dump site is operating in an un-engineered manner, where pollutants from leachates, landfill gas and the indiscriminate burning of waste are allowed to escape to the atmosphere.	No immediate mitigation measures that can be applied, where long term, only closure is the most feasible mitigation measure, where detailed design studies have been initiated on the closure/capping of the existing dump site and a tentative cost of 07 million US Dollars has also been estimated for the activity and different methods such as bio-mining, capping, are being explored. Following closure, the residual risk would be medium where the continuous robust monitoring of the capped site would be required.	Medium
ESS 2: Labor and Working Condition					
Occupational Health and Safety Occupational Health and Safety	Operations (Current Conditions)	High	Currently, the people working at the existing dump site in any capacity include: • Mostly the waste pickers who reside at Haji Ibrahim Goth and work in an informal manner at the dumpsite through picking recyclable items out of the incoming waste, • Waste truck drivers who have to navigate through the site to dump their wastes at different areas. • SSWMB workers who overall manage the operations of the dump site. With pools of leachates formed throughout the site, a lack of proper, paved roads, the trucks and people sharing the same roads,	Currently, there are no measures being practiced by the SSWMB or the people at the site, where some immediate measures that can be implemented to improve OHS conditions include: • Provision of Personal Protective Equipment to the waste pickers at site • Designating particular locations of the dumpsite where waste is dumped, and people can pick waste, where the entry and egress of vehicles is observed to avoid any accidents. Alongside this place temporary controls and measures for dealing with leachate and landfill gas.	Substantial

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			and waste dumps being lit on fire to reduce volumes, the overall occupational health and safety conditions of working at the site are extremely hazardous.	With the provision of these mitigation measures, the risk factor still remains high as the dumpsite would still be there, with people still having to traverse through it to get around, introducing OHS risks. Alongside these mitigation measures presented, a detailed Labor Management Procedures has been developed to manage the risks of child labor, forced labor, SEA/SH, labor disputes and occupational health and safety. The LMP details the approach that will be implemented to meet the national requirements and the objectives of the World bank ESS2: Labour and working Conditions and WB ESS4: Community Health & Safety. Similarly, a Gender Action plan has also been developed highlighting provisions of gender to be taken into account. Through the application and implementation of the provisions of the LMP, and the GAP the residual risk of these impacts will still be substantial due to the presence of the dump site.	
	Closure/ Capping	Substantial	At the time of capping, it is planned to start capping from the western part of the site, i.e., the part of the dumpsite adjacent to the settlement (an area that roughly shares a 900 m border with the settlement).	A detailed Labor Management Procedures has been developed to manage the risks of child labor, forced labor, SEA/SH, labor disputes and occupational health and safety. The LMP details the approach that will be	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			This in itself would have OHS risks as work would be taking place in a highly polluted area. Hence, the risk is substantial.	implemented to meet the national requirements and the objectives of the World bank ESS2: Labour and working Conditions and WB ESS4: Community Health & Safety. Similarly, a Gender Action plan has also been developed highlighting provisions of gender to be taken into account. Through the application and implementation of the provisions of the LMP, and the GAP, and the closure of the dump site the residual risk of these impacts will be medium.	
Labor risks	Operations (Current Conditions), Closure/Capping	Substantial	Workers and people at Haji Ibrahim Goth may be exposed to labor risks such as child and forced labor, GBV, discrimination, SEA/SH, and labor exploitations.		Medium
ESS 3: Resource Efficiency and Pollution Prevention Management					
Soil Contamination	Operations (Current Conditions)	High	The existing dumpsite spreads over more than 200 acres, where waste is being dumped into an excavated area with no protective lining. Furthermore, the soil and sand that is being swept up from the street every day is also being deposited at the dump site, leading to considerable soil contamination from current operations.	No such mitigation measures can be proposed currently. Risk to be accordingly studied and measures to be designed by the consultant studying the closure of the dump site.	-
	Closure/ Capping	Medium	The closure of the dump site will involve the potential treatment and remediation of any contamination found including soil.	Following closure, the risk of soil contamination should be low given that monitoring of the various pollutants being generated e.g., leachate and landfill gas is carried out and any issues addressed accordingly.	Low
Pollution of Water Resources	Operations (Current Conditions) &	Substantial	As understood from the environmental investigations conducted of the site, surface water resources around the site have not been polluted. However, some	No such mitigation measures can be proposed as such currently. Risk to be accordingly studied and measures to be	-

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
	Closure/ Capping		pollutants. (e.g., barium, chloride, fluoride, and lead) with elevated concentrations in the leachate generated on site, have also exhibited elevated levels in the groundwater quality found in the area. Further detailed investigations are required at the site to understand the impact of the site on the groundwater of the area. Nevertheless, with no protective liners, percolation and movement of leachate and pollution generated may lead to groundwater and surface water quality deterioration, which is a substantial risk.	designed by the consultant studying the closure of the dump site. Given that the overall groundwater quality of the city is deteriorated due to indiscriminate dumping of wastes and discharge of effluents from industries and municipalities into unlined canals, remediation/ closure must be planned accordingly.	
Air Pollution	Operations (Current Conditions)	High	Currently, the sources of air pollution at the site include: • Extensive burning of wastes at the site by waste pickers to reduce volume of waste and find recyclable items. • Generation of landfill gas at the site and lack of capture/control mechanisms • Movement of heavy vehicles at the site in the form of garbage disposal trucks All of these items pose a high risk of extreme air quality deterioration, particularly the burning of wastes as the highest quantity of waste arriving at the site is single use plastic (polyethene bags), which when burned produce toxic pollutants such as microplastics,	Some immediate mitigation measures that can be implemented include: • Spreading awareness on the burning of wastes and providing alternatives. • SSWMB oversight on not allowing burning of waste, and immediately putting out any fires identified. The risk after this should be substantial, and as such will require the closure of the site as a long-term solution.	Substantial

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			bisphenols, and phthalates, all toxins that can disrupt neurodevelopment, endocrine, and reproductive functions in humans.		
	Closure/ Capping	Medium	The closure of the dump site will involve identification of measures for the capture and management of landfill gas. This will also put an end to the indiscriminate burning of waste at the site.	Following closure when landfill gas is managed, monitored, and controlled, and the risk of indiscriminate burning of waste is also reduced, then the risk of air pollution should be low.	Low
Noise	Operation (Current Conditions)	Medium	Noise is produced due to the operation of machinery and other equipment. Sources of noise currently include the movement of trucks that bring in waste to the dump site.	Some mitigation measures here include: • Working during specified hours after contractors have submitted work schedules and they have been shared with the stakeholders in the AOI. • Regular maintenance of machinery, equipment and vehicles shall be carried out. Through the application of these mitigation measures and those detailed in the impacts chapter, the risk can be considered to be low.	Low
	Closure/Capping	Substantial	Machinery that will be used during the closure of the site may include heavy machinery such as bulldozers, excavators, stabilizers, concrete mixing plant, pneumatic drills, and other equipment. This may cause disturbance to the activities in the mosques, schools, hospitals, and households within AoI.	Some mitigation measures here include: • Informing stakeholders within the AOI of commencement of work • Working during specified hours • Regularly checking and ensuring that machines are well maintained. • Using plantations as natural barriers to noise propagation, particularly near the safety zone between Haji Ibrahim goths	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
				Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium.	
ESS 4: Community Health and Safety					
Traffic & Vehicular Movement	Operation (Current Conditions)	Substantial	Currently, there are no separate routes or roads for vehicles and movement of humans, where narrow paths have been carved out of the existing dumpsite for the movement of both. This has the potential of creating accidents and issues for the people, particularly waste pickers at the site.	Some immediate mitigation measures include: • Designating particular locations of the dumpsite where waste is dumped, and people can pick waste, where the entry and egress of vehicles is observed to avoid any accidents. Alongside this place temporary controls and measures for dealing with leachate and landfill gas. • Providing people with PPEs • Monitoring the speed of vehicles in the area The application of these measures should reduce the risk to medium.	Medium
	Closure/Capping	Substantial	During closure, there will be heavy machinery and vehicles on site in line with the technology chosen which may be a source of harm to the people. After closure, however, there should be no more vehicular movement on site, unless it is for the monitoring being conducted.	Some mitigation measures here include: • Using of vehicles in designated areas and avoiding roads that are used by the population. • Parking of vehicles in the designated areas • Erection of fencing or barriers around the population at Haji Ibrahim Goth to reduce risk of accidents. Further mitigation measures are to be defined after the study for capping is completed. Nevertheless, the adoption of these risks should reduce the risk of traffic related	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				accidents during capping to medium, and then post capping to low.	
Community Health and Safety Risks	Operations (Current Conditions)	High	Current community health and safety risks include: • Exposure to dusts and air emissions from the existing dump site including from the indiscriminate burning of wastes that produces harmful emissions. All of these items pose a high risk of extreme air quality deterioration, particularly the burning of wastes as the highest quantity of waste arriving at the site is single use plastic (polyethene bags), which when burned produce toxic pollutants such as microplastics, bisphenols, and phthalates, all toxins that can disrupt neurodevelopment, endocrine, and reproductive functions in humans, particularly vulnerable populations such as children and the elderly. • Exposure to hazardous materials and wastes including industrial waste and medical waste that currently finds its way to the site through third party contractors. • Continued contamination of soil, groundwater aquifers, and air from the open dumpsite, through the unmitigated and un-engineered dumping of wastes.	There are certain mitigation measures that the operations team at the existing dump site can apply to improve community health and safety conditions whilst operations continue at the dumpsite: • Disallow people from burning waste at the site, where if burning waste is found, then it is immediately extinguished using the appropriate firefighting equipment. • Avoid dumping wastes near the community at Haji Ibrahim Goth and the pathways they use for travel. • Cover and contain waste that using a layer of soil or other appropriate materials to minimize the dispersion of pollutants into the air. • Carry out fumigations at the site to reduce the risk of vectors and disease transmission to the extent feasible during the development of the new cells, along with the potential odor generation and propagation. Nevertheless, to truly reduce the risk from the existing dump site, the appropriate long-term measure would be to carry out a detailed study for the capping/ closure of the dumpsite along with any potential rehabilitation of the site deemed necessary.	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			• Leachate management and potential for contamination of surface water resources and groundwater resources. • Transmission of diseases through vectors at the community in Haji Ibrahim Goth and the nearby areas in the AOI. The overall community health and safety risks under the current conditions are high.	The closure/ capping of the site should look into the following items to effectively reduce community health and safety risks: • Usage of appropriate cover materials that includes impermeable layers of materials with appropriate thickness in line with the conditions identified at the site. • Designing proper gas venting and collection systems to prevent gases from migrating into surrounding areas. • Designing of appropriate leachate control and treatment mechanisms to prevent the migration of contaminated leachate into surrounding surface and ground water. • Designing of appropriate drainage systems to control surface water runoff and to prevent erosion. • Designing of appropriate monitoring wells around the closed site to regularly assess the groundwater quality. • Establishment of security measures to prevent unauthorized access to the closed site. • Development of a post closure monitoring plan to assess the long-	

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				term effectiveness of the closure and capping measures. • Development and communication of emergency response plans to address any unforeseen events or issues that may arise after closure. If these items are considered during the design of the closure/ capping of the site, and implemented, then following closure, the risk of these items should be low.	
	Closure/ Capping	Medium	Following closure there will still be needs to monitor the effectiveness of the closure through monitoring of the landfill gas, and leachates.	Following closure, with the use of a robust monitoring mechanism, the overall risk towards community health and safety should be low.	Low
Social Conflict, GBV, SEA/SH	Operation (Current Conditions), Closure/ Capping	Substantial	Currently, there are no procedures defining the risks of SEA/SH and GBV, along with a potential mechanism for aiding survivors. Furthermore, during the closure phase, conflicts may arise between labor force and local community, including the risk of SEA/SH and GBV.	A Gender Action plan has been developed highlighting provisions of gender to be taken into account and the different risks and their mitigation measures along with a grievance redress mechanism that will work to reduce this risk to medium.	Medium
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources					
Biodiversity Flora	Operations (current conditions), Closure/ Capping	Substantial	Currently the risks to biodiversity include: • Deterioration of the critically endangered plants of Commiphora wightii on site • Goats and cow in large numbers are observed to graze on the organic matter	The capping will take care of the grazing of animals, however, will require that the Commiphora wightii are relocated before that to ensure that no plants are disturbed from capping. The residual risk should then be low.	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			on site, where pollutants from the waste are ingested, and diseases may be introduced in the animals which are passed on as part of the food cycle.		
ESS 8: Cultural Heritage					
Chance Find Procedures	Operations (current conditions), Closure/ Capping	Low	There are no notified sites of cultural heritage or importance in the area.	Chance finds procedures have been established and added in the **Annex-VIII** should any items of archaeological and cultural value be identified. The residual impact should then be low.	Low
ESS 10: Stakeholder Engagement and Information Disclosure					
Stakeholder engagement	Operations (current conditions), Closure/ Capping	Substantial	The project-affected population and sensitive receptors may not be aware of the proposed project and particularly the measures being taken place at different times of the project, which would be an issue given the close proximity of their siting to the site and the dependence of 1/3 of the population on waste picking activities.	A stakeholder engagement plan has been prepared in line with ESS-10 highlighting the stakeholders in the area, and their consultation preferences and frequencies. If the SEP is implemented, then the residual risk should be medium.	Medium

*Note: This Risk Assessment for the existing dumpsite and its closure has been conducted prior to the respective detailed design studies, where the table may be revised in line with the findings of the studies.

Table ES5 – Summary of E&S Risk Assessment for the Development of the Sanitary Engineered Landfill Cell

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
ESS1: Assessment & Management of Environmental & Social Risks & Impacts					

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Adequate Coverage of Project Risks & Impacts along with definition of mitigation measures for Development of New Sanitary Landfill Cell	Construction & Operation	High	Conducting an inadequate assessment or not conducting an assessment that does not cover the guidelines of the World Bank's ESF and local regulations. This would be a high risk.	The ESIA prepared for the cell covers all risks in detail in line with the project's construction and operation phases. Furthermore, the following associated Environmental & Social instruments have also been prepared in line with the requirements of the ESF: 1. Environmental & Social Management Framework 2. Resettlement Framework 3. Stakeholder Engagement Plan 4. Labor Management Procedures 5. Gender Action Plan 6. Livelihood Restoration Plan (given that no physical involuntary resettlement is involved). Following proper implementation of the measures provided in this ESIA and the associated instruments, the residual risk should be low.	Low
ESS 2: Labor and Working Condition					
Occupational Health and Safety	Construction	Substantial	Construction workers are exposed to occupational health and safety risks and hazards when performing construction activities such as operation of heavy equipment and machines, labor works, civil works, and others, along with working near polluted areas.	A detailed Labor Management Procedures has been developed to manage the risks of child labor, forced labor, SEA/SH, labor disputes and occupational health and safety. The LMP details the approach that will be implemented to meet the national requirements and the objectives of the World bank ESS2: Labour and working Conditions and WB ESS4: Community Health & Safety. Similarly, a Gender Action plan has also been	Medium
	Operation	Medium	Workers are exposed to occupational health and safety hazards during O&M activities including the disposal and		Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			compaction of waste, laying of top cover, leachate management, etc.	developed highlighting provisions of gender to be taken into account.	
Labor risks	Construction, Operation	Substantial	Workers may be exposed to labor risks such as child and forced labor, GBV, discrimination, SEA/SH, and labor exploitations.	Furthermore, a sanitation plan and a health & safety manual have been attached as **Annex-IX** and **Annex-X** respectively. Through the application and implementation of the provisions of the LMP, and the GAP the residual risk of these impacts will be low to medium.	Medium
ESS 3: Resource Efficiency and Pollution Prevention Management					
Resource Efficiency	Construction	Medium	Non-renewable materials such as water, crushed aggregates, sand, cement, and fuel will be used during construction where these materials cannot be used again.	Some mitigation measures that may be used here include: • Use of efficient and well-maintained machines • Implement energy and water conservation measures. • Training workers on energy & water conservation measures A resource conservation plan has also been attached as **Annex-XI** to this report. Through the implementation of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be medium.	Medium
Soil Contamination	Construction	Medium	Given that the area where the cell is planned is virgin land, the chance of existing soil contamination is low, however, the soil will be subject to minor trimming and cutting, and potential erosion from movement of machinery. Erosion may	Some mitigation measures that may be used here include: • Using Safety Data Sheets during handling and storage of chemicals	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			increase during intense rainfall events, and contamination may be caused by oil and chemical spills or uncontrolled runoff from equipment washing yards.	• All maintenance of heavy equipment and vehicles to be done in an area with designated lined flooring • Controlling runoff volumes and intercepting before leaving sites Through the application of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be low.	
Pollution of Water Resources	Construction	Medium	Runoff from the construction works area may contain increased loads of sediments, suspended solids and other contaminants which will increase the pollution load of the available water resources in the project area. The following are the potential sources of pollution of water sources: • Discharge of untreated wastewater from contractors' camps and construction site • Oil and chemical spills • Dumping of wastes from contractors' camps and construction site	Some mitigation measures that may be used here include: • Wastewater from washing of vehicles or equipment will not be directly discharged in any water source or the storm drainage. • Provision of sanitary toilet facilities in the constructors' camp • All the effluents will be discharged into existing sewerage system as per the requirements of stringent environmental quality standards. • Septic tanks will be constructed to provide primary treatment after which the wastewater will be discharged into existing sewerage network system with the prior approval of KWSB. Through the application of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be low to medium.	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Air Pollution	Construction	Substantial	The use of vehicles, heavy equipment and generator sets will emit gaseous air pollutants such as carbon monoxide (CO), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2). Earthmoving activities and excavation will generate dusts. This may cause nuisance and respiratory stresses to vulnerable groups such as children and elderly.	Some mitigation measures that may be used here include: • Regular water sprinkling on the site and access roads will be carried out to suppress excessive dust emission(s). The frequency of water sprinkling will be increased in summer season as per the requirement. • The vehicles carrying construction materials and the construction material storage areas will be covered with tarpaulin. • Excavated materials will always be covered. Through the application of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be medium.	Medium
	Operation	Medium	During the operational phase of the landfill cells, the western valley will work as a semi aerobic landfill and the eastern valley as a conventional landfill, meaning only the eastern valley will produce methane in considerable quantities for concern. Nevertheless, as per engineering calculations provided in the project description chapter above, it is not estimated that there will be considerable amounts of landfill gas being generated, where appropriate engineering controls	Some mitigation measures that may be used here include: • All vehicles, machinery, equipment, and generators used during construction activities will be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions and subsequent impacts. • Personal Protective Equipment's (PPEs) like masks, goggles which are suitable for specific jobs will be provided to workers and visitors.	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			have been defined to capture and properly deal with the gases also.	Through the application of these mitigation measures and those detailed in the impacts chapter, the risk can be considered to be low to medium.	
Noise	Construction	Substantial	The noise may be produced due to the operation of construction machinery and other equipment. Sources of noise during construction are heavy machinery such as bulldozers, excavators, stabilizers, concrete mixing plant, pneumatic drills, stone crushers, asphalt plants and other equipment. This may cause disturbance to the activities in the mosques, schools, hospitals, and households within AoI.	Some mitigation measures here include: • Informing stakeholders within the AOI of commencement of work • Working during specified hours after contractors have submitted work schedules and they have been shared with the stakeholders in the AOI. • Regular maintenance of machinery, equipment and vehicles shall be carried out. Through the application of these mitigation measures and those detailed in the impacts chapter, the risk can be considered to be medium.	Medium
	Operation	Medium	The operation of the landfill cells including the movement of machinery and disposal of waste is what will contribute to noise.	Some mitigation measures here include: • Working during specified hours • Regularly checking and ensuring that machines are well maintained. • Using plantations as natural barriers to noise propagation, particularly near the safety zone between Haji Ibrahim goths. This is further elaborated upon in the tree plantation plan attached as **Annex-XII.** Through the application of these measures and those detailed in the impacts chapter, the risk can be considered low to medium.	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Construction Wastes	Construction	Medium	Domestic solid wastes will be generated by the workers in the contractors' camps. Improper storing of kitchen and food wastes may attract rodents and other pests. Construction wastes will be generated. These wastes can also be hazardous. Improper storage and disposal of these wastes may cause pollution to soil and in water if dump in water bodies.	Some mitigation measures here include: • Having the contractor develop and implement a site-specific waste management plan. • Designation of specified areas for different kinds of waste • Prohibiting burning of waste • Recycling items to the extent possible A waste management plan has also been prepared and attached as **Annex-XIII**. Through the application of these measures and those detailed in the impacts chapter, the risk can be considered low to medium.	Low
ESS 4: Community Health and Safety					
Traffic	Construction	Substantial	The dump site will still have incoming waste vehicles, where construction vehicles for the new cell will also be on site. Given that both will be in separate areas of the site, the routes to these sites will still have some overlap and may lead to traffic congestion. This may also lead to people who use the masjid, graveyard, and schools to have accessibility issues.	Some mitigation measures here include: • Contractor to Conduct a traffic survey prior to mobilization at site to identify traffic load and possible traffic congestion. • Finalize a site-specific traffic management plan. • Inform stakeholders in the AOI about traffic disruptions. • Construction vehicles to be parked in designated areas. A guide traffic management plan has been attached as **Annex-XIV** to this report. Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium adverse.	Medium
	Operation	Medium	During operations, and after the development of the ring road/ access road,	Some mitigation measures here include:	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			and designated areas for waste disposal, parking, and washing, along with the implementation of an overall traffic management plan, it is expected that overall traffic impacts will be low.	• Using of vehicles in designated areas and roads • Parking of vehicles in the designated areas Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium.	
Community Health and Safety Risks	Construction	High	Community health and safety risks include (i) Exposure to dusts and air emissions from the construction site may cause respiratory distress most especially to the vulnerable groups such as children and the elderly (ii) Exposure to hazardous materials and wastes, (iii) site stability of new cell and existing dump, (iv) flood risk, (vi) fugitive emissions, (vii) continued contamination of soil, groundwater aquifers, and air from the open dumpsite, (viii) leachate management. The community may also be exposed to communicable diseases, vector-borne diseases, and water-borne diseases due to the influx of workers.	Some mitigation measures here include: • The construction activities will be planned and managed in close consultation with these stakeholders to minimize the vulnerability of above impacts on these sensitive receptors, where construction sites will be fenced. • Special arrangements will be ensured to the accessibility and safety of the educational institutes which cater to toddlers and young kids. • The speed of the vehicles will be controlled (at 30 to 40 km/hr) to reduce the probability of severe accidents, debris flows and dust emission which can harm the educational and health institutions. • Development of a buffer zone between Haji Ibrahim Goth and the landfill cells and development, where plantations will be carried out to act as a natural barrier. A community health & safety plan is attached to this report as **Annex-XV** along with emergency preparedness and response procedures attached as **Annex-XVI**.	Substantial

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium to substantial.	
	Operation	Substantial	The community health and safety risks during operations include (i) continued exposure to landfill gas and subsequent impacts (asphyxiation in closed areas, etc.), (ii) leachate management, (iii) flood risk, (iv) site stability, (v) and attraction of vermin.	Some mitigation measures here include: • Monitoring of landfill gas and water quality at different areas of sensitive receptors • Ensure efficient working of the gas processing plant. • Measures for these have been incorporated in the engineering design, where plantations in the buffer between the cell and the settlement at Haji Ibrahim Goth will serve as a barrier between vermin. Subsequently, despite the low amounts of leachate and landfill gas estimated, appropriate engineering controls have been introduced to minimize this impact. Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium to substantial.	Medium
Vibration	Construction	Medium	Construction activities may generate vibration that may cause structural damage to the nearby buildings and may also cause disturbance to the activities of the community within AoI.	The setback from the village to the nearest area where construction is taking place is considerable enough such that through attenuation, the vibration reaching the village should be minimal. The residual impact is low	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
	Operation	Medium	Operational Activities will involve the movement of heavy machinery involving the disposal of waste	The setback from the village to the nearest area where construction is taking place is considerable enough such that through attenuation, the vibration reaching the village should be minimal. The residual impact is low.	Low
Social Conflict, GBV, SEA/SH	Construction	Substantial	During the construction phase of the project, conflicts may arise between labor force and local community, including the risk of SEA/SH and GBV, which is a substantial risk.	A Gender Action plan has been developed highlighting provisions of gender to be taken into account and the different risks and their mitigation measures. Through the application and implementation of the provisions of the GAP the residual risk of these impacts will be medium adverse. Furthermore, a Grievance Redress Mechanism has been developed including GBV/SEA/SH measures which will be used and maintained during construction and operations.	Medium
Security Personnel	Construction & Operation	Substantial	With the presence of a sizable population present at Haji Ibrahim Goth right next to the site, the deployment of security personnel with arms during construction and operation for the protection of site and construction materials will be required. The abuse of power by these security personnel is an issue that will have to be proactively dealt with. This is a substantial risk.	Mitigation measures here include: • Conduct training, equipping, and monitoring of such security workers in line with Good International Industry Practices and applicable laws, along with on how to deal with the community. • No use of force to be allowed in providing security except for preventive and defensive purposes in proportion to the nature and extent of the threat. • Background checks to be done on security personnel prior to hiring to ensure there are no past transgressions.	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				• Review any and all allegations of unlawful or abusive acts of security personnel and take action as necessary to prevent recurrence and, where necessary, report unlawful and abusive acts to authorities. Following this, the residual risk should be low.	
ESS 5: Land Acquisition, Restriction on Land Use, and Involuntary Resettlement					
Resettlement & Livelihood Restoration	Operation	Low	There is no land acquisition or physical displacement/involuntary resettlement involved, however, around 1,067 waste pickers reside next to the site at Haji Ibrahim Goth and earn their livelihoods from waste picking at Jam Chakro. Given that the new site will be access controlled, these people will no longer be allowed to continue picking waste at the site.	No physical resettlement or relocation involved, where only livelihood loss is foreseen under the subproject. As such, a separate livelihood restoration plan has been prepared capturing these impacts and tailoring appropriate mitigation measures to ensure the affected persons are able to learn new skills and find new livelihoods. Furthermore, a transition plan for the waste picking community at Haji Ibrahim Goth has also been developed and added as **Annex-VII**. Through the application of the LRP, the residual impact should be low.	Low
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources					
Biodiversity Flora	Construction	Medium	It is estimated that from activities, around 07 grasses, 58 shrubs, 10 trees, and 667 plants of Commiphora wightii will be removed. Commiphora wightii is a critically endangered plant as per the IUCN Red List and is found only in South Asia. These plants cannot be removed as is and must be moved to another suitable location outside the cell area (or into the buffer area).	The Commiphora Wightii will be relocated and replanted to the buffer zone area between the new cells and the settlement at Haji Ibrahim Goth. This will be done in collaboration with the community to promote ownership of the plantations and ensure care of the buffer zone. Successfully doing this will allow for the residual impact to be medium to substantial	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
				adverse as it is greatly possibly for some plants to not survive the relocation.	
ESS 8: Cultural Heritage					
	Construction	Low	There is no designated cultural heritage site within the AOI of the project.	A chance find procedure has been developed and attached to the **Annex-VIII** for implementation.	Low
ESS 10: Stakeholder Engagement and Information Disclosure					
Stakeholder engagement	Construction	Substantial	The project-affected population and sensitive receptors may not be aware of the proposed project, which would be an issue given the close proximity of their siting to the site.	A stakeholder engagement plan has been prepared in line with ESS-10 highlighting the stakeholders in the area, and their consultation preferences and frequencies after detailed rounds of consultations with the people at Haji Ibrahim Goth. Once the SEP is implemented, then the residual risk should be low to medium.	Medium

ES-6 GRIEVANCE REDRESS MECHANISM (GRM)

The project has developed a dedicated GRM to receive and resolve all complaints and grievances related to project-supported activities. A Grievance Redress Committee has already been notified, comprising relevant staff from the SWEEP PIU, with the Project Director at its head and the Stakeholder Engagement and Gender Specialist as the secretary. Other than the GRC members, the committee may also utilize existing resources at the SWEEP-PIU and SSWMB to address and resolve grievances. Available SSWMB staff at the PIU will be tasked to operate and manage key interfaces such as dedicated telephone lines and email accounts set up to receive complaints, who will then relay to the pertinent SWEEP personnel to settle grievances and provide feedback related to project activities. The existing SSWMB team will be provided training to manage project-specific communications and grievances, which will require response and redressal procedures that are distinct from normal complaints on services. The existing SSWMB team may be supplemented with additional resources using project financing if needed. The design of the GRM will continue to be strengthened in light of the feedback provided during the stakeholder consultations and grievances received to better address the envisaged objectives.

A separate GRM will be established for the project workers also, addressing their grievances regarding wages, payments, living and working conditions, terms of employments and similar issues.

ES-7 STAKEHOLDER CONSULTATION & PUBLIC DISCLOSURE

Consultations were carried out during the study with relevant government departments such as the Sindh Environmental Protection Agency, District Commissioners, Non-Governmental Organizations (NGOs), Civil Society Organizations (CSOs), and local communities. Various rounds of consultative meetings were conducted in the study area to make the public aware of the project design and development as further information continued to become available, and to obtain the stakeholders feedback on it for potential inclusion in the design. Major categories of participants in these meetings comprised of local populations, community groups, and the villagers of Haji Ibrahim Goth.

Separate consultations were conducted with NGO, Institutions, and Industries for vocational training and recruitment of waste pickers following the provision of trainings planned under the Livelihood Restoration Plan.

The purpose of stakeholder consultations was to engage all stakeholders and record their concerns. During stakeholder's consultations, information regarding the project's main features, design, and benefits were shared. The stakeholders' concerns on the current issues being faced due to the operation of the dump site were raised and addressed accordingly. A Stakeholder Engagement Plan (SEP) has been prepared for the entire SWEEP to comply with the ESS-10 requirement.

Consultations were conducted from November 2022 to October 2023, in the sub-project areas while conducting the ESIA study.

ES-8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The ESMP sets out mitigation measures and actions against each anticipated impact, its monitoring requirements, responsibilities, and schedules for the implementation of the suggested mitigation measures. The summary of mitigation measures for the anticipated significant impacts is as follow:

Mitigation Measures: the design of the landfill cells has been optimized in line with discussions conducted with the concerned stakeholders to increase overall acceptability of the project.

Accordingly, mobilization, construction, and maintenance activities will be planned and managed considering the peak visiting and working hours of nearby community and sensitive receptors to minimize the adverse impacts on them. A tree plantation plan has been formulated with the recommendations and technical support of concerned Departments which will be implemented during construction phase. The details of livelihood restoration and upliftment for the waste pickers are suggested in the LRP to offset the impacts related to livelihood loss. Apart from above, occupational and community Health and Safety (H&S) management sub-plan; emergency preparedness and response sub-plan; restoration and rehabilitation sub-plan; waste management sub-plan; resource conservation sub-plan; drinking water supply and sanitation sub-plan; traffic management sub-plan; chance find procedures and change management sub-plan will be prepared and implemented to eliminate as well as reduce the severity of predicted E&S impacts. Environmental and social monitoring will also to be undertaken during both the construction and operational phases to ensure the effectiveness of the proposed mitigation measures. The ESMP also provides its implementation mechanism during construction and operational phases. The key element of the ESMP are the environmental and social mitigation and management matrix; environmental monitoring plan; planning for ESMP implementation; institutional requirements; training and capacity building; communication and documentation; guideline for the site-specific management plans; environmental and social cost for implementation of this ESMP.

Implementation Arrangements during Construction Phase: The key entities involved during the construction phase of the proposed sub-project are:

- PIU SWEEP as employer/proponent in which project Director (PD) is the executive head of the entire SWEEP Project. The PD is responsible for necessary policy, administrative and financial decisions, and actions for effective and timely implementation of the project as per the approved framework and implementation schedules. Environment and Social Cell (ESC) of PIU which currently consists of two environment specialists, a social development specialist and a gender specialist will be responsible for overall implementation of ESMP.
- Sindh Environmental Protection Agency (SEPA) – will undertake audits (as and when required) of the proposed project activities with respect to the protocols as defined in ESMP and environmental requirements,
- Supervision Consultant (SC) will overall supervise the construction activities at site and compliance of ESMP. SC will review and approve the contractor's management plans and also prepare monthly monitoring and evaluation report for each site and submit to ESC.
- Third Party Environmental and Social Consultant (External Monitor) will monitor the environmental and social parameters and conduct field surveys at the construction sites to evaluate compliance level.
- Contractor(s) will make sure the compliance of ESMP and will also be responsible for effective liaison. Prepare and submit the monthly, quarterly, biannually, annually, and final progress reports and coordinate with Environmental and Social Safeguard of SC.

Implementation during O&M: During the O&M phase, the facilities established under the proposed project will be administrated by the SSWMB as employer/proponent. The E&S staff of the SSWMB at O&M phase will be responsible for overall implementation of O&M phase ESMP and other E&S aspects of the facilities established under SWEEP.

E&S Monitoring and Training. The E&S monitoring plan has also been prepared as a part of ESMP which details the monitoring mechanism of a specific receptor/item, its frequency, and physical/ecological parameters to be considered. Though the anticipated E&S impacts are mostly site specific and reversible, proper implementation of mitigation measures will be required to further reduce the potential risks and impacts. A comprehensive training program has been proposed to train the Contractor(s) staff who will be involved during construction phase and the professional staff from the SSWMB involved at the operational phase of the project. All required permits shall be obtained from the concerned departments prior to starting the related activity.

ESMP Budget: The Environmental and Social Management Plan (ESMP) cost will be included as an integral part of the contract document with the Contractor. It should be noted that the environmental cost will not be treated as a separate entity, as its various components will be accounted for within the bidding document under different expense categories. The total estimated cost for environmental and social management, monitoring, and auditing throughout the pre-construction, construction, and operation and maintenance phases amounts to approximately **PKR 193.3 million**. This cost does not include any potential expenses related to livelihood restoration. It is important to note that the annual cost will be regularly updated for future years as per the project requirements.

1.Introduction

The Government of Sindh (GoS) through the Sindh Solid Waste Management Board (SSWMB) is planning to construct a sanitary, engineered, landfill cells in Karachi within the premises of the Jam Chakro site (specific works described ahead in the document). The proposed sub-project will be implemented under the umbrella of the Solid Waste Emergency & Efficiency Project (SWEEP) (funded by the World Bank (WB)) which focuses on prioritized interventions and improvements in the Solid Waste Management (SWM) sector. To address the potential environmental and social impacts of this proposed sub-project, this Environmental and Social Impact Assessment (ESIA) has been prepared in accordance with the guidelines and requirements of the Sindh Environmental Protection Agency (SEPA) and the World Bank's Environmental and Social Framework (ESF). The feasibility study against which this ESIA has been prepared is attached to this report as **Annex-I.**

1.1 Background – Solid Waste & Karachi

In Pakistan, the cities, and towns, are struggling to manage solid waste. According to a statistical survey, Pakistan was estimated to produce around 31 million metric tons of solid waste a year annually[4]. Insufficient public spending on essential infrastructure, weak institutions, and low professionalization of skillsets within the sector constrain the adequate management of waste, leading to adverse outcomes such as reduced liveability, environmental degradation, and high incidence of marine and plastic pollution. Waste collection remains low across the country where any waste collected is generally disposed in uncontrolled dumps. There are no sanitary landfills or other adequate treatment facilities currently available to treat solid waste collected from any city in Pakistan.

Karachi with an estimated population of 16.024 million[5], is Pakistan's largest city, economic and financial hub, and main port. It contributes 15 percent of national GDP and the largest share of national tax revenues, industrial employment, manufacturing, and high-end services.[6] The city dominates the economic landscape of Sindh, with nearly all of the province's industrial and service economy, and the majority of its labor force. It continues to be the engine of economic growth for the country, given its size, location, and industrial and human capital. In recent decades, however, the city's liveability and competitiveness have declined. The Karachi City Diagnostic and Transformation Strategy identifies an infrastructure gap of over US$ 9 billion in public infrastructure. Karachi now ranks 169 out of 173 cities globally for liveability[7]. Nearly half of its residents live in informal settlements ('*katchi abadis*'), only half of the city's water demand is met; public transport has deteriorated; and the city has a chronic problem with inadequate solid waste management and pollution.

The city of Karachi generates an estimated 10,000 tons of municipal solid waste every day.[8] Only a fraction of this waste (60%) is collected, and none of it is disposed in sanitary engineered facilities. Most of the waste (estimated around 60 percent)[9] is transported to two large unsanitary dumps, Jam Chakro and Gond Pass, located within 30-40 km from the city center, where neither of the facility meets international standards for waste disposal. The chronic backlog of uncollected waste has decreased the operating capacity of much of the urban infrastructure – i.e., the city's

[4]Silpa, Lisa Yao, Perinaz Bhada-Tata, and Frank Van Woerden. 2018. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-1329-0. License: Creative Commons Attribution CC BY 3.0 IGO
[5] Population of Karachi Division National Population and Housing Census 2017.
[6] World Bank (2018), Transforming Karachi into a Liveable and Competitive Megacity: A City Diagnostic and Transformation Strategy.
7 Economist Intelligent Unit
8 Lodhi, F. (2022). (rep.). Report on Environmental Compliance by Sindh Solid Waste Management Board (SSWMB) (pp. 1–16). Karachi, Sindh.
[9]Silpa, Lisa Yao, Perinaz Bhada-Tata, and Frank Van Woerden. 2018. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-1329-0. License: Creative Commons Attribution CC BY 3.0 IGO

drainage system is clogged by waste, contributing to persistent flooding; movement along several secondary roads is impeded due to litter; water sources are contaminated, and public spaces are unattractive and unsanitary. The environmental and human health implications are severe: open burning of waste generates high levels of persistent and toxic chemicals that contribute to poor air quality and cause cardio-vascular diseases; inadequate solid waste management (SWM) has been identified as an important factor behind continued incidence of polio in Karachi[10]; surface and groundwater pollution by inadequate disposal of waste is well documented, and a factor in the prevalence of water-borne diseases. Pollution from plastics is of concern: plastics account for about 60 percent of waste found on Karachi's beaches by density.[11]

Furthermore, the SSWMB has been able to calculate the amount of solid waste generated in each of the districts of the city, where this data is also represented below:

Table 1.1 - Daily Waste Generation in Karachi

S. No.	District	Amount of Waste Generated Daily (Tons/Day)
1	Malir	600
2	West	1600
3	Keamari	700
4	East	1600
5	South	1100
6	Korangi	2000
7	Central	2400
Source: Report on Environmental Compliance by SSWMB, 2022		

Karachi ranks below low-income country benchmarks in SWM on all parameters. Limited institutional capacity, a weak and fragmented governance structure, and the lack of infrastructure along the entire value chain impact the sector's efficiency. This situation is not new. A diagnostic study of the sector was completed in 2018[12], and two ongoing urban sector operations[13] are addressing some of the underpinning institutional and governance challenges that have hampered the efficacy of investments in the sector. A priority of the urban policy engagement with the GoS is SWM, which is central to efforts to improve liveability and competitiveness of Karachi. Ongoing policy efforts are focusing on improving the overall institutional environment (e.g., capacity, analytics, planning) in which future infrastructure investments can succeed. The GoS is cognizant of problems in the waste sector and has taken several steps to improve the situation in recent years. GoS set up a specialized agency in 2014, the Sindh Solid Waste Management Board (SSWMB), and has increased allocations and expenditure significantly to engage private sector contractors for front-end waste collection.

1.2 Project Overview

SWEEP aims to mitigate the impacts of flooding and COVID-19 emergencies, and to improve solid waste management services in Karachi. To alleviate this situation, the SWEEP project was planned with 3 components:

4. Component 1 – Immediate Emergency Response Interventions
5. Component 2 – Development of SWM Backbone Infrastructure
6. Component 3 – Project Management & Implementation Support

The project supports the Government of Sindh (GoS) to improve solid waste management services

[10] Provincial Task Force for the eradication of polio.
[11] Waste distribution studies of four beaches in Karachi.
[12] World Bank (2018), "Transforming Karachi into a Liveable and Competitive Megacity: A City Diagnostic and Transformation Strategy"
[13] Karachi Neighbourhood Improvement Project (KNIP, FY17), and Competitive and Liveable City of Karachi (CLICK, FY19).

in Karachi, through the incremental upgrading of infrastructure for collection, transfer, final disposal, and treatment of solid waste in Karachi. The Sindh Solid Waste Management Board (SSWMB) is the implementing agency for SWEEP and has established a Project Implementation Unit (PIU) under a government-appointed Project Director, with technical resources for engineering, environmental and social management, procurement, financial management and other key functions. The project comprises of:

Component 1: Immediate Emergency Response Interventions (Total Cost: US$ 11.0 million; WB financing: US$ 11.0 million)

Interventions under the emergency component aimed to mitigate high flooding risk for the 2020 monsoon through financing labor intensive emergency works for cleaning of solid waste from stormwater drains in Karachi. The World Bank and the Government of Sindh agreed in April 2021 that the allocation under Component 1 will not be used to retroactively or prospectively finance any nullah cleaning works, or any studies related to the nullahs.

Component 2: Development of SWM Backbone Infrastructure (Total cost: US$ 84.0 million; WB financing: US$ 84.0 million)

SWEEP will finance core investments in infrastructure, along the SWM value chain, to provide end-to-end solutions to the management of solid waste in the short to medium term. The proposed project will build on institutional strengthening and technical assistance activities provided under CLICK to support the development of environmentally, socially, and financially sustainable alternatives for Karachi, bringing in public and private sector stakeholders. The modernization of the SWM system will be achieved through a series of incremental improvements, as described below:

Subcomponent 2.1: Urgent Collection Equipment for Under-served Districts and Improvement of Kachra Kundis (WB financing: US$ 10 million)

Provision of Equipment: The proposed project will support the provision of critical equipment to improve occupational safety and collection efficiency. Equipment will include, inter alia: (a) PPE and light equipment for workers; (b) collection trucks; and (c) bins and containers to improve collection efficiency and properly service the network of *kachra kundis*.[14] The equipment procurement will be complemented by a focus on: (a) assuring an operational model is in place to manage and maintain the equipment; and (b) assuring mechanisms are in place to fund the operation and servicing of the equipment. Equipment will also be acquired by the SSWMB to improve associated operations (such as transfer sites). Contracts for procurement of equipment will include a stock of spare parts, training of mechanics at each depot, and an adequate maintenance and service period.

Improvement of Kachra Kundis: The project will finance approximately 80 kachra kundis to improve waste collection services[15] (upgrading 30 existing kachra kundis and constructing approximately 50 kachra kundis). The location of interventions will be finalized based on need and consultations with nearby residents, particularly in underserviced and flood-prone areas. The designs of kachra kundis will be customized to each location to maximize operability by relevant operational staff and contractors.

[14] *Kachra Kundis* are designated waste collection points consisting of basic concrete slabs with minimal confinement, where waste accumulates awaiting collection.
[15] Numbers as per the Project Appraisal Document (PAD)

Subcomponent 2.2: Construction of new sanitary disposal cell at Jam Chakro Dumpsite (WB financing: US$ 20 million)

This subcomponent will support, inter alia, the construction of a new sanitary landfill cell within the Jam Chakro site, improved safety measures for the dumpsite, rehabilitation of areas that have reached capacity, and improved living conditions and livelihoods for the community of waste pickers residing within the dumpsite. Specifically, the subcomponent will finance the following:

(a) *Design and construction of a new landfill cell* on underutilized available land within the perimeter of the Jam Chakro site. The new landfill cell will provide Karachi with modern disposal capacity for the next three to four years, based on current incoming volumes.
(b) *Measures to improve safety and environmental performance of the dumpsite,* including, inter alia: (i) construction of a perimeter fence/wall to limit intrusion and restrict waste deposits within site limits; (ii) stabilization of areas at risk of collapse by unstable slopes; (iii) retrofitting access gate, weighbridge and offices for better control of incoming flows; (iv) construction of test wells to monitor potential groundwater contamination; and (v) fire extinction activities to stop constant burning and re-ignition through covering or cooling.
(c) *Progressive closure and rehabilitation of areas that have reached capacity*, through standard methods to progressively reduce impacts associated with the operation of Jam Chakro.
(d) *Community Support Plan for waste pickers living at Jam Chakro.* There is a settlement of roughly 723 households living within the dumpsite and earning livelihood from scavenging activities. In the immediate instance, the project will aim to improve occupational safety as well as living conditions, starting with safe and efficient sorting conditions, such as those that will be provided at the Material Recovery Facility (MRF). In the medium to long-term, a resettlement and/or livelihoods restoration plan for the community will be implemented.

Subcomponent 2.3: Construction/ Upgrading of Transfer Stations (WB financing: US$ 20 million)

The proposed project will finance the construction or upgrading of up to six modern transfer stations. The SSWMB currently operates several basic transfer sites. The current network of transfer sites is insufficient, entailing large accumulations of waste across the city. The development of adequate transfer capacity is essential to improve the efficiency of the overall system including costs, environmental and social impacts, and general quality of service. The project will also support the development and implementation of an appropriate operating model for the operation and maintenance of these sites, likely with private sector participation.

Subcomponent 2.4: Development of Long-Term Waste Solutions for Karachi (WB financing: US$ 34 million)

The project will support the development of long-term waste solutions for Karachi, which address the limited capacity remaining at existing disposal sites. The project may consider multiple operating models making use of project financing, private capital, or public private partnerships. A top priority will be the construction of a new sanitary landfill site for Karachi. GoS has designated a 3,000-acre site in Dhabeji, about 60 kilometres east of Karachi, for the development of an integrated waste treatment facility. The project will finance the planning, design, and construction of a modern facility, with adjacent activities to sort, process, and extract value from the waste.

In addition to constructing the landfill, the project will provide support including planning, feasibility studies, engineering designs, development of business and operating models, and advisory services for the preparation of a larger ecosystem of waste treatment solutions. These solutions will aim to maximize waste volumes to be reused or recycled, generate energy from specific waste streams, while preparing the remaining fraction for final disposal at the landfill. The development of this ecosystem will require a combination of private and public investments. The project may

support the design and construction of solutions to improve treatment of non-municipal waste streams such as medical waste and/or construction and demolition (C&D) waste by supporting, inter alia: (a) Assessment of existing systems for collection, transport and disposal of medical and C&D waste streams; (b) Identification of gaps to be addressed through investments in technologies and management modalities; (c) Development of service improvement plans needed to build end-to-end solutions for each stream, and policy recommendations on regulation and tariffs for generators; and (d) Identification of priority investments, including technical specifications for transport, treatment and disposal solutions, optimal locations for facilities, contractual arrangements, etc. Operating models for such investments will also include private sector participation for provision of services and operations & maintenance of assets.

Component 3: Project Management and Implementation Support (Total cost: US$ 10.0 million; WB financing: US$ 5.0 million)

This component will support implementing agencies, primarily the Project Implementation Unit (PIU) under the SSWMB, to manage and implement activities and investments under SWEEP. The component will support skillsets and resources to manage the PIU's workload and associated expenses related to managing procurements, contract supervision, and oversight of infrastructure investments. In particular, the component will finance consultancies for environment and social assessments and instruments, monitoring implementation of safeguards plans, and resettlement aspects. Other consultants for feasibility studies, engineering design and supervision, and contractors for infrastructure works will be financed under the different components. In addition, this component will finance interventions such as trainings and skill development in the areas of monitoring and evaluation, communication, audits, social and environmental management, engineering, operations and maintenance, and project management. The component will cover costs related to skilling and capacity building requirements of SSWMB's staff and engineers, related to operations and maintenance of infrastructure commissioned under SWEEP, per international standards and design specifications. GoS' financing under the component will be used for salaries for civil servants posted in the PIU, and compensation for resettlement impacts related to civil works.

1.3 Project Proponent

The SSWMB is the primary agency for all activities undertaken under SWEEP**.** SSWMB has the institutional mandate for transport and transfer of waste (the middle end) including operation of transfer facilities, disposal of solid waste and operation of disposal facilities. The Board also manages collection of waste (the front-end) in all seven districts of Karachi through private contractors. Under SWEEP, SSWMB will be closely looking after activities in Component 2 (Development of SWM Backbone Infrastructure), including construction and operation of infrastructure. In addition, SSWMB will also support SWEEP – PIU in procurement of equipment, as needed, to carry out waste collection, routine clean-up, and maintenance tasks. The SWEEP PIU's functions include: (i) SWM engineering, (ii) procurement and contract management, (iii) environment safeguards, climate change and disaster resilience, (iv) social development, gender, stakeholder engagement, grievance redressals mechanism and communications, (v) financial management, and (vi) monitoring and evaluation (M&E), including a Management Information System (MIS).

1.4 Sub-Project in Focus

Currently, Sub-Component 2.2 is planned for implementation under SWEEP, where a sanitary landfill cell (in line with international standards and best practices) is planned for development alongside the existing dumpsite at the Jam Chakro site. The development of the engineered landfill cells is the focus of this ESIA report. The location of the Jam Chakro site is described below:

Table 1.2 - Location Details of Jam Chakro Site

Site	Co-ordinates	District	Zone	Description of Location
Jam Chakro Landfill Site	25°2'24.78" N 67°1'42.54" E	West	Manghopir	Located along the Surjani Town Link Road

Currently, the boundaries of the Jam Chakro site comprise of unutilized (vacant) land immediately to the north of the existing open dump site, which is where the cells have been planned, over an area of 145 acres. Access to the site will be provided through a road that will be developed through the existing dumpsite. A small portion of the existing dumpsite also falls within the area of the newly planned cells (approximately 10 acres in the area for phase 5).

Immediately West of the existing dump site is the informal settlement of Haji Ibrahim Goth, housing informal waste pickers and people squatting in the area. This overview of the site is also depicted below in **Figure 1.1**. Here, the 5 parcels in yellow highlight the 5 phases in which the proposed engineered landfill cells will be developed, while other polygons and items are described on the figure itself.

Alongside the development of the new cells, detailed designing for immediate dump remediation measures will also be undertaken, as well as a feasibility and options study for long term remediation and rehabilitation of the old dumpsite. This, however, is not currently part of this ESIA and will have its own Environmental & Social Due Diligence once the technology and method for rehabilitation and closure have been identified.

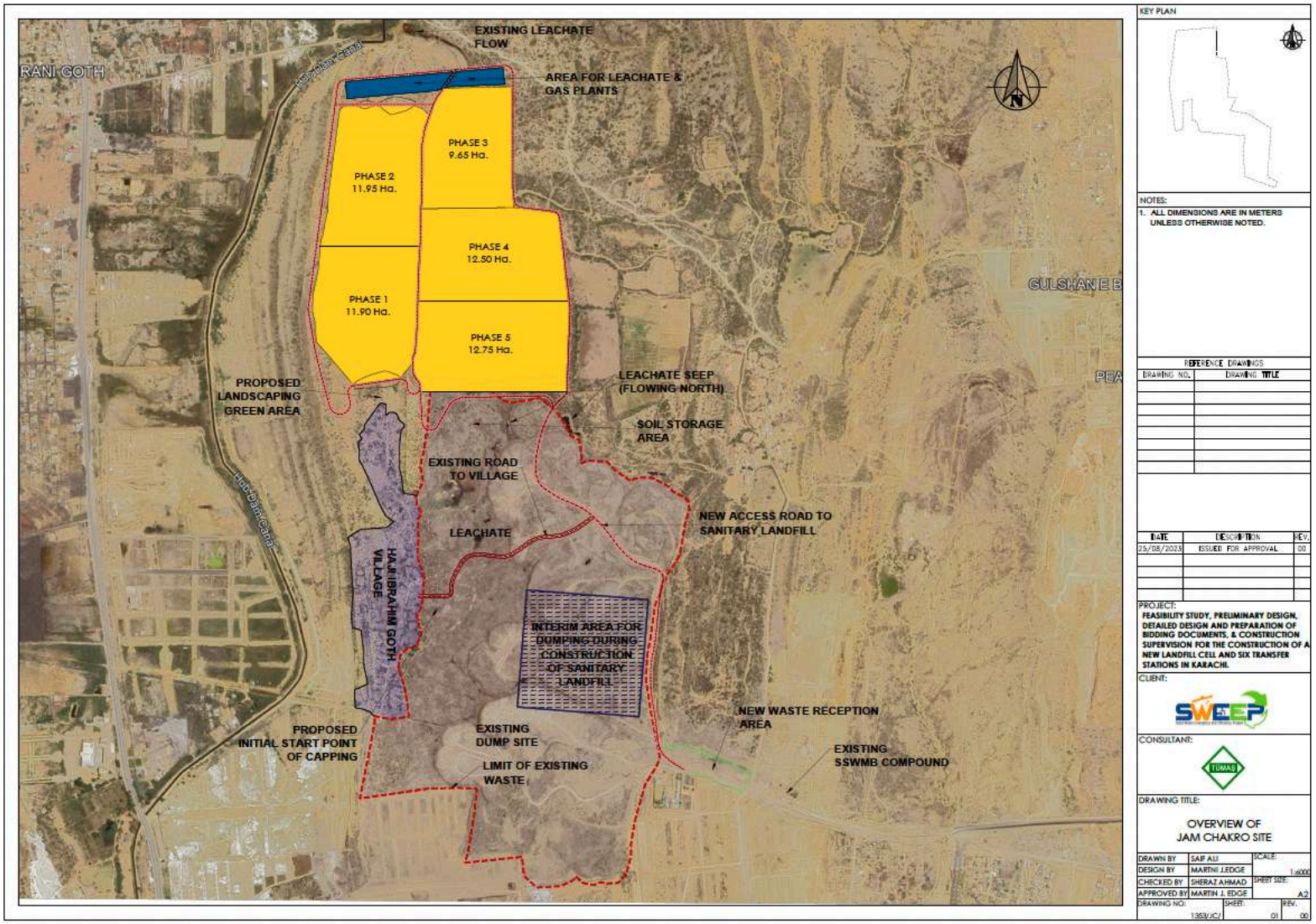


Figure 1.1 – Overview of Jam Chakro Site

1.5 Need for ESIA

The Sindh Environmental Protection Act -2014 is the governing environmental law for the proposed sub-project, with the Sindh Environmental Protection Agency (SEPA) as the governing authority for environmental matters pertaining to the project.

The need for this ESIA is warranted as per Section 17 of the Sindh Environmental Protection Act, 2014, which states:

No proponent of a project shall commence construction or operation unless he has filed with the Agency an Initial Environmental Examination or Environmental Impact Assessment and has obtained from the Agency approval in respect thereof.

Furthermore, the Review of Environmental Assessment Regulations 2021 of SEPA also provides the necessary details pertaining to the preparation, submission, and review of different environmental assessments, including EIA reports. The categorization of the proposed upgradation project falls under the following category defined in the regulations:

Schedule III – Projects Requiring an EIA
Category H – Waste Disposal & Treatment
Sub-Category (2) – Solid Waste Municipal Landfill Sites

Furthermore, the World Bank has also categorized the project as a High-risk project in line with the prevailing conditions of the area and based on the World Bank's ESF. This also warrants the need for an ESIA which considers the impact of the project on the physical, biological, and social environment, and adequately provides measures in line with the Bank's mitigation hierarchy.

To comply with the local legal regulations, this ESIA will be submitted to SEPA for their review and approval process prior to project implementation where the time for the approval process has already been factored into project planning.

1.6 Objective of ESIA

The prime objective of the ESIA study is to identify and assess the anticipated impacts and risks of the proposed sub-project, and to accordingly recommend adequate mitigation measures to prevent/ minimize the identified impacts on the surrounding physical, biological, and social environment. This is done through adopting changes and practices, which ameliorate the environmental and social performance of a project during its different stages (pre-construction, construction, and operation).

More specifically, other associated objectives of this ESIA are to:

- Facilitate the SWEEP PIU in ensuring the environmental and social sustainability of the project.
- Establish a baseline of the existing environmental and social conditions in the project area prior to project initiation, by collecting secondary and primary data/ information on physical, biological, and socio-economic conditions.
- Identify potentially significant environmental and social impacts (positive and negative) during the different stages of the project.
- Conduct, record, and report public consultations and participation with major stakeholders; and
- Devise an Environmental and Social Management Plan (ESMP) for all stages of the project as a tool for the implementation of the suggested measures, along with a monitoring and

evaluation mechanism with adequate resources including capacity building of the implementing agencies.

1.7 Other Environmental & Social Studies

Alongside this ESIA, a separate Livelihood Restoration Plan (LRP) has also been developed to address impacts that will arise pertaining to the livelihoods of those involved in waste picking at the proposed sub-project site (A Livelihood Restoration Plan has been prepared in lieu of a traditional Resettlement Plan as the implementing agency has strived to avoid any involuntary resettlement or physical relocation of any persons near the sub-project site in line with the World Bank's Mitigation Hierarchy). Furthermore, the following documents have also been prepared for the SWEEP Project as a whole:

- Environmental & Social Management Framework (ESMF)
- Resettlement Framework (RF)
- Stakeholder Engagement Plan (SEP)
- Labor Management Procedures (LMP)
- Gender Action Plan (GAP)

These documents can be accessed and viewed from the SWEEP website[16].

1.8 Approach & Methodology

The detailed approach & methodology used for this ESIA is given below:

1.8.1 Literature Review

Prior to mobilization, a desktop study was conducted through collection and review of guidelines, data, and reports related to the project, that included (a) review of relevant Environmental Legislations and WB ESF, 2018; (b) Google Earth Satellite Imagery; (c) socio-economic Data of Census 2017; (d) relevant design data provided by the client and the design consultant, and (e) reference of similar project ESIA documents.

1.8.2 Review of Environmental Laws and Institutional Requirements

The project needs to comply with all the applicable environmental and social policies, laws, and guidelines, Acts, and legislations of the Government of Pakistan (GoP) and GoS. Moreover, the Environmental and Social standards (ESS) of WB ESF, 2018 related to the proposed project have also been discussed in detail in chapter 3 of this ESIA.

1.8.3 Delineation of Area of Influence (AOI)

The Area of Influence of a project encompasses the primary project site(s) and related facilities such as the contractor camps, temporary material stacking areas and vehicle parking areas, where project impacts are perceived to take place. The Environmental and Social risks and impacts were analysed for all relevant stages of the project cycle, including pre-construction, construction, and operational phases of the project.
The AOI for the sub-project area has been considered as 500 meters from the boundary of the Jam Chakro site.

[16] https://sweep.gos.pk/downloads/

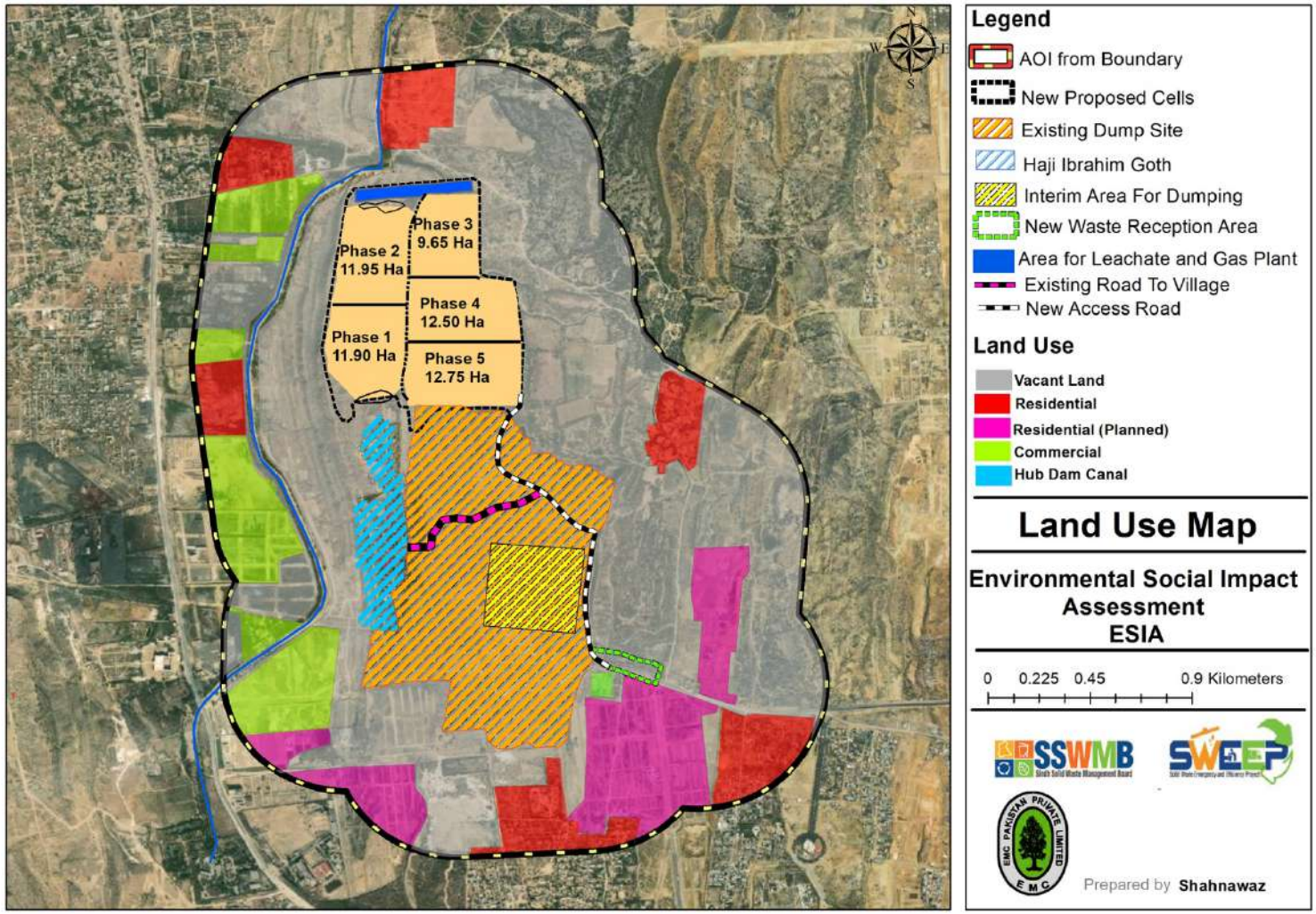


Figure 1.2 - Land Use & Area of Influence for Jam Chakro Site

The rationale for selection of a 500 m buffer from the site boundaries was considered where any significant environmental and social impacts would likely occur within this specified space. The proposed location of the cell, the different parts of the Jam Chakro site, and the sensitive receptors in the AOI are briefly described below and in more detail in the upcoming baseline chapter:

Table 1.3 - Receptors in AOI & Distances from Boundaries of Jam Chakro Site

S. No.	Settlement/ Receptor	Nature of Receptor	Sensitivity of Receptor	Proximity to Boundary of Old Dump Site	Proximity to Boundary of New Cells
1	Haji Ibrahim Goth	Informal Settlement residing next to the landfill site.	Sensitive	Approximately 900 m of the settlement is immediately adjacent to the existing dump site	Approximately 130 m from the Northern side of the settlement.
2	Al Zainab Residency	A proposed residential development next to the landfill site,	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 300 m from the old dumpsite.	Approximately 1.3 km from the proposed cells.
3	North Town Residency	A proposed residential development near the landfill site	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 263 m from the old dumpsite	Approximately 1.5 km from the proposed cells
4	North Town Residency Phase II	A proposed residential development near the landfill site	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 210 m from the old dumpsite.	Approximately 1.6 km from the proposed cells
5	Hope Medical Facility	A makeshift medical center to cater to the people of Haji Ibrahim Goth	Sensitive	Immediately adjacent to existing dumpsite	Approximately 1.03 km from the proposed cells.
6	Ali Town Residency	A proposed residential development across from the landfill site	Non-sensitive as it is currently in the process of construction	Approximately 750 m from the old dump site	Approximately 310 m from the proposed cells where the settlement is located across the Hub Dam Canal, still under construction, and sheltered from the proposed development due to the ridges that encapsulate the cells.
7	Haji Abdul Rehman Goth	A proposed residential development, North of the landfill site	Non-sensitive as it is currently in the process of construction. There is an imposing natural ridge and a surface water channel between the landfill cells and the residential development	Approximately 1,150 m from the old dumpsite	Approximately 300 m from the proposed cells, where the settlement is located across the Hub Dam Canal, is sparsely populated, and sheltered from the proposed development due to the ridges that encapsulate the cells.
8	Gul Muhammad Qalandri Goth	A settlement on the North of the landfill site	Relatively non-sensitive as it is not in the wind direction and away from the dump site	Approximately 1,200 m from the old dump site	Approximately 500 m from the proposed cells where the settlement is sheltered from the proposed development due to the ridges that encapsulate the cells.

9	Idara Al Khair Campus 3	A school for the children of Haji Ibrahim Goth	Sensitive	Immediately on the border of the old dumpsite	Approximately 1.3 km from the proposed cells
10	Hamdard Industrial Complex	An industry operating in the area	Non-sensitive	Approximately 560 m from the old dumpsite	Approximately 1.7 km from the proposed cells
11	Sumayya Northern Industrial Zone	A proposed industrial zone across the Hub Dam Canal from the landfill site	Non-sensitive as it is currently under development	Approximately 300 m from the old dumpsite	Approximately 579 m from the proposed cells, where the proposed industrial zone is across the hub dam canal, and sheltered from the proposed development due to the ridges that encapsulate the cells.
12	Al Ghafoor Industrial Zone	A proposed industrial zone to the Southwest of the landfill site	Non-Sensitive as it is currently under development	Approximately 100 m from the old dumpsite	Approximately 1,320 m from the proposed cells
S. No.	**Settlement/ Receptor**	**Nature of Receptor**	**Sensitivity of Receptor**	**Proximity to Boundary of Old Dump Site**	**Proximity to Boundary of New Cells**
1	Haji Ibrahim Goth	Informal Settlement residing next to the Jam Chakro site.	Sensitive	Approximately 900 m of the settlement is immediately adjacent to the existing dump site	Approximately 130 m from the Northern side of the settlement.
2	Al Zainab Residency	A proposed residential development next to the Jam Chakro site.	Non-sensitive, as it is an empty plot currently where construction is yet to begin	Approximately 300 m from the old dumpsite.	Approximately 1.3 km from the proposed cells.
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6	Ali Town Residency	A proposed residential development across from the Jam Chakro site.	Non-sensitive as it is currently in the process of construction	Approximately 750 m from the old dump site	Approximately 310 m from the proposed cells where the settlement is located across the Hub Dam Canal, still under construction, and sheltered from the proposed development due to the ridges that encapsulate the cells.
7	Haji Abdul Rehman Goth	A proposed residential development, North of the Jam Chakro site.	Non-sensitive as it is currently in the process of construction. There is an imposing natural ridge and a surface water	Approximately 1,150 m from the old dumpsite	Approximately 300 m from the proposed cells, where the settlement is located across the Hub Dam Canal, is sparsely populated, and sheltered from the

			channel between the landfill cells and the residential development		proposed development due to the ridges that encapsulate the cells.
8	Gul Muhammad Qalandri Goth	A settlement on the North of the Jam Chakro site.	Relatively non-sensitive as it is not in the wind direction and away from the dump site	Approximately 1,200 m from the old dump site	Approximately 500 m from the proposed cells where the settlement is sheltered from the proposed development due to the ridges that encapsulate the cells.
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12	Al Ghafoor Industrial Zone	A proposed industrial zone to the Southwest of the Jam Chakro site.	Non-Sensitive as it is currently under development	Approximately 100 m from the old dumpsite	Approximately 1,320 m from the proposed cells

1.8.4 Analysis of Alternatives

It is a mandatory requirement for the ESIA study to analyse each potential alternative available that could have been developed to meet the objectives and recommend the most environmentally, socially, and economically feasible option.

To select the most viable design and location for the landfill cells, keeping in view the environmental, economic, and social constraints, the analysis of different alternatives (siting, technical, etc.) was carried out. In addition, the No Project Option (NPO) was also discussed with reference to the increasing solid waste generation trends with the increasing populations. This exercise confirmed the justification for the need of the project.

1.8.5 Environmental and Social Baseline Surveys of the Project

Following the selection of the most feasible design alternatives for the landfill cells, along with the mapping of the AOI, detailed environmental and social surveys were conducted within the AOI for environmental parameters on which any adverse or positive impacts ere envisaged by the implementation of the proposed sub-project. Prior to the start of field activities, comprehensive checklists, proformas, and maps were developed covering the following main parameters:

A) Physical Environment

The information acquired for the establishment of the physical environmental baseline included the following parameters:

- Land Resources (including land use pattern, soil composition, contamination of soil and soil erosion, etc.)
- Water resources and flow patterns (including available surface and groundwater resources and natural streams, hydrology, spring water, water supply, water contamination sources, watersheds, etc.)
- Climate data (including temperature, rainfall, humidity, wind speed, and direction, etc.)
- Ambient air quality and noise level monitoring data; and
- Existing solid waste management and effluent disposal practices, along with stormwater drainage

B) Environmental Monitoring, Sampling, Testing & Modelling

Environmental Monitoring has the key role to assess the status of the existing environment that changes spatially and temporally. However, the goals, sample collection strategies, and methods of analysis used in monitoring must be well defined in advance to obtain robust results. In the preparation of a sampling plan, goals, strategies, and methods must be considered in conjunction with an understanding of the target environment, including the physical, chemical, and biological variables and processes involved. Environmental Monitoring has been conducted for the following parameters:

- Ambient Air Quality Monitoring (08-24 hours)
- Noise Measurements (24 hours)
- Sampling & Analysis of Drinking Water, Soil, Municipal wastewater, leachates, and groundwater

C) Ecological Environment

Information collected through primary (field surveys) and secondary data sources for the establishment of the ecological baseline included the following main parameters:

- Flora (trees, shrubs, herbs, grasses, and overall vegetation including valuable or rare trees and their loss due to implementation of the project, etc.)
- Fauna/ Wildlife (mammals, reptiles, amphibians, and avifauna)
- Agriculture and livestock
- Protected Areas, Natural Parks, Game Reserves, Wildlife Sanctuaries, or any other ecologically important areas (surveys confirmed that no such areas were found in the AOI of the project sites)
- Migratory birds' corridors (survey confirmed that no migratory birds' corridors are found in and around the AOI)
- Endangered species (both flora and fauna)

D) Socio-Economic Environment

Surveys were carried out within the AOI to establish a comprehensive socio-economic baseline information for the local settled population. Particular emphasis was placed on analysing the informal settlement of Haji Ibrahim Goth, located in close proximity to the boundaries of the Jam Chakro site and the proposed new landfill cell. To facilitate the development of a robust socio-economic baseline, a census survey was conducted in August 2022, targeting the residents of Haji Ibrahim Goth. Utilizing Google Earth, the Consultant marked visible structures, followed by in person visits to record households counts, population data, and socio-economic during which the following information was recorded as part of the census:

1. The count of households living in each residential structure.
2. The population in each household, family structure and related demographics.

3. A comprehensive collection of socio-economic data of the people living around Jam Chakro Site.

The initial count in August 2022 documented 713 residential households and 63 commercial structures. A subsequent survey in October 2022 refined this count. A cut-off date for eligibility for livelihood restoration measures was set in November 2022, resulting in a final count of 3,448 residents, residing in 723 makeshift/thatched houses in the vicinity. Among the total, 1067 individuals from 660 households who are directly involved in waste picking activities at the Jam Chakro Site, while the remaining residents are engaged in various occupations such as house jobs, trading/business, labor work, contractual jobs, driving, and others. Waste picking is not only their primary source of livelihood but also the skill they possess.

The survey tools used for these surveys are attached as **Annex-II**.

1.8.6 Stakeholder Consultations

Expansive stakeholder identification and consultation was also conducted as per the Stakeholder Engagement Plan for SWEEP. The project stakeholders were identified during the inception/ scoping stage and meetings were conducted with them during field surveys to receive feedback on the anticipated environmental and social issues related to the project impacts and suggested mitigation measures. Meetings were carried out with project affected persons, and relevant departments to discuss the issues/ constraints and get their views and feedback to mitigate the potential environmental and social impacts associated with the implementation and operation of the project. Letters were also written to the concerned departments through the clients for communication and feedback on the project.
Moreover, consultation workshops were also conducted to engage the concerned stakeholders.

1.8.7 Impact Assessment & Mitigation Measures

A logical and systemic approach was adopted for impact identification and assessment. The process began during the screening and continued through scoping which identified the key issues and classified them into different categories. The tools, which were used for impact assessment, are:

- Checklists to identify the impacts during field investigations/ surveys.
- Matrices for qualitative assessment of the identified impacts; and
- Overlays for the quantification of significant impacts of land use-based aspect on images from Google Earth and field verification.

The assessment of potential environmental and social impacts in terms of their nature, extent, location, timing, and duration were carried out. The severity of the assessed impact was determined considering the magnitude and likelihood, along with the sensitivity of the receptor. The impacts were correlated to the project location, design, construction, and operational stages. Based on the impacts prediction and as a result of public/ stakeholder consultations, the ESIA team screened the adverse environmental and social impacts for inclusion in the mitigation measures and ESMP. Public consultations (which provided feedback of the impacts from the stakeholder's viewpoint) were used to screen out the insignificant impacts. Matrices and overlays were used for the evaluation of temporal and spatial impacts respectively.

The Consultants proposed pragmatic, economically feasible, and socially acceptable mitigation measures for the significant adverse environmental and social impacts. These measures were based on exploring the ways to achieve the project objectives causing least disturbance to the existing environment by alternative ways, proposing changes in the project design, through improved monitoring and management practices (storage of construction materials, labor camps, waste disposal, disposal of construction debris etc.).

1.8.8 Environmental & Social Management Plan (ESMP)

An ESMP has also been prepared to ensure the adequacy and effectiveness of the proposed measures by clearly identifying the roles and responsibilities of the agencies responsible for implementation, monitoring, and auditing of ESMP activities, existing and suggested framework, necessary approvals, training needs and the required further studies. It includes an organizational setup, a monitoring mechanism, monitoring plan, where environmental monitoring, ecological and social component/ social mitigation measures were introduced as part of the ESMP. Environmental monitoring, evaluation, auditing, and reporting mechanisms were also proposed as part of the ESMP.

1.9 Report Organization

This report contains nine chapters, where the contents of each chapter are described as follows:

- **Chapter 1**– "Introduction" describes introduction, location of project, objective, and purpose of the ESIA report.
- **Chapter 2 -** "Analysis of Alternatives" provides details on alternate designs and options considered for the proposed interventions, location, and design.
- **Chapter 3** – "Project Description" furnishes an overall description of the project, including its background, features and key components, timeframe, and cost.
- **Chapter 4** – "Environment Legislative Requirements and Framework" elucidates the current legal framework including national and WB's ESF requirements which are applicable to the proposed project in the context of environment and sustainable development.
- **Chapter 5** – "Description of the Environment" comprises a detailed narrative of the existing (baseline) conditions of the project area, with respect to its physical, biological, and socio-economic environment.
- **Chapter 6** – "Anticipated Impacts and Mitigation Measures" elaborates the likely impacts of the project on the physical, biological, and socio-economic environment during the construction and operation stages and lays down the proposed measures to mitigate the adverse impacts of the project.
- **Chapter 7** – "Grievance Redress Mechanism" describes the need for establishing a GRM and define the grievance redress procedure.
- **Chapter 8** – "Information on Disclosure, Consultation and Participation" provides summary of consultative sessions with the local community as well as with other stakeholders including local politicians, local government officials, policy makers and NGOs for their opinions and suggestions on the project; and
- **Chapter 9** – "Environmental and Social Management Plan" provides the mechanism to be adopted for the implementation of measures and monitoring the environment during all stages.

2. Analysis of Alternatives

This chapter deals with an analytical overview of the different alternatives that have been considered for the proposed project sites. The analysis has been carried out critically to justify the need for the project and of the selected options. Apart from the economic viability, environmental sustainability and social footprint have also been considered whilst analysing the alternatives considered for the proposed project. As the proposed project involves construction of landfill cell for the city of Karachi, therefore, the following alternatives have been considered during the course of the study:

a) No-Project Option
b) Options for managing municipal solid waste.
c) Design alternatives
    i. Standard Engineered Landfill
    ii. Bio reactor landfill
    iii. Semi Aerobic Landfill-Fukuoka Method

All alternatives considered for the proposed project are discussed below:

2.1 No Project Option (NPO)

Karachi has witnessed a burst of population over the previous decade, which in turn has spurred an exponential increase in urbanization, housing, transportation, and health facilities, increasing the already present on existing infrastructure facilities.

Currently, the city produces an estimated 10,000 tons of municipal solid waste every day[17]. However, only a fraction of this is collected (60%), where none of it is disposed in sanitary engineered facilities. The current generation, coupled with the backlog of uncontrolled waste decreases the operating capacity of much of the urban infrastructure, i.e., the city's drainage system is clogged by waste, contributing to persistent flooding; movement along several secondary roads is impeded due to waste; water sources are contaminated, and public spaces are unattractive and unsanitary. The environmental and human health implications are severe: open burning of waste generates high levels of persistent and toxic chemicals that contribute to the poor air quality and cause cardio-vascular diseases; inadequate SWM has been identified as an important factor behind continued incidence of polio in Karachi[18]; surface and groundwater pollution by inadequate disposal of waste is well documented, and a factor in the prevalence of water-borne diseases. Pollution from plastics is of concern: plastics account for about 60 percent of waste found on Karachi's beaches by density.[19]

Currently, the city does not hold any engineered landfill site, Jam Chakro which serves as the dumpsite is the only waste disposal facility in Karachi. Jam Chakro dumpsite have no leachate collection system, neither base lining to hold leachate infiltration into soil or groundwater nor does it have gas collection system to treat methane and carbon dioxide gases being continuously emitting from landfill. Further open dumping is not suitable method for waste disposal as it requires large land for disposal of waste above ground. Thus, due to non-engineered methods of waste disposal there are considerable impacts on the environment such as deterioration of air quality, contamination of groundwater and soil, congregation of vectors and vermin. Considerable social impacts also accompany in the form of disturbance to near-by community in the form of indiscriminate dumping and spreading of waste in and around the sites, and an overall deterioration of the quality of life. With the increasing population of the city, and through it an increase in the amount of solid waste generated, an overall improvement in the solid waste management

[17] Lodhi, F. (2022). (rep.). Report on Environmental Compliance by Sindh Solid Waste Management Board (SSWMB)
[18] Provincial Task Force for the eradication of polio.
[19] Waste distribution studies of four beaches in Karachi.

infrastructure of the city is required, including construction of landfill site where their detrimental impacts on the physical, ecological, and social environment would be addressed through the construction of landfill cell. Hence, the No Project Option is not a feasible option in the long term.

2.2 Options for managing Solid Waste

Two broad types of landfills are commonly recognised:

- 'Open dumps' in which landfilling is uncontrolled and there are no barriers to the dispersion of any pollutants arising from the degradation of the waste into the surrounding environment; and
- Sanitary (engineered) landfills in which waste disposal is controlled and operated using the principle of 'containment'. Landfilled waste is separated from the environment by engineered barriers (liners), and both leachate and landfill gas are collected and treated, including after the closure of the landfill.

Currently, all MSW disposed to land in Karachi is to open dumps. The below table summarizes the main difference between open dumping and Sanitary landfill.

Table 2.1: Main Differences Between Open Dumping and Sanitary Landfills

Criteria	Open Dump	Sanitary Landfill
Filling Method	Land raise – typically above ground	Usually mix of land fill and land raise – below and above existing ground
Efficiency of Use of Land Area	Low efficiency, no to minimal compaction of waste, low in situ density	Moderate efficiency, compaction by mobile plant, initial in situ compacted density typically 0.8-1.0 t/m3
Deposited waste thickness	Usually a few metres, requiring large land take	Greater overall thickness as site is planned and engineered
Land take	Very large	Large but less than open dump since land take can be reduced by developing excavated void
Control of emissions (leachate, landfill gas, smoke, litter, dust, odour, etc.)	None	Use of engineered barriers to control leachate generation and emissions. Landfill gas can be controlled via installation of gas collection and extraction system. Systems and measures in place to mitigate landfill fires, odours and escape of fugitive dust and litter
Control of potential disease vectors (e.g., insects and rodents)	None	Standard operating practices for pest control – use of cover materials and regular fogging, fumigation, and baiting
Treatment of pollutants	None – uncontrolled dispersion into the environment	Leachate treatment plant to reduce pollution load to acceptable standards prior to discharge or leachate recirculated to the waste mass

		Landfill gas can be flared off or converted to electricity
Energy recovery	None	Capture and utilisation of landfill gas; conversion to electricity possible
Access control	Poor – usually no restrictions	Controlled access – can preclude waste pickers and animals
Capital cost	Very low – usually no infrastructure provided	Much higher than open dumps because of installation of engineering control measures but less than other treatment and management options
Operation Cost	Very low since minimal plant and equipment in use	Higher than open dumps – greater use of plant and equipment for compaction, treatment of leachate and control of landfill gas
Closure and restoration	Site usually abandoned with little or no restoration	Engineered barrier and soil cover over completed areas
Aftercare post closure	None	20+ years of post-closure maintenance, treatment of leachate and control of landfill gas.

The quantities of leachate and gas can be reduced, and potential impacts mitigated further, if biological treatment of the residual waste is undertaken to stabilise the waste before landfilling (via, for example, mechanical biological treatment).

The financial costs of developing and operating a sanitary landfill are considerably higher than for open dumping; however, when the environmental costs are considered, together with the potential for energy recovery from landfill gas utilisation, sanitary landfilling is assessed to be a more cost-effective solution for disposing of residual waste providing high standards of operational performance are achieved and maintained.

New sanitary landfills developed to modern international standards include the following key engineering measures:

- Basal and top containment systems (engineered liner).
- Leachate collection and transfer system.
- Leachate treatment system.
- Landfill gas collection and extraction system.
- Landfill gas utilisation system.
- Surface water drainage measures; and
- Specified standard operational procedures.

Typically, to justify the capital investments in the above measures, a minimum site life of fifteen-twenty (15-20) years is warranted. The actual site life will be determined, inter alia, by the quantity of waste received, the quantity of waste diverted successfully for treatment (if any), the in-situ density of the compacted waste, the degree of waste decomposition in the landfill and the available void capacity that can be established.

2.3 Potential Viable Treatment and Disposal Option

It is understood that there are no short- to medium-term plans to introduce source segregation throughout the districts of Karachi. Accordingly, available options for treatment of MSW to divert this from landfilling are somewhat limited table 2.2 summarizes options that appear to be viable. Whilst some options are considered technically viable, they may not be deemed acceptable necessarily from a cost-benefit perspective or from environmental consideration.

Centralised separation is the only route for obtaining a compostable/digestible fraction from residual waste. The techniques involved include mechanical processing, optical processing, and hand-picking. The digestible fraction obtained inevitably is significantly more contaminated than source separated biowaste with inevitable consequences for the digestate's ultimate utilization and marketability. There is also the risk of larger non-separated components of the waste causing physical damage to treatment plants (by abrasion, blockages, or tangling).

The financial sustainability of processing mixed MSW is often marginal and typically requires some form of cost recovery to the operator, either in the form of a substantial gate fee or a direct subsidy from the government. For this reason alone, where cost recovery is not a fundamental objective in the current waste management system, it would appear that the cost benefit ration of any form of treatment of mixed MSW is likely to be significantly negative.

Table 2.2: Potentially Viable Treatment and Disposal Options

Options	Sub-option	Viability		Remarks
		Yes	No	
Landfill	Open dump		**O**	Not viable or sustainable from environmental considerations.
	Sanitary landfill	**O**		Fundamental requirement for the disposal of all residual wastes.
Biological Treatment	Composting	**O**		Output of low quality from mixed MSW – high degree of contamination likely restricting markets for the product. Sustainability and viability influenced by degree of contamination and the quality of the compost.
	Anaerobic Digestion		**O**	
Material Recovery	Dirty MRF	**O**		Viability marginal given potential for contamination from mixed MSW. Low % recovery. Sustainability and viability influenced by degree of contamination and market prices for recovered materials
	Clean MRF		**O**	Not viable without segregation at source.
	MBT	**O**		Viability marginal given potential for contamination from mixed MSW. Material recovery – as for dirty MRF. Grey compost of low quality. Viability improved if market exists for RDF
Thermal treatment	Incineration		**O**	Calorific value of mixed MSW may be too low without preparation of RDF. High investment and operational cost
	Pyrolysis		**O**	Requires pre-sorting of mixed MSW. High investment and operational cost.
	Gasification		**O**	Requires pre-sorting of mixed MSW. High investment and operational cost.

2.4 Location & Siting Alternatives

Given that the sanitary landfill seems the most feasible option out of all considered thus far in terms of mitigating current risks and moving forward with waste operations in a sustainable manner, the next alternative to consider would be the location and siting of these landfill cells.

Currently Karachi has 2 dumpsites, Jam Chakro and Gond Pass, with both located in District West. Out of the approximate 10,000 tons of waste generated daily in the city, most of it is diverted to the Jam Chakro site compared to Gond Pass. Furthermore, given that landfills require a large area to deal with the amount of waste being generated in the city, the unutilized land at the Jam Chakro site was chosen for the development of the cells in line with the Bank's mitigation hierarchy (instead of acquiring land somewhere else and dealing with any potential resettlement).

The siting of the cells at the site was also chosen in line with the Bank's mitigation hierarchy where unutilized areas from current dumping operations were chosen to avoid potential environmental impacts from the excavation and movement of legacy waste present at the dumpsite. The land where the informal settlement of Haji Ibrahim Goth was also ruled out as potentially available land to avoid impacts related to involuntary resettlement or physical relocation of the persons currently residing there.

2.5 Design Alternatives

There are a variety of different approaches within the term 'engineered' landfill that range from simple dry encapsulation of the waste mass to minimize the ingress of water into the waste and the migration of leachate from the base of the landfill, through to active and controlled management of landfill process operations that aim to speed up the rate of waste decomposition, landfill gas evolution and stabilization of the waste mass. As the level of sophistication increases in the management of landfill process operations, so too does the complexity of site engineering.
Three main types of engineered landfill may be recognised, each of them is discussed in below sections.

2.5.1 Standard Engineered Landfill

A 'standard' sanitary landfill in which containment measures are installed to minimize leachate generation, allied with the cell method of site operation, capture, and treat any leachate generated and capture and treatment of evolved landfill gas produced from anaerobic decomposition of the waste, either by flaring or conversion to electricity.

Traditionally, engineered landfill development has focussed on the adoption of measures to isolate the waste mass waste using the principle of containment. Landfilled waste is separated from the environment by engineered barriers (liners) **figure 2.1**, and both leachate and landfill gas are collected **figure 2.2** and treated, including for a sustained period of time after the closure of the landfill.

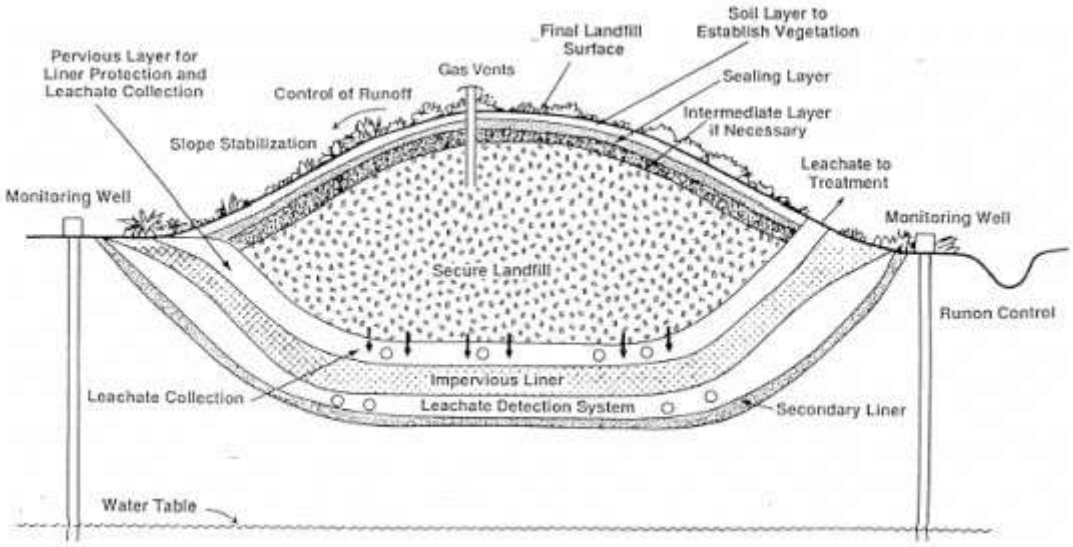


Figure 2.1: Typical Cross-Section Through an Engineered Landfill



Figure 2.2: Leachate Collection Pipework on the Base of a Lined Engineered Landfill

Decomposition of waste occurs anaerobically and, depending upon the composition of the deposited waste, the climatic regime, and operational controls during waste filling, can result in strong leachate and extended periods of landfill gas generation that require management over several tens of years, even after landfill closure (post closure maintenance). There is a long-term legacy cost often associated with the development of a sanitary landfill since the stabilization of the waste mass occurs over a prolonged period of time.

2.5.2 Bio-Reactor Landfill

In brief, a bioreactor landfill is a complex sanitary landfill that uses enhanced microbiological processes to transform and stabilize the readily and moderately decomposable organic waste

constituents within five (5) to ten (10) years of bioreactor process implementation. The bioreactor landfill significantly increases the extent of organic waste decomposition, conversion rates and process effectiveness over what would otherwise occur within the landfill. Stabilization means that the environmental performance measurement parameters (landfill gas composition and generation rate and leachate constituent concentrations) remain at steady levels, and should not increase, in the event of any partial containment system failures beyond five (5) to ten (10) years of bioreactor process implementation.

The bioreactor landfill requires certain specific management activities and operational modifications to enhance microbial decomposition processes. The single most important and cost-effective method is liquid addition and management. Other strategies, including waste shredding, pH adjustment, nutrient addition, waste pre-disposal and post-disposal conditioning, and temperature management, may also serve to optimise the bioreactor process. Successful implementation also requires the development and implementation of focused operational and development plans. The schematic of a bioreactor landfill is show in **figure 2.3**.

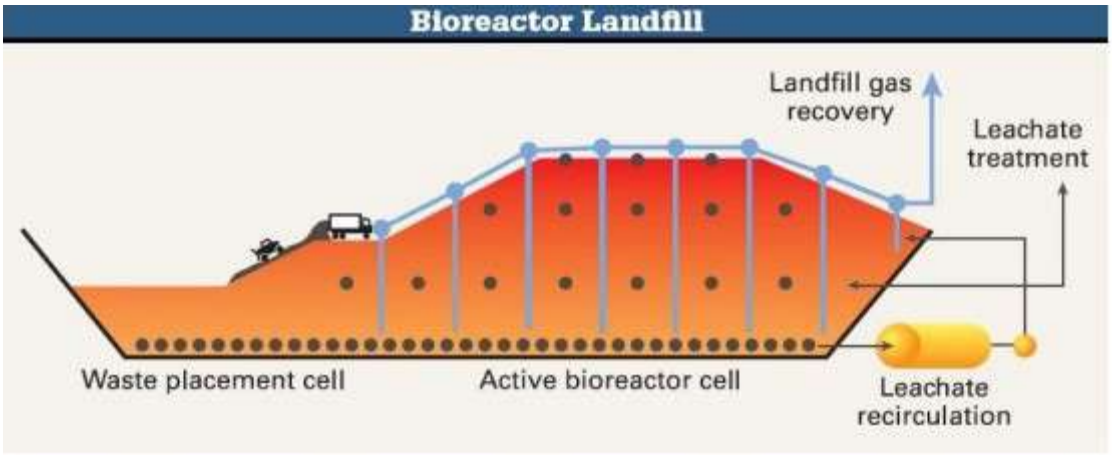


Figure 2.3: Typical Cross-Section Through a Bioreactor Landfill

2.5.3 Semi Aerobic Landfill - Fukuoka Method

A 'semi-aerobic' landfill (Fukuoka method) in which air is allowed to enter the base of the landfill in order to achieve waste decomposition aerobically, as against anaerobic decomposition.

This method, which is akin to the aerobic bioreactor landfill discussed above, is based on the introduction of air into the waste mass as waste decomposition proceeds. The primary method of achieving this is to place large diameter perforated pipes at the base of the landfill **figure 2.4**, with gravel surround, through which leachate is drained continuously, whilst allowing the passage of air into the base of the landfill. Heat from the fermentation of microorganisms provides the driving force to generate convection current within the landfill, which is comparable to an uprising current of heated water from the bottom of bath tab to the upper part. In this way, fresh air is introduced to the bottom part of landfill from outside. A dense network of vertical pipes that connect with the pipes at the base allow air to circulate by convection within the waste mass, as well as the drainage of leachate **figure 2.5**.



Figure 2.4: Large Diameter Pipe on the Base of a Semi-Aerobic Landfill

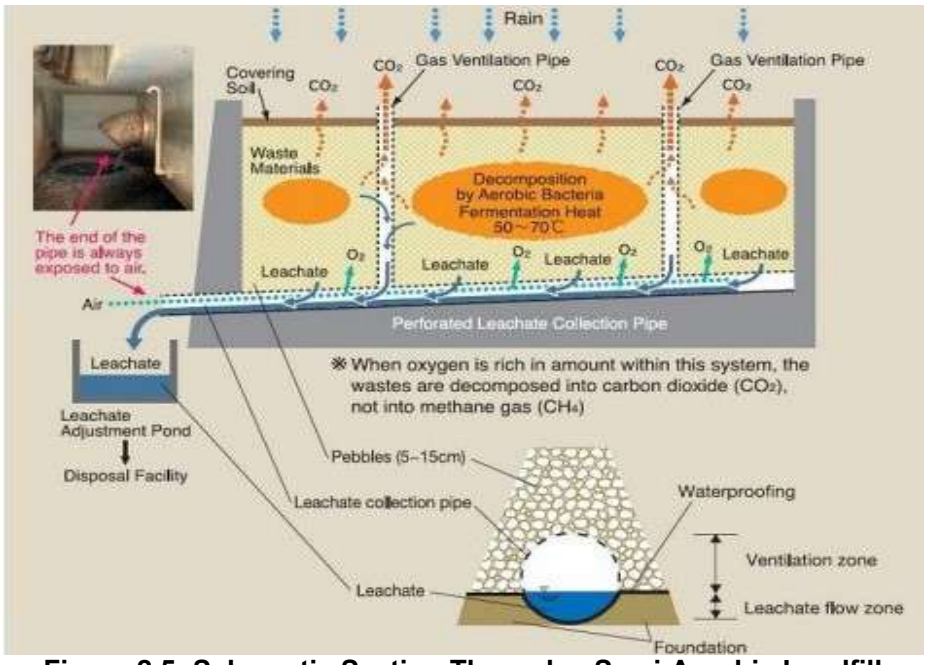


Figure 2.5: Schematic Section Through a Semi-Aerobic Landfill

The core of the method for a semi-aerobic landfill is microbial fermentation, together with the precondition that aerobic conditions should be maintained - the method is not readily applicable in places with poor oxygen supply, such as in landfills developed in cells excavated below natural ground level. These topographic constraints do not exist with a standard landfill or an anaerobic bioreactor landfill, although any cell with a base a few metres below natural ground level will invariably require pumping of the leachate out of the cell base.

2.6 Conclusion

With regard to the topography at Jam Chakro, it would appear possible to develop the western valley on the basis of a semi aerobic landfill since the natural slope is to the north and the presence of bedrock close to the surface precludes significant excavation to increase void capacity. Accordingly, the base grading of the cell would follow the existing topography and would permit leachate to be drained by gravity from south to north at a slope of approximately 2%.

The benefit of this approach in the western valley is the reduction in complexity of landfill engineering and, more importantly, in the reduced strength of leachate, the production of CO2 rather than CH4 and the more rapid stabilization of the waste mass, with reduced aftercare/post closure costs.

For the eastern part of the site, the situation is less clearcut since drainage of leachate by gravity is not feasible because of the shallow ground slopes and extended drainage path from south to north. A standard landfill, or a variant based on recirculation of leachate (bioreactor landfill) would appear to be more appropriate for this part of the site.

In line with the Bank's mitigation hierarchy, the location and design for the new cells were finalized such that the population at Haji Ibrahim Goth was avoided to ensure no physical involuntary resettlement is involved, and the existing dumpsite area was also kept to a minimal to avoid unnecessary environmental impacts from the excavation and removal of legacy waste.

3. Sub-Project Description

This section presents the technical details of the proposed sub-project such as the design of the landfill cell, the associated structures, construction materials, machinery, and equipment required, drinking and sanitation facilities during construction, location of construction camps, project cost, and implementation schedule. Detailed sub-project description is presented in the 'Engineering Feasibility Study' (EFS) attached as **Annex-I**. This section provides a summary of the project.

3.1 Need for Sub-Project

Karachi is one of the most populous cities in the world, and its population has been growing rapidly over the years. With more people producing waste, the volume of solid waste generated in the city has increased significantly, making it essential to have designated areas for waste disposal. To date, Karachi does not have an engineered landfill site, where the current waste disposal sites at Jam Chakro and Gond pass can be considered as dumpsites.

Dumpsites have resulted in severe environmental pollution as they lack proper lining and containment measures, allowing leachate (toxic liquid) to seep into the soil and groundwater, contaminating nearby water bodies and posing risks to public health and the environment. Furthermore, open dumping and burning of waste at dumpsites also releases harmful pollutants into the air, including greenhouse gases and toxic fumes. This leads to respiratory problems and other health issues for nearby residents and people working in the area.

Thus, there is great need to develop an engineered landfill site in Karachi, with proper lining, leachate collection and a gas treatment system, which will offer a controlled environment for waste disposal, minimizing potential hazards associated with open dumping and improper waste management practices.

3.2 Sub-Project Cost

The capital cost of the sanitary landfill cell is estimated at PKR 18.9 billion, which includes the estimated take-off quantities of the materials, earth works, and equipment, construction, contingencies, consultancies, etc.

3.3 Phasing of Site Development

The landfill cells will be developed such that all construction works for site development are undertaken under a single construction contract. Accordingly, the development of the sanitary landfill will be single stage rather than phased via progressive development cell by cell.

This will result in landfill base preparation works, including base grading works, be carried out for the whole landfill cell area, with the exception being that the basal engineered lining system and the leachate collection system shall be installed only in those cells which will receive MSW during the active life of the construction and operations contract. In addition, leachate treatment and landfill gas collection and treatment facilities will be constructed at the outset.

Since the whole of the landfill cell base will be developed from the outset, stormwater drainage systems will be installed in the landfill cell base independent of any leachate collection system.

Subsequent to the development and commencement of operations of the proposed cells, the existing dumpsite has also been proposed for capping and closure. Further details are provided in Section 3.7.

3.4 Sub-Project Timeline

In line with the activities defined above, to construct the whole landfill cells, including base grading works, installation of stormwater systems, and the installation of leachate management systems and basil engineered lining system for the cells proposed for immediate waste reception, the development timeline is estimated at 02 years.

The timeline for closure of the existing dumpsite is yet to be determined, however, studies shall be completed before the operation of the new cells commences.

3.5 Overview of Site Development

3.5.1 Introduction

For practical purposes, the site is subdivided into four separate areas as defined in **Figure 3.1:**

1. Access road corridor from the existing entrance to the dump site to the new sanitary landfill cells through the existing dumpsite.
2. An administration and waste reception area ('Administration Area'), at the south-east corner of the site at the end of the access road corridor.
3. The landfill cells per se, which occupies the majority of the project site; and
4. An area for the treatment of leachate and landfill gas at the north-east corner of the site.

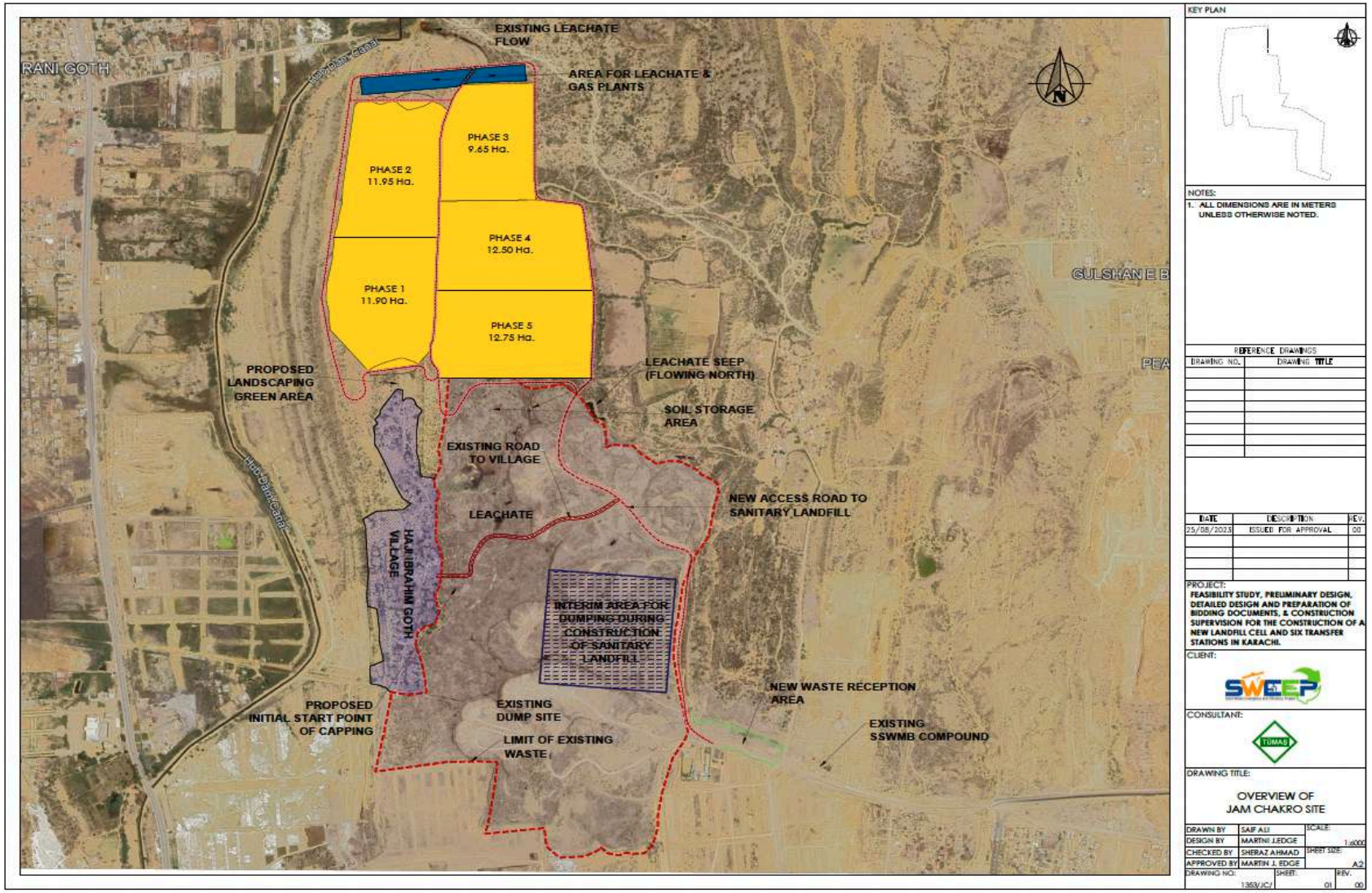


Figure 3.1: Overview of Potential Site Development Phasing

3.5.2 Site Access

Since there is currently no direct, metalled, access road to the proposed sanitary landfill cell, a new access road shall be designed and constructed. Currently, after exploring the different possible options, the most feasible option would be to clear a path within the existing dumpsite to the outer rim of the proposed cells, after which the road would essentially run around the perimeter of the proposed cells, forming a ring road around it. For this, waste would be cleared to a level to the extent where an acceptable strength bearing ratio is obtained for the development of the road.

3.5.3 Buffer Zones and Standoffs

A buffer zone of a minimum of ten (10) metres has been adopted all around the site perimeter in the design, on both sides of the proposed ring road, where this buffer zone shall be used to develop the following:

- Perimeter fencing for access and litter control.
- Vegetative planting for screening out litter and odour control.
- Internal roads to the waste disposal area, plant areas and for site maintenance; and
- Stormwater drainage to prevent run-on into the site and to capture run-off from any restored surface of the waste disposal area.

In the proposed location of the treatment plants in the northern part of the site the buffer zone extends to approximately 50 m in width.

Along the south-western boundary of the site, adjacent to nearby residential development at Haji Ibrahim Goth, the buffer zone is wider, being a minimum of 15 m, but for the most part ranging between 20 m and 50 m or more depending on the layout of the settlements in Haji Ibrahim Goth.

Similarly, the buffer between the proposed cells and the closest part of the settlement at Haji Ibrahim Goth, has been proposed as a landscaping area where the plantations proposed will serve as a natural buffer between the population and the cells. The distances from the closest house North in Haji Ibrahim Goth and the different parts of the cell are given below:

- Distance between outer edge of cell and closest settlement – 65 m
- Distance between outer edge of road embankment and closest settlement – 52 m

3.5.4 Administration Area

A list of proposed infrastructure to be developed and constructed/installed at the landfill cell, together with the approximate indicative sizing, is summarized on **Table 3.1** and is based upon consideration of functional requirements for landfill operation. Final sizing will be based on, inter alia, the available site geometry and utility requirements.

Table 3.1 - Support Infrastructure

Component	Typical size	Type
Weighbridge	100-ton, 18 m x 3.5 m	Surface mounted, 1 No.
RFID Readers/system		
Security office (site entrance)	12 m x 9 m	RCC
Entrance Gate - vehicle	12m W	Double leaf/sliding gate
Entrance Gate - pedestrian	1 m W	
Boundary wall	2.40 H	
Emergency access gate	6 m W	Double leaf
Administration Office	23 m x 10 m	RCC, 2 storeys

Amenity Block	27.5 m x 9 m	RCC
Testing laboratory	20 m x 15 m	RCC
Mosque	9 m x 6 m	RCC
Parking for staff vehicles	18 m x 10 m (size varies)	Covered shelters
Workshop	20 m x 20 m	RCC
Store	10 m x 15 m	Combined with workshop
Workshop Apron	20 m x 15 m	Hardstanding
Parking yard for trailers		
Transformer		Sized based on site load list
Solar panels		Sized based on site load list + 30%
Standby generator	Mobile, diesel, 100 kVA	Emergency back-up (critical systems only)
Substation	20 m x 12 m	RCC
Water Reservoir	10,000 gallons	Potable water
Water Reservoir	25,000 gallons	Raw water – wash water
Vehicle cleaning		High pressure wash system for trailer bodies and wheels, hose bibs
Wash water collection system		Sump and sedimentation tank
Leachate collection system and chambers		
Water Borehole		Raw water
Sewerage system		Septic tank and soakage pit
Fire Water Tank	50,000 gallons	
Foam Tank		
Fire alarm & detection system		Buildings
Fire Fighting System		Hydrants/hose reels as per NFPA
Radio tower		
Light posts	6 m high	Floodlights
Stormwater collection system		Sump and drains/rainwater harvesting
CCTV system		Security and treatment plant areas
Landscaping and buffer zones	5 m W (varies)	Grass, shrubs, trees
Irrigation system		Manual
Signage		As required

3.5.5 Landfill Footprint

The landfill cells footprint has been optimized to maximise the available space for the disposal of MSW and, hence, extend the lifespan of the landfill cells to the maximum extent possible. The footprint occupied by the landfill cells is approximately 145 acres (approximately 58.75 ha.) and comprises just under 70% of the total site area.

The landfill cells footprint has been subdivided into five areas (MSW1-MSW5), nominally termed as Cells', as indicated in **Figure 3.1**. Smaller tipping cells will be developed within each Cell during site operations, where the subdivision of Cells is indicative and will be adjusted and optimized during detailed design to provide an approximate equal lifespan for planning purposes.

Each Cell is separated by inter-phase embankments designed to separate the Cells both for leachate and stormwater management and control and for counter-bearing to provide lateral restraint to the waste mound during disposal operations.

In the eastern part of the site (Cell MSW3-MSW5) leachate collection systems and landfill gas management systems would be independent in each Cell; in the west the natural topography and gradient to the north dictates that Cells MSW1 to MSW2 are linked and have a common drainage system. Provision has been made for the recirculation and re-infiltration of leachate back to the landfill cells area to enhance the rate of waste decomposition and waste stabilization.

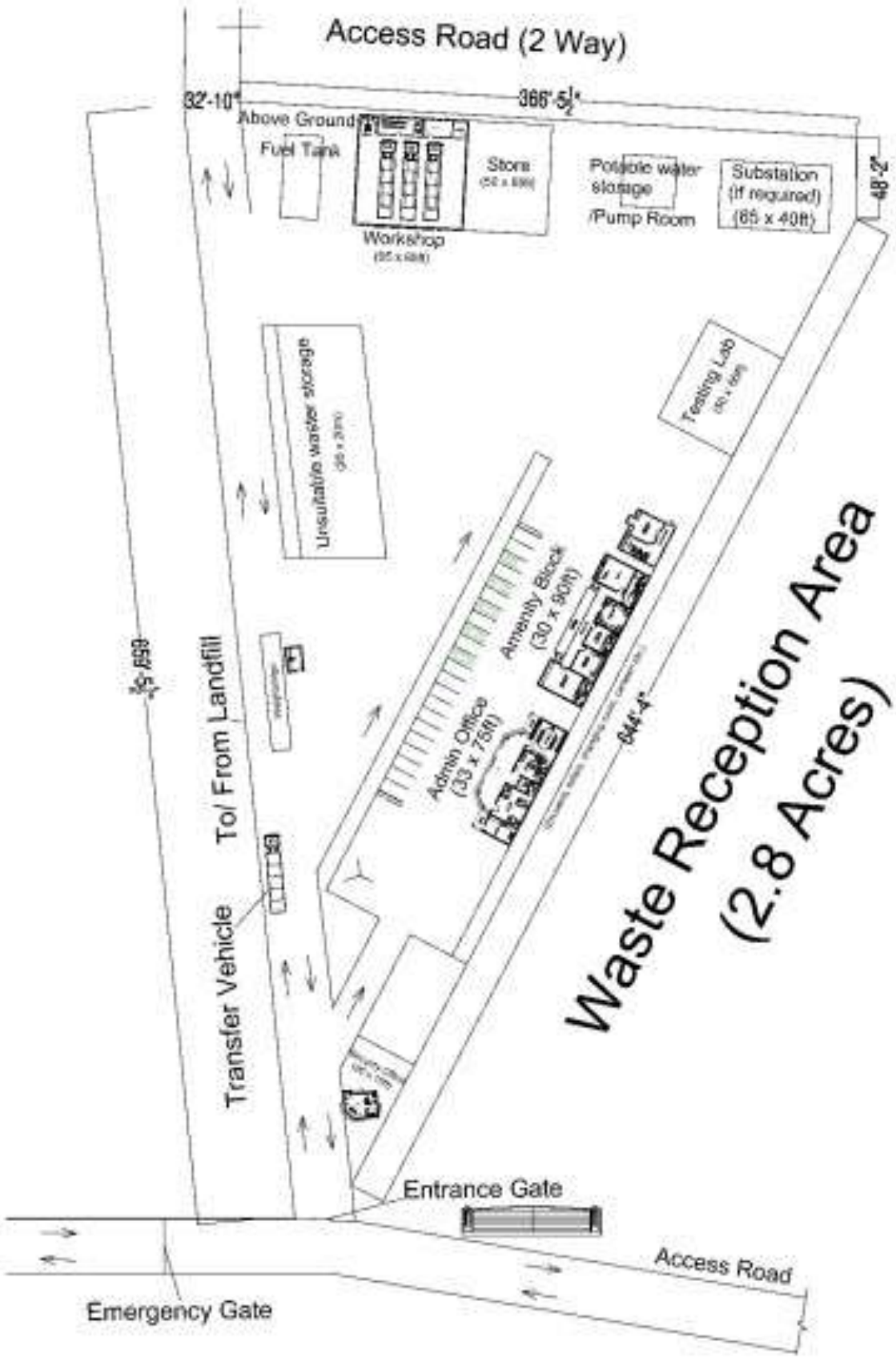


Figure 3.2:Overview of Potential Arrangement of Waste Reception Area

3.5.6 Treatment & Processing Plants

The north-east corner of the site has been allocated for the treatment and processing plants for the management of leachate and landfill gas. The plants are located at the lowest elevation of the site to facilitate leachate drainage by gravity and to minimize pumping requirements. The leachate treatment area will comprise a series of leachate tanks served by leachate transfer pipes from the leachate collection sumps in each Cell. A leachate recirculation system (re-infiltration system) will be developed at the leachate holding tanks to permit the transfer of leachate back to the waste mass; re-pumping of leachate into the landfill body shall provide for increased compaction and for maintaining the moisture content at an optimum level for maximum gas generation and yield. Further details are added in section 3.6.7.

The leachate from the existing dump site from legacy waste also currently flows through the area proposed for the new cells and up North out of the boundaries of the site due to site topography. This leachate will be collected prior to entering the area for the new cells where it will be used for recirculation or treatment for closure of the existing dumpsite.

A gas processing plant is also proposed to be located adjacent to the leachate treatment area. This will comprise a series of flares to flare off accumulated and captured landfill gas for low quantities, whereas the volume of gas generated at the site increases to a feasible level, it is proposed to install gas engines to convert the captured gas to electricity, to supplement site power requirements. Excess electricity generated above the site power demand can be exported back to the grid.

Further details on both of these treatment plants are provided below in the landfill engineering design section 3.6.

3.5.7 Roads

The majority of the landfill cells will be surrounded by a perimeter road for both waste delivery vehicles and to facilitate maintenance. Different types of roads are proposed depending upon the assessed traffic load and function.

For waste delivery vehicles access roads shall be two lanes, a minimum of 6.5 m wide and provided with double surface dressing. Maintenance roads shall be one lane, minimum of 4 m wide and surfaced with gravel.

The Administration Area will be paved to the same standard as that of the primary roads used by waste delivery traffic.

Within the landfill cells temporary haul roads, 6 m wide and surfaced with free-draining granular material, shall provide access to the tipping area.

3.5.8 Stormwater Drainage

Stormwater drainage channels shall be installed on the landfill cells side of the perimeter road to prevent runoff from the road entering the waste disposal area and to intercept runoff from the cells surface once restored. Stormwater will be directed towards a series of retention ponds which will trap any entrained sediment.

All stormwater run-off from buildings and from paved surfaces in the Administration Area will be intercepted and directed to a retention pond in the Administration Area (rainwater harvesting). Rainwater collected in the stormwater ponds may be used as a source of raw water, when available, for:

- Flushing of sanitary fixtures in site buildings.
- Cleaning of external hard surfaces in the Administration Area.
- Wash water for use in the Wash Bays.
- Dampening of dust on site roads.
- Irrigation water for landscaped areas in the Administration Area; and
- Fire water for fighting in the Administration Area and the landfill cells.

3.5.9 Site Security

Security of the site will be achieved by the following measures:

- Boundary wall around the whole of the facility.
- Lockable entrance gates on each entry road to, and exit road from, the site.
- Gate House (security office) at the site entrance, manned by security personnel.
- Internal fencing to the recyclable storage area.
- CCTV system covering critical areas of the facility - at the site entrances, at the treatment plant area and at the Administration Area; and
- Internal fencing to the leachate plant and landfill gas plant areas

3.5.10 Community Development

Alongside the development of the new cells and the subsequent closure of the existing dumpsite, there will be investments in improving water supply, sewerage, and streets as part of a community development plan for the Haji Ibrahim Goth settlement. The studies and detailed maps for provision of paved roads for efficient connectivity, and WASH facilities are attached as **Annex-III**. These works will be part of a small works contract to be implemented in parallel with the landfill cells construction contract and will be executed in approximately 3 months.

As part of the works, the total street area is planned to span 19,415 square meters, providing improved accessibility and connectivity within the community. Additionally, the construction plan involves the installation of four septic tanks and soakage pits, collectively capable of accommodating an average flow of 39,000 gallons, with each tank designed to handle 9,750 UK gallons. To enhance drainage efficiency, a 12-inch (300 mm) drainage line covering 7,980 running feet will be established, complemented by the incorporation of 56 manholes.
The source of the water supply network is the existing network from Hub Dam, located approximately 3,900 feet from the project site. The main water supply line enters the village away from all indicated boundaries, following the topography of the area and its master plan. The main water supply line maintains a consistent 8-inch diameter throughout the entire network, ensuring the required pressures of 10-15 psi at maximum high levels. Velocities are carefully controlled, not exceeding 6 ft/s, to prevent potential damages such as leakages and water surge pressure at bends. These comprehensive measures aim to address sanitation needs, manage wastewater, and establish a robust drainage system for the sustainable development of the village.

3.6 Landfill Cells Engineering Design

The following sections will serve to describe the design and the factors taken into account when finalizing the design for the 5,000 tpd capacity landfill cells proposed[20].

3.6.1 Introduction

The recommended approach for disposal of MSW delivered to the site is conventional landfilling supplemented by the recirculation of leachate to the waste mass to assist with compaction of the

[20] 5,000 tonnes per day have been chosen as the design capacity, as average waste delivered to the Jam Chakro landfill site during the year from June 2021 to August 2022 was 4,840 tons/ day (SSWMB records).

waste. Addition of water is required because of the prevailing climatic regime which demonstrates a significant soil moisture deficit on an annual basis.

Recirculation of leachate has the added benefit of providing treatment of the leachate by the binding of contaminants within the waste mass as the waste decomposes, whilst also providing optimal conditions for the generation of landfill gas under anaerobic conditions which can be captured and, subsequently, converted to electrical energy.

Notwithstanding this, the option exists to trial a semi-aerobic landfill in the western valley to gauge the efficacy of this approach and to attempt to reduce the requirements for leachate treatment and to limit greenhouse gas emissions at least in the initial stages of landfill development. It is recommended that this approach should be adopted for the western valley.

Should a semi-aerobic landfill not prove to be beneficial, then the landfill in the western valley can be converted to a traditional contained landfill by modifying the outlet of the leachate collection system at the northern end of the valley.

3.6.2 Perimeter Embankments

Perimeter embankments shall be constructed at both ends of the western valley in order to increase the volumetric capacity of the landfill cells. Provisionally, small embankment dams, up to 8 m high, will be constructed across the southern end of the valley as well as the northern end of the valley. Dam slopes shall be 1V:3H and be formed of suitable granular fill obtained from site-won material. Outer dam facing shall be of low permeability and suitable to maintain a vegetative cover to inhibit erosion.

For the eastern part of the site, small perimeter embankments up to approximately 3 m high shall again serve to increase the volumetric capacity of the site. These embankments, constructed along the northern, eastern, and southern margin of the landfill cells will provide some lateral restraint to the waste mound.

3.6.3 Interphase Embankments

Geometry
Small embankments, between 2 and 4 m high, will be constructed between each Cell. The inter-phase embankments serve to compartmentalize each phase of the landfill cells with respect to containment engineering, leachate collection and management and stormwater management.

Material of Construction

The embankments will be formed from site-won excavated soils compacted to >95% of the Maximum Dry Density (MDD) and at 0% to +2% above the Optimum Moisture Content (OMC).

Stability of Embankments

Geotechnical results indicate that site-won materials have high frictional strength with an adequate Factor of Safety (FoS) to be constructed at slopes of 1V:3H under both operational (FoS > 1.6) and seismic loads (FoS > 1.15).

3.6.4 Site Preparation

Site Clearing

The site will be cleared on existing vegetation in stages in advance of the commencement of construction activities across the site. Cleared vegetation shall be shredded and stockpiled for use in site greening and landscaping works. Large trees may be cut for timber and removed from site.

Groundwater Control

Temporary groundwater control in advance of construction activities will be required in any area where groundwater is encountered during the shallow excavations planned. Groundwater control may be achieved by the construction of shallow trenches excavated to rockhead and by the use of temporary sumps and dewatering pumps. All groundwater shall be clarified in sedimentation ponds before it is permitted to be discharged off-site. Groundwater shall meet national water quality standards before it is discharged off-site.

Excavation of Superficial Material

Excavation of superficial materials at the site is required to achieve the design grades and elevations on the landfill cells base, the levels on the perimeter of the landfill and for other site construction activities (foundations for structures, road construction). In the western valley, the upper slopes are covered with a very thin veneer of gravelly soil which can be readily removed. In the eastern part of the site, the thickness of superficial soils is greater and is underlain by extremely weak to weak sandstone which will require to be excavated to achieve the design grades. Conventional construction equipment (excavators, dozers with rippers, wheel loaders, dump trucks, etc.) are suitable for this purpose.

Temporary Storage of Site-Won Materials

Screening and stockpiling of site-won materials will be required where such materials are re-used in the permanent works. Excess material and materials unsuitable for use in the construction works will be stored in temporary stockpiles located within the southern parts of the site close to the waste reception area.

Stormwater Management

Construction works, including excavation and grading works, should be programmed for the dry season in order to reduce the requirement for stormwater management. Temporary berms, bunds and ponds shall be constructed to control stormwater flows in the event of inclement weather and to avoid the transportation of silt and sediment off-site from areas that have been cleared of vegetation and are undergoing construction and development. Permanent surface drains shall be constructed to collect run-off from the restored landfill surface.

3.6.5 Base Grading

Base Preparation and Compaction

The base of the landfill will be prepared and shaped prior to the installation of containment measures designed to inhibit the migration of leachate into the surrounding environment.
Shaping, to the lines and elevations shown on the drawings, will involve one or more of the following:

- Excavation of superficial soils.
- Ripping or blasting of competent rock; and/or
- Filling of depressions

Upon achieving design grades and elevations the base of the site will be cleared of any large obstructions and will be proof rolled.

3.6.6 Basal Lining System

Leachate contains highly polluting substances which, if not contained, could seep into any underlying groundwater or adjacent surface water, and render such water unfit for consumption or unsafe and toxic for aquatic life. Landfill gases, such as methane (CH4), carbon dioxide (CO2), carbon monoxide (CO) and hydrogen sulphide (H2S), contribute to global warming and climate change or may occur in elevated concentrations that are toxic to human, animal, and plant life or potentially explosive in confined spaces.
The primary method of containing uncontrolled migration of leachate and of landfill gases is to install engineered barriers of low permeability on the base, sides and top of the landfill.
The system of basal containment proposed on the base and sides of the landfill comprises a composite lining system particularly where the base slope is flatter than 1.0V:30.0H (1.9o, grade 3.33%). The basal lining system could be reduced to a single barrier where slopes are steeper than 1V:30H, subject to not exceeding a proposed maximum stipulated seepage rate of no more than twenty-five (25) litres/day/hectare of lined cell. A composite barrier is better at reducing leachate migration into the subsoil than either a clay liner or a single geomembrane layer. However, on steep slopes where drainage is rapid then a single High-Density Polyethylene (HDPE) liner would likely be sufficient.

The proposed lining system is consistent with the requirements for engineered barriers in municipal solid waste landfills adopted internationally (for example, Subtitle D of the Resource Conservation and Recovery Act, US Environmental Protection Agency).

Geo-composite Clay Liner (GCL)

The GCL proposed is a 4 – 6 mm thick reinforced GCL consisting of a layer of sodium activated bentonite sandwiched between two non-woven, needle punched geotextiles, the intrinsic permeability of which is $<1\times10^{-9}$ ms^{-1} and produced in conformity with National Standard Material Specification 595 (US EPA).

Rolls of GCL shall be overlapped to ensure adequate sealing. The GCL panels shall also be stitched together in order to ensure that the panels remain in place under all loading conditions. The GCL shall be constrained after placement in order to inhibit uncontrolled swelling of the bentonite clay.

The bentonite clay layer of the GCL will swell and become self-sealing in the unlikely event that it becomes damp from any seepage of leachate through the primary HDPE membrane installed above the GCL. The soils underlying the existing waste have been observed to comprise predominantly silty or clayey gravelly fine to medium sands, the residual weathering products of the underlying bedrock. Soils of unsuitable permeability will be improved by the addition of bentonite or be replaced by clean soils of lower permeability. To ensure the GCL will function adequately the estimated confinement pressures imposed on the GCL should be consistent with waste fill thickness and density. The confinement is required where the GCL hydrates.

High Density Polyethylene (HDPE) Membrane

The primary liner comprises a 2 mm thick HDPE flexible geomembrane, with an intrinsic permeability of approximately 1×10^{-13} ms^{-1}. The HDPE geomembrane will be textured on the underside in order to increase interface stability between the GCL and the HDPE geomembrane and/or the side slopes of the landfill, where laid over bedrock surfaces.

It is not proposed to provide a leak detection layer between the HDPE and GCL since this negates the benefit of placing the |GCL in intimate contact with the geomembrane liner. In addition, providing a leak detection layer (granular substrate) does not, in itself, serve to identify where the primary liner may be breached, thus hindering the ability to repair any such breach.

The geomembrane will be welded in panels in situ by specialist and experienced installers following strict CQA/CQC protocols. All welds and panels shall be tested and approved prior to placement of any overlying materials.

Geotextile

A geotextile, with a proposed weight of 1,200 grams/m^2, will be placed immediately above the geomembrane for liner protection prior to the placement of the overlying leachate collection gravel and pipework. This geotextile is heavy duty but deemed necessary given the proposed thickness of waste to be placed in the landfill.

Anchor Trench Design and Construction

The lining system will be installed throughout the base of each Cell and will be brought up to the margin of each Cell. The GCL and the HDPE liner will be tied into the ground surface in an anchor trench constructed along the upper margin of each Cell. If the GCL is omitted on the steeper side slopes of the western valley, approximately 10 m above the base of the slope/cell base, then an anchor trench will be constructed at a lower level.

3.6.7 Leachate Collection and Management System

Leachate Generation

Leachate generation depends on a variety of factors, including:

- Incident precipitation (average 175 mm/year for the period 2001-2020).
- Evaporation (average > 2,500 mm/year).
- The extent of the waste surface that is open and exposed.
- The rate at which the site is covered and capped; and
- The permeability and water holding capacity of the waste material.

Leachate tanks will be provided at the northern end of the site for the collection and temporary storage of leachate. These will be sized based an assumed infiltration rate of 85% (-15% run-off and evaporation) and a 40% release rate due to water holding and capillary effects over time.

Two scenarios have been used to calculate the amount of leachate expected for the cells (details can be found in the feasibility report attached as Annex-I), where daily leachate volumes are expected to vary from 1 m^3/day up to 96.5 m^3/day once the site is filled fully and capped. The leachate generation for the second scenario is calculated to be approximately 85% of those calculated for scenario 1.

Leachate Collection Gravel

A gravel layer, 30 cm thick will be placed above the basal lining system in order to facilitate the drainage of leachate towards the leachate collection pipes. The gravel shall be formed from crushed rock, with a grain-size of 16/32 and be free of carbonate (< 5%). The upper surface of the gravel will be covered with a geotextile of 800g/m². Given the waste thickness it is necessary to have robust thickness for filtration.

Leachate Collection Pipes

There are two main-types of pipes:

- Perforated (2/3 slotted); and
- Non-perforated (solid).

Pipes of different dimensions and ratings shall be provided, subject to confirmation of required capacity and strength. These are likely to be DN250 PN10 and DN350 PN16.

Perforated pipes shall be 2/3rd slotted and placed on the prepared, profiled, and sealed basal lining system. Perforated collection pipes shall be laid in a herringbone pattern, have a dimension of DN250 PN10 and will lead into a main collection pipe of DN350 PN16. Perforated pipes shall be wrapped by a geotextile filter cloth to prevent the ingress of fines into the pipe. Solid pipes in the dimension of DN350/PN16 penetrate the landfill embankment and basal sealing system in order to drain the leachate to the Leachate Sumps and further to the leachate collection tanks.
The minimum gradient of any collection pipe will be 2%.

Non-contaminated surface water from the Cells that are not in operation will be kept separate from, and discharged separately from, the leachate.

Leachate Collection Sumps/Chambers

Leachate collection sumps will be constructed at the margins of each Cell. The incoming leachate pipes are assumed to be of dimension DN350 and will be reduced (by connector) to a dimension of DN200 surface water pipe. Due to the basal lining system the landfill can be used temporarily for leachate storage as the need arises. Leachate pipe DN350, as well storm/surface water pipe DN200, shall be installed with non-corrosive butterfly valves.
A typical leachate collection sump is illustrated on fig 3.3.

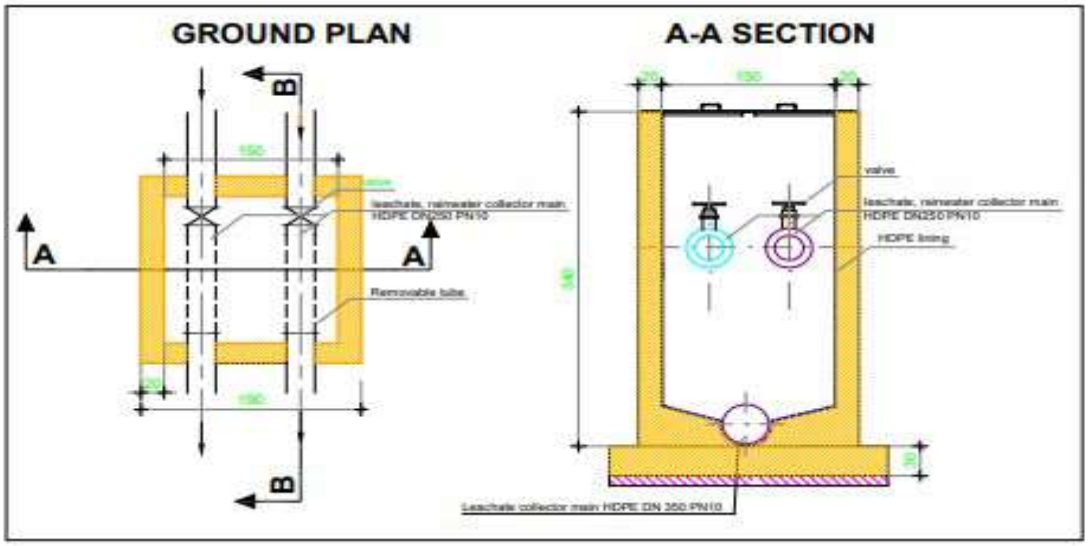


Figure 3.3 - Typical Leachate Collection Sump

Pipe Clean Outs

Leachate collection pipes will be required be flushed on a regular basis to reduce clogging and maintain the flow capacity of the collection system. Clean out access will be provided at the edge of each Cell where the leachate collection pipe is brought to the surface. The pipe end will be provided with a concrete surround to protect the pipe and flanges from damage. Cleaning will be carried out with high pressure jets.

Leachate Tanks

The tanks will consist of several sedimentation sections. This design allows to reduce the operational and treatment costs. The last sector (purification sector) stores those semi-purified leachates which will be pumped back towards the landfill body for wetting the incoming waste to achieve an increased compaction rate, reduction of wind-blown litter and an increased generation of methane due to the provision of necessary conditions for the biological process (>55° moisture).

Leachate storage tanks shall have a sufficient volume to collect and store leachate for a period of 15 days under maximum precipitation conditions.

For health and safety reason the storage of leachate to be carried out in tank made from sulphate resistant concrete. The potential layout of the leachate tanks is illustrated on fig 3.5, together with sections through the tanks Fig 3.6.

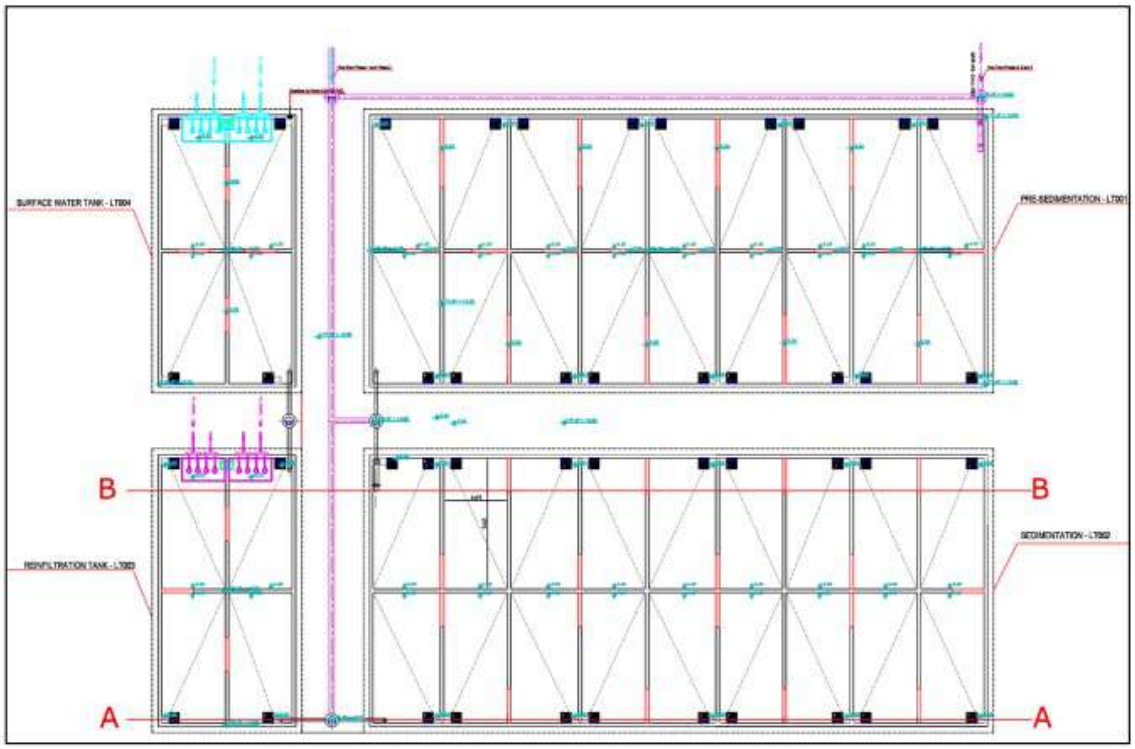


Figure 3.4: Plan View of Leachate Tanks

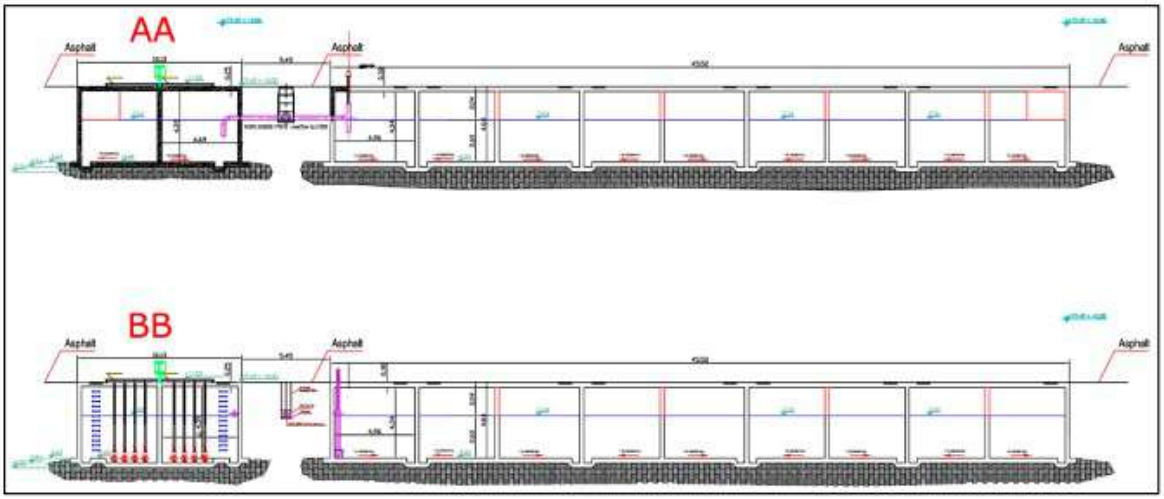


Figure 3.5: Sections Through the Leachate Tanks

3.6.8 Leachate Treatment

The **primary** method of leachate treatment shall be by leachate recirculation to the waste mass, given the prevailing climatic conditions and the fact that estimated leachate quantities are low. Re-infiltration shall be achieved by a combination of:

- mobile tanker and spray bar in the active waste deposition area; and
- by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level.

A ring main will be developed around the landfill Cells comprising HDPE DN100 which will supply re-infiltration connections installed at 50 meters intervals. The re-infiltration pumps shall be located at the leachate tanks in the re-infiltration pumping chamber. There shall be a minimum of two submersible water pumps. A local PLC station will supply the pumps with electricity. Pumps in leachate tank shall be rated for protection class EX2.

Re-infiltration units will supply the connection/distribution points where tube connection (Storz-B) will allow a controlled distribution of leachate during operation. The distribution at the surface will be carried out via fire-fighting hoses and perforated HDPE pipes (DN65).

Re-infiltration pumps shall have a capacity of 10m³ per hour and a head of 90m. The outlet piping is of DN95 and connected with the ring-piping system build of HDPE DN100 and supplies the re-infiltration tubes, installed at 30 meters spacing within the waste disposal area and the ring main around the cell margins. The power is 9.5 kW each and a total quantity of 2 x 4 pumps is required to permit an alternating operation and continuous service and maintenance programme without interference of the re-infiltration operation.

Re-infiltration units will supply the leachate at the required spots onto the landfill body and will serve the connection/distribution points where tube connection (Storz-B) will allow a controlled distribution of leachate during operation. The distribution at the surface will be carried out via fire-fighting hoses and perforated HDPE pipes (DN65). The re-infiltration pumping chamber is located within the leachate collection tank. The re-infiltration unit is adjusted with a minimum of two submersible water pumps. A local PLC station will supply the pumps with electricity. Pumps in leachate tank shall be rated for protection class EX2.

A SCADA system will record and illustrate the flow of each pump (flowmeter ex-protected), as well the amperage and pump operational hours, in order to understand the volume of leachate managed as well as pump service and maintenance needs. Leachate levels in the tanks will also be monitored via level sensors which will activate/deactivate pump operation based upon leachate levels.

Local Control Panels (LCPs) at each tank permit the manual control and operation of the pumps. A central control panel for all leachate pumps is located in the PLC Container at the landfill gas. The signals from this centralized panel will be transferred to the central SCADA unit located in the Operations Room of the Administration Building.

It is not anticipated that other methods of leachate treatment shall be required, given:

a) the prevailing climatic regime.
b) the rapid waste input rate (5,000 tons per day).
c) Limited size of areas opens during waste filling; and
d) Rapid rate of closure of completed cells.

Should leachate re-circulation not prove to be completely effective as a leachate management process, then it will be necessary to consider other forms of treatment that might be more appropriate, particularly if treated leachate is required to be discharged off-site.
The simplest alternative form of treatment, other than recirculation, is the provision of shallow evaporation ponds to take advantage of the prevailing climatic conditions. There is sufficient area at the southern margin of cell 6 to develop such ponds, each with an area of 200 m^2 (20 x 10 m) and with a maximum depth of 2 m (holding capacity with 0.5 m freeboard is 300 m^3).

3.6.9 Landfill Gas Management

Gas Collection Wells

The landfill gas collection system is designed from bottom up to avoid emission during landfill operation and to avoid drilling through the garbage when the cell is filled with waste. When two meters of waste layer is deposited in the first cell a 30m x 30m grid of perforated gas recovery pipes are installed (fig 2-6 and fig 2-7) and are brought up as waste filling progresses.

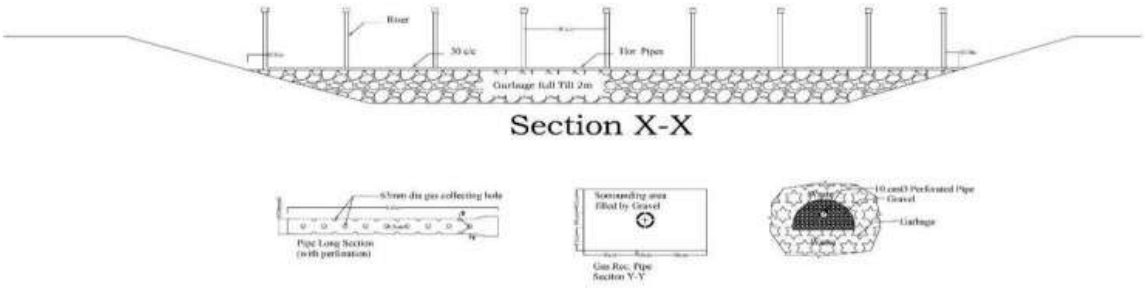


Figure 3.6: Vertical gas wells

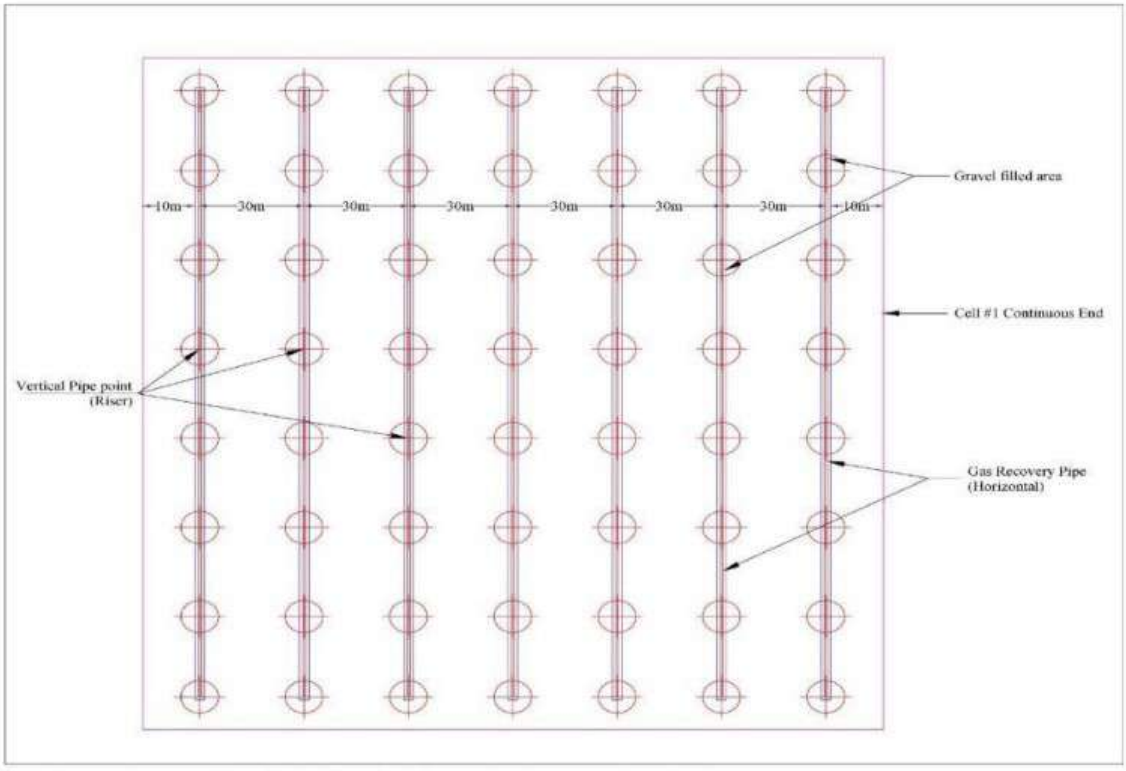


Figure 3.7: Landfill Gas Recovery System

An overlap of 15% in the radius of influence of each well is normally designed between adjacent gas wells, such that the final radius between wells is reduced to 20m. The vertical and horizontal pipework typically comprises HDPE DN65 PN16, perforated and surrounded by a gravel pack. The gas well is extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome is installed at the top of the well.

The gas collection wells/domes are connected via HDPE DN65 perforated pipes to collection strings. Each string is lead to a main collection pipe at the manifold and can be regulated with a separate valve based on the quality of gas.

3.6.10 Gas Generation Estimates

An assessment of potential gas generation has been made over an assumed 10-year operating lifespan under a design capacity input of 5,000 tons per day from 2026 to 2035 with a total amount of 18,250,000 tons, where the yearly estimated generation is provided below:

Table 3.2 - Landfill Gas Generation Estimates

Year	Total landfill gas		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*
2026	0	0	0
2027	1.766E+04	1.494E+07	1.004E+03
2028	3.463E+04	2.930E+07	1.968E+03
2029	5.094E+04	4.309E+07	2.895E+03
2030	6.660E+04	5.634E+07	3.785E+03
2031	8.165E+04	6.907E+07	4.641E+03
2032	9.611E+04	8.130E+07	5.463E+03
2033	1.100E+05	9.306E+07	6.253E+03
2034	1.234E+05	1.043E+08	7.011E+03
2035	1.362E+05	1.152E+08	7.740E+03

The gas generation increasing factor is assumed to be 5% due to thermophilic conditions (about 60°C). The methane concentration within the landfill gas is assumed to be 50%. Since MSW is currently received mixed, without separation of the organics, then the Total Organic Content (TOC) has been assumed to be 250 kg/ton of input. Gas capturing efficiency was predicted at 50% during the operating life of active waste deposition.

Treatment by flaring would start in the 1st year to capture low-quality gas with a gas flare capacity of 3,000 Nm3/h and a ratio of 1:5. Thereafter, as gas quality improved flares with a capacity of 10,000 Nm3/h and a ratio of 1:6 (from 1,600 Nm3/h to 10,000 Nm3/h) will be installed.

3.6.11 Gas Treatment Plant

The gas treatment plant shall consist of:

- Series of manifolds connecting all gas wells in each Cell.
- Low Calorific Flare 3,000 Nm^3 per hour, v=1:5.
- High Temperature Flares 10,000 Nm^3 per hour; v=1:6, number to be determined based on gas yield.
- Gas engines (each up to 10 MW capacity).
- Gas cleaning and distribution container (filters and condensate separator).
- PLC container.
- SCADA container.
- Cooling units (chiller) linked with stormwater pond 4 (fed by stormwater tank and related pumps) and heat-exchanger.

Condensates from the purification filters shall be discharged into the leachate tank and the condensates re-infiltrated into the landfill body.

Gas blowers supply gas to the flares and operate independently from each other. All blowers, necessary P&ID as well gas-analyser and control units are integrated in the PLC container. Electricity supply will be provided via the PLC container. Operational and controlling signals are transmitted into the control container and further towards the SCADA system in the Administration Building.

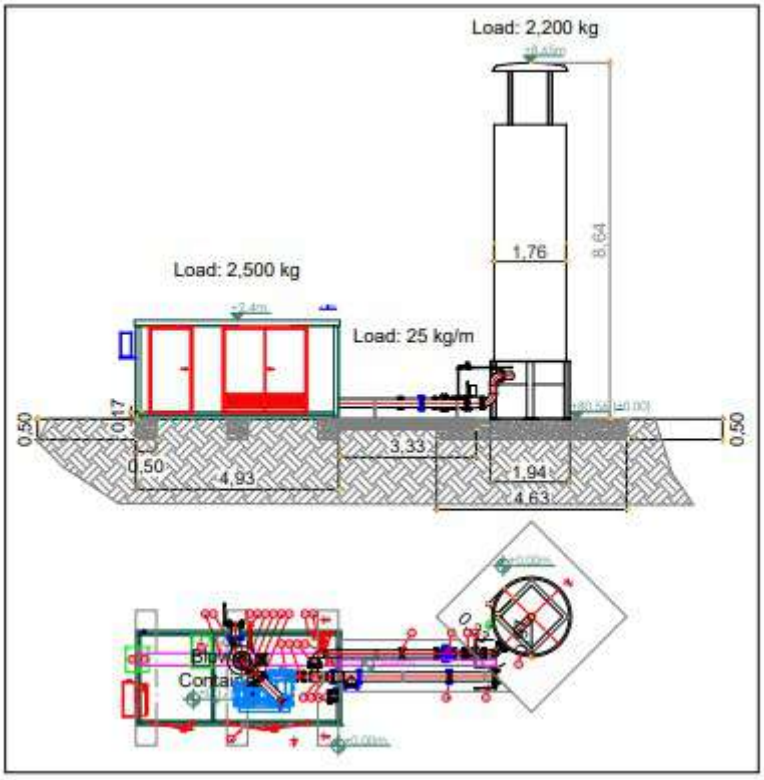


Figure 3.8: Gas Blower and Flare

3.6.12 Surface Restoration and Capping

Capping System Components

Capping is an ongoing process to mitigate and minimize:

- Odour.
- Wind-blown litter.
- Precipitation infiltration.
- Reduced biogas migration into the atmosphere; and
- Birds and vermin.

Capping will be undertaken once deposited and compacted waste achieves final height in any part of the landfill. Capping will proceed in parallel with waste deposition in the active tipping area. After waste has achieved final height infill material will be placed onto the landfill slopes and profiled to a first shape. The infill material will be formed from low quality site-won overburden, recovered from the materials used for daily cover. Thereafter, two layers shall be installed, each 25 cm thick, of clay, profiled and compacted to 98% of the MDD at a moisture content in the range of OMC 0% to OMC +3%.

The specification of this material as follows:

- Clay/bentonite content (<0.002 mm): >35%
- Fine fraction content (<0.063mm): > 60%
- Lime content: < 30%

- Organic matter content < 5%
- Carbons content: < 15%
- Permeability of capping material < 10^{-7} cm [1]
- Linear Shrinkage: 0 – 10%
- Plasticity index: 15 <PI < 35
- Yielding point: 0 - 45
- Moisture content after laying: Between OMC and OMC +3% •
- Proctor: >98% MDD

Topsoil consists of organic activated soil (humus). Due to low availability of humus on site, overburden can be enriched by the addition of compost from a composting facility at a minimum addition of 15 %.

- Laying and compacting of available soil-structured layer of 2 x 25cm.
- Compacting.
- Seeding 40kg per ha.
- Rolling; and
- Watering

Seeding, at an application rate of 40 kg /ha, requires a total of 2, 800 kg of seeds over an area of approximately 70 ha (landfill and buffer area).

Potential Restoration Profile

A final capping gradient of 1V:3H is normally proposed to maximise the available volumetric capacity (fig 2-9). As waste decomposes and degrades the surface of the landfill will settle, often by 20% or more, with a consequent reduction in surface gradient to 1V:3.6H.
Given the site geometry and the possibility of seismic activity it is anticipated that the initial restoration profile may need to be flatter, for example 1V:4H, in order to maintain the stability of the final slopes in the waste mass. Slope stability calculations will be undertaken to confirm the final slope profile under both static and dynamic (seismic) loading. It may also be necessary to provide benches on the slopes, both to improve stability and also for control of surface water run-off.

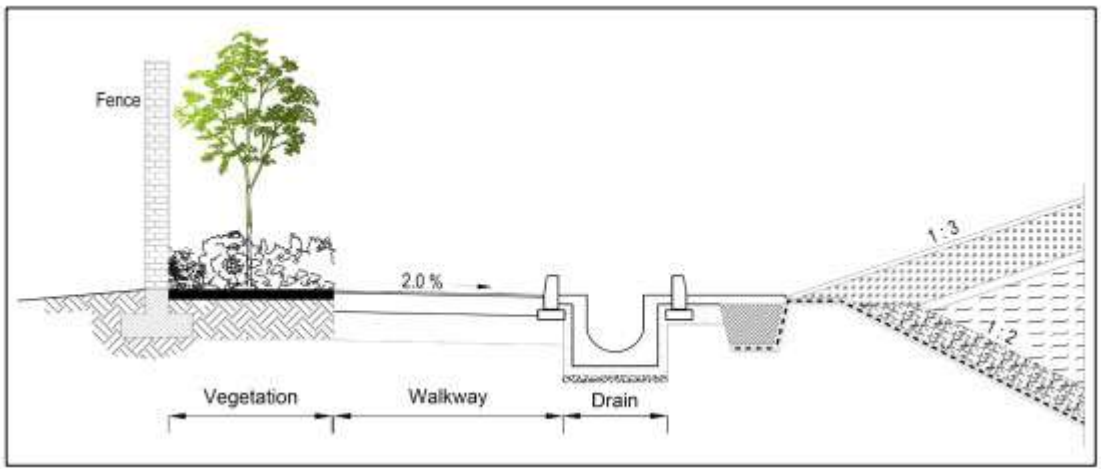


Figure 3.9: Schematic Section Through a Restored Landfill Profile

3.6.13 Estimated Lifespan

The estimated lifespan has been computed for a variety of scenarios assuming different compacted densities for the landfilled waste and assuming that the quantity of waste delivered to

the landfill remains at an average of 5,000 tons per day waste input for the duration of the active life of the landfill.

The projected lifespan ranges from a minimum of 7.04 years at a compacted density of 0.8 t/m^3 to 10.56 years at a compacted density of 1.2 t/m^3. The actual lifespan of the landfill is subject to a number of variables, including waste input rate and the degree of compaction achieved.

3.7 Closure of Existing Dump Site

Whilst the construction works of the proposed cells are underway, the waste from the city would continue to be disposed of at the existing dumpsite, where **Figure 3.1** depicts the particular location of the existing dumpsite that shall be used for dumping activities (this has been chosen as it is the farthest distance from the settlement at Haji Ibrahim Goth to minimize impacts on the people residing there).

Once, however, the cells come into operation, waste from the city will be disposed of there, and the existing dumpsite shall be rehabilitated/ remediated and capped for closure starting with the area immediately adjacent to the settlement at Haji Ibrahim Goth. Detailed design and engineering studies will be undertaken to explore the potential opportunities and technologies that may be used to achieve successful closure of the existing dumpsite e.g., bio-mining, capping, etc.

The closure will ensure that the following items are addressed accordingly:

- Regulatory Compliances- Ensure that all closure activities comply with local, and federal regulations governing landfill closure, including compliance with laws of the local Sindh EPA
- Final Cover System – Choosing adequate materials for the final cover system to be installed to ensure that the emissions and impacts from the existing dumpsite can be effectively managed.
- Gas Management – The effective management of landfill gas emissions during and after the closure process, which may include landfill gas collection and control systems.
- Leachate Management – The effective management and monitoring of leachate collection and treatment to prevent groundwater and surface water contamination.
- Cap Maintenance - Regular inspections and maintenance of the integrity of the landfill cap to ensure its effectiveness in preventing water infiltration and gas escape.
- Monitoring Wells – Continue Monitoring Groundwater quality and gas emissions (including methane, Hydrogen Sulfide, and carbon dioxide) through a network of monitoring wells and regularly report results to Sindh EPA
- Vegetation & Landscaping – Promote the establishment of native vegetation on the landfill cap, which can help with erosion control and improve the site's aesthetics.
- Public Communication – Prepare and implement a plan for keeping stakeholders aware of any updates and potential risks or changes in site conditions.
- Security Measures – Implement security measures to prevent unauthorized access to the closed landfill site.
- Post-Closure Care – Ensure robust mechanisms are in place for post closure care including ongoing monitoring and maintenance activities as required.

Currently, a consultant has been brought onboard to conduct these studies and ensure their completion before the commencement of operations of the new cells. Currently, the tentative cost for this has been estimated at 07 million US Dollars, however, shall be finalized when detailed design studies are complete.

3.8 Project Construction Work Force & Construction Camps

3.8.1 Site Work Force

Manpower demand estimation is an essential component to facilitate deployment of manpower. The project involves professional, administrative, skilled, and unskilled labor which will be deployed.

For the construction activities. Based on numbers obtained from the design consultant a peak number of 100 skilled and unskilled laborers are estimated to be employed for the construction of the landfill cell. The actual number of laborers shall ultimately, however, depend on the contractor's activity schedule at the time when contract is awarded. The contractor will hire unskilled labor from the local communities and a training program will be conducted for unskilled workers.

Similarly, during operations, it is estimated that there will be 62 workers on site.

3.8.2 Construction Camps

Currently camp sites have not been finalized, where the ESIA consultant has provided guidelines for camp site selection, establishment, and operations to ensure minimal impacts. Camp sites will be selected with careful consideration of the below mentioned factors to ensure the smooth operation of construction activities while minimizing any negative impact on the surrounding areas. The contractor is responsible for identifying suitable construction camp sites in accordance with the following guidelines:

Land Acquisition & Resettlement

- The establishment of contractor camps will not involve any land acquisition or any potential resettlement issues, where if land is being rented, then the contractor will negotiate directly with the landowner. A written rent agreement will be prepared signed by the both parties.

Distance from Settlements

- Camp Sites should be situated away from existing settlements.
- Consideration should be given to maintaining a considerable buffer zone between the camp site and residential areas or sensitive receptors, to the extent possible.

Proximity to Project Site

- Camp sites should be selected near the project area to ensure the convenient access to the nearby or main link road.
- This proximity will facilitate transportation of materials, machinery, and personnel.

Workforce Management

- Camp sites must not pose a threat to domestic or public water supplies, and care should be taken to prevent drainage from the camps from affecting water sources.
- The size of the camp site should be adequate to prevent overcrowding of necessary structures.
- Precautions should be taken to avoid any damage to property, vegetation, irrigation systems, and drinking water supply systems.
- Camp sites should be in areas that are not prone to periodic flooding.
- Construction camp sites should not be situated near ecologically sensitive areas such as wildlife sanctuaries, game reserves, national parks, or forest areas.

Approval of Camp Sites

- The contractor, in consultation with the Supervision Consultant (SC), will select the final locations of the contractor camps.

- The selected locations will be subject to approval from the SWEEP PIU in line with the provisions of the Labor Management Procedures developed.

Code of Ethics & Cultural Observations

- A code of ethics (including GBV awareness) has been established for laborers to guide their interactions with the surrounding communities and among themselves and is made part of the Labor Management Procedures. Laborers at the construction camps must adhere to this Code of Conduct that promotes positive interactions with the surrounding communities and fosters a harmonious working environment amongst themselves.

Given that no such zoning laws exist or are being implemented in the area, the best-case scenario for the contractors would be if they were allowed to set up camp at a suitable, available location within the premises of the landfill site.

3.9 Electrical Demand & Source

3.9.1 Construction Phase

During construction, electricity will be provided by diesel power generators with a capacity of up to 125 KVA each.

3.9.2 Operational Phase

During operations, not only will a dedicated sub-station be set up at the administrative area of the site, but solar installations will also be carried out to supplement the site's electricity demand.

3.10 Water Demand & Source

In this section, the water demand for construction and operational stages is assessed and reported, along with the potential source for this water, where potable water will be required for consumption purposes at the site. Dedicated water supplies will be stored for firefighting purposes and emergency response needs adequately in line with the fire risk at the site during construction and operations.

3.10.1 Construction Phase

The source of water during the construction phase will be from water bowser tanks. The WHO defines between 50 and 100 litres of water per person per day are needed to ensure that the most basic needs are met, and no health concerns arise[21]. In this case, considering the higher end of the spectrum for the project, where each worker will require 100 litres/day, the water consumption is estimated to be over 10,000 litres /day[22] for 100 construction workers.

3.10.2 Operational Phase

Similarly, during operations, for 62 personnel, it is estimated that roughly 6,200 litres/day of water will be required. The source of the water will be from water bowsers, where the water will be stored in dedicated tanks for use on site.

21 UN – Water Decade Programme on Advocacy and Communication and Water Supply and Sanitation Collaborative Council
22. Tentative Work Force Requirements refer section 3.22".
= (100) x (100) = 10,000 litres/day

3.11 Wastewater Generation

3.11.1 Construction Phase

The estimated wastewater generation during the construction phase for 100 workers is estimated at 8,000 litres/day[23] from the construction camps. Septic tanks will be constructed to provide primary treatment after which the wastewater will be discharged from the site.

3.11.2 Operational Phase

The estimated wastewater generation during the construction phase for 62 workers is estimated at 4,960 litres/day[24] from the offices and buildings constructed. Proper septic tanks will be constructed for treatment prior to discharged from the site.

3.12 Solid Waste Generation

Due to the construction activities, waste will be generated at the construction sites and contractor camps. The excavated materials will be reused where applicable for construction purposes. Solid waste generated during construction and camp operations shall be safely disposed of in the operating landfill site.

Considering 0.5 kg/capita/day of solid waste generated, the estimated solid waste generation is considered to be 50 kg/day for 100 workers during the construction phase. Similarly, during the operational phase, the estimated solid waste is considered to be 31 kg/ day.

[23] Design criteria of Public Health Engineering for Water Supply, Sewerage, and Stormwater Drainage (Domestic sewage generation = 80% of water consumed/ day)

[24] Design criteria of Public Health Engineering for Water Supply, Sewerage, and Stormwater Drainage (Domestic sewage generation = 80% of water consumed/ day)

4. Relevant Legislative Requirements & Framework

This chapter provides an overview of the policy framework and legislation that applies to control the environmental and social consequences arising from the proposed project implementation and operation. The project needs to comply with all the applicable environmental policies, laws, guidelines, acts, and legislations of GoS and the provincial government. The proposed project is being funded by the World Bank, hence, the requirements of the WB ESF, 2018 are also discussed in the following sections.

4.1 Sindh Environmental & Social Regulatory Authorities

The key national regulatory agencies that are implementors of the applicable environmental and social policies are listed below:

Table 4.1 - Functions of Sindh's Environmental & Social Regulatory Authorities

Organization	Functions/ Role
Sindh Environmental Protection Authority (SEPA)	• Regulating environmental issues • Reviewing and checking environmental assessment reports prepared as per the legal requirements. • Environmental approvals of the project • Ensuring compliance and reviewing the performance of environmental management plans implementation
Sindh Labor & Human Resources Department	• Guaranteeing the rights of workers like the right to organize, the right to collective bargaining, participation in the affairs of the implementing agency, health & safety, minimum wages, compensation, etc. are followed in the project
Sindh Social Welfare Department & Women Development Department	• Transformation of the government into an organization that actively practices and promotes gender equality and women empowerment. • Mainstreaming gender equality perspective across public policies, laws, programs, and projects by departments and agencies of the government with a focus on women empowerment. • Looking after various marginalized segments of population such as poor persons with disabilities, orphans, victims of violence and specifically women to ensure the welfare and support the marginalized groups of society.
Employees Old Age Benefit Institute (EOBI)	• Make sure that workers are benefitted after retirement from the collected/ raised funds.

4.2 Summary of Relevant Strategies, Policies, Acts and Legislation

A summary of the major relevant strategies, policies, Acts, and legislation from the environmental perspective are briefly discussed in the tables below:

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project

Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project	Regulatory Requirement from Project
1.	Sindh Strategy for Sustainable Development, 2007	The Sindh Strategy for Sustainable Development (SSSD) proposed a ten-year sustainable development agenda for Sindh. The main focus of SSSD is to promote the sustainable use of natural resources. It targets to reduce poverty and enhance social development through the participation of the people of Sindh. SSSD recommends for the sustainable development and environmentally complying operations of industries: incentive mechanisms for reducing pollution; awareness raising of industrialists and stakeholders; promote cleaner production; enforce pollution charges as per SEPA 2014; prepare baseline of all industrial estates and sites to establish the pollution levels, waste disposal practices, air emissions, generation of hazardous waste for the preparation of environmental management plans for complying SEPA 2014; preparation of EIAs for all industrial development and infrastructure projects.	This strategy is applicable as the proposed Project involves the establishment of solid waste disposal and treatment facility.	No regulatory requirement (Is the overarching strategy under which the Sindh Environmental Protection Act 2014 was made).
2.	Sindh Drinking Water Policy, 2017	This policy is to provide safely managed drinking water whose supply is adequate, well maintained, and sustainable; and to enhance public awareness about health, nutrition and hygiene related to safe drinking water. The basic objective of this policy is to introduce legislative measures and regulations to create an enabling framework for safely managed drinking water supply, regulation of water usage, extraction, treatment transportation and distribution.	This policy is applicable for the Project in terms of quality of drinking water to be provided to laborers.	Ensure that clean water is provided to laborers and staff working on project.
3.	Karachi Strategic Development Plan 2020	The vision of Karachi Strategic Development Plan 2020 (KSDP) is to “transforming Karachi into a world class city and attractive economic centre with a decent life for Karachiites”. Implementation of the KSDP-2020 is provided a legal coverage under Section 40 of the Sindh Local Government Ordinance 2001 (SLGO). It recognizes that higher level of air pollution persists in the city due to automobile and industrial	The relevance of KSDP is to cater the economic and other related interventions in Karachi city. One of the objectives of KSDP is the identification of	No regulatory requirements, however, it has a section and recommendations on how the waste management of the city should be carried out.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
		emissions, open burning of solid waste, and other domestic and commercial emissions. Hazardous industrial waste is burnt in substandard incinerators resulting hazardous emissions.	social, economic, environment, and urban infrastructure issues related to solid waste management	
4.	Sindh Sanitation Policy, 2017	The goal of the Provincial Sanitation policy is to ensure that the population of Sindh has access to a safely managed sanitation service and sanitary environment that is nutrition-sensitive and hygienic. The policy touches upon important facets of infrastructure where extensive work is required to be able to achieve this goal, i.e., sanitation coverage, wastewater collection and treatment, domestic solid waste management, hazardous and industrial waste management, along with measures required, and the key players responsible.	One of the objectives is to improve the overall solid waste management network, capacity, and delivery.	No regulatory requirements, however, the development of the sub-project will contribute partly to the goals of the policy.
5.	Sindh Environmental Protection Act, 2014	Sindh Environmental Protection Agency as a part of Sindh Act No. VIII of 2014 prepared Sindh Environmental Protection Act (SEPA), 2014 which was passed by the provincial assembly of Sindh on 24th February 2014 and asserted by the Governor of Sindh on 19th March 2014 and notified on 20th March 2014. It is a fairly comprehensive legislation and provides legislative framework for protection, conservation, rehabilitation, and improvement of the environment. It contains concrete action plans and programs for the prevention of pollution and promotes sustainable development. Act has 11 parts with 37 Sections followed by sub-sections and clauses. Part VI is related to the environmental examinations and assessments while part X is related to the public participation.	The proposed Project is located mainly in Karachi so it falls under the jurisdiction of the SEPA that will be the responsible authority for governing the environmental compliance of the project with local guidelines.	Prior to project construction, an Environmental Impact Assessment must be conducted against which an approval has to be obtained from the department.
6.	Sindh Environmental	These regulations set out: • Key policy and procedural requirements for filing an EIA.	Defines the categories for different projects, where the	As per the categories defined, the following project falls into

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
	Protection Agency, (Review of EC, IEE, and EIA) Regulations, 2021	• The purpose of environmental assessment. • The goals of sustainable development. • The requirement that environmental assessment be integrated with feasibility studies. • The jurisdiction of the Provincial EPA and Planning & Development (P&D) Departments. • The responsibilities of proponents. • Duties of responsible authorities. • Provides schedules of proposals that the Project requires either EC, IEE, or an EIA. • The environmental screening process of the projects under schedule I, II and III; and • The procedure for the environmental approval for filing the case with the Sindh EPA for the granting of the NOC.	type of study/ assessment required (Checklist, IEE, EIA) against each category of project is defined to fulfil local environmental compliance.	the category of an EIA based on: Schedule III – Projects Requiring an EIA Category (H) – Waste Disposal & Treatment Sub-Category (2) - Solid Wate Municipal Landfill Sites
7.	Sindh Environmental Quality Standards (2016)	SEPA has formulated the Sindh Environmental Quality Standards (SEQS) as per Clause (g) of sub-section (1) of Section 6 of SEPA Act 2014. The SEQS were promulgated in 2016 which includes standards for liquid effluent, industrial gaseous emissions, ambient air, drinking water quality, noise levels and standards for motor vehicle exhaust, diesel vehicle, and petrol vehicles.	Defines acceptable standards for the construction and operation of different projects in Sindh with respect to ambient air quality, vehicular and exhaust emissions, drinking water quality, and effluent quality.	All projects to be implemented in Sindh must conform to SEQS during all the phases i.e., construction and operation.
8.	Guidelines for the Preparation and Review of Environmental Reports, 1997	These guidelines describe the format and content of IEE/EIA reports to be submitted to Environmental Protection Agency (EPA) or obtaining NOC/approval. The guidelines present: • The environmental assessment report format. • Assessing impacts. • Mitigation and impact management and preparing an environmental management plan.	These guidelines serve to describe the format, practices, and procedures to be employed when reporting environmental assessments.	No requirements, only guidelines for items to be included in assessments.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
		• Reporting. • Review and decision making. • Monitoring and auditing; and • Project Management.		
9.	Guidelines for Environmental Assessment	Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development Projects. The guidelines that are relevant to the proposed Project are listed below. • Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997. • Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May 1997; and • Sectoral Guidelines: Pakistan Environmental Assessment Procedures, Pakistan Environmental Protection Agency, October 1997.	These guidelines serve to describe the format, practices, and procedures to be employed when conducting environmental assessments.	No requirements, only guidelines for items to be included in assessments.
10.	Pakistan Climate Change Act, 2016	The Prime Minister of Pakistan established Pakistan Climate Change Council which coordinates and supervises the enforcement of the provisions of the Act, monitor implementation of the international agreements relating to climate change, approve and monitor implementation of comprehensive adaptation and mitigation policies, strategies, plans, programs, projects and other measures formulated by the authority to meet Pakistan's international obligations, monitor the implementation of National Adaptation Plan and its constituent provincial and local adaptation action plans, approves guidelines for the protection and conservation of renewable and non-renewable resources, species, habitats and biodiversity adversely affected or threatened by climate change.	The Act is applicable to proposed project as the proposed project involves the solid waste management activities that may contribute to generation of greenhouse gases.	Requires compliance with local EPA and its requirements

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
11.	Sindh Solid Waste Management Act, 2021	The Sindh Solid Waste Management Act, 2021 enacted to establish a board for collection and disposal of all solid waste, to arrange effective delivery of sanitation services, to provide pollution free environment and to deal with other relevant matters. The Board established under the Act headed by the Chief Minister or his nominee and constitutes of thirteen other ex-officio members of other relevant departments.	This Act is applicable as the main Act of the implementing agency of the project. It will define the boundaries in which the project must take place, and continue operations in.	No requirements, only defines the ambit of SSWMB's operations.
12.	The Sindh Local Government Act 2013 and Sindh Local Government (Amendment) Act, 2021	Under the Sindh Local Government Act 2013 (SLGA), Chapter VI, land use planning; implementation of building by-laws; management of environmental and health hazards; food adulteration; provision and maintenance of water supply schemes and public sources of drinking water; and mobilization of communities for the upgrade of local infrastructure (transportation, landscaping, and removal of encroachments) are the responsibilities of municipal corporations/committees. The 2021 amendment served to define municipal corporations and committees, along with establishing a relationship between elected councils and provincial departments working in administrative boundaries.	This Act is applicable for the proposed Project due to its location and nature of use of public sources during construction stage of the proposed Project.	Act demands provision of utilities and municipal services to the population in an environmentally friendly manner, which this project would be contributing towards after development.
13.	Sindh Public Property Act, 2010	The act has been passed to avoid illegal encroachments and provide measures for removal of encroachment from public property and to retrieve possession. The City Government will provide continuous oversight and reinforcement to facilitate the properties to remain free from illegal encroachments.	Neither land acquisition nor physical displacement is envisaged under this project however livelihood of waste pickers will be affected.	Encroachments cannot be cleared under this project without being compensated properly first as the Bank does not work in areas where anti-encroachment drives have been conducted (as per the agreed Environmental & Social Commitment Plan)[25].

[25] In Section 5.1, the ESCP dictates that if any removal of encroachments or resettlement from any subproject site is to take place, then measures and provisions laid out in the project's resettlement framework will become applicable.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
				As such, the sub-project site is owned by the Government and free from any such encumbrances, where no removal of encroachments has taken place since November 2019.
14.	Sindh Factories (Amendment) Act, 2021	The Act deals with regulations related to Project Area workers and workplace EHS requirements. The Factories Act also provides regulations with provision for general health and safety of the work force in their work area. Conditions are specified for clean workplace, toilets, waste handling, provision of drinking water quality, worker health and hygiene etc. Under the Act, no occupier of a factory shall be allowed to start manufacturing process unless he has obtained factory registration certificate from the Directorate of Labor. The Act does not allow a child below the age of 14 years to work in a factory in any case. The new Law restricts the employment of contractual labor in manufacturing process. The amendment 2021 is specifically related to the provision of safe transportation facility to women workers, working hours and working periods of seasonal and whole year factories.	This Act is applicable for the Project workers as well as belonging community including men, adults, women, adolescent working in and near the construction industry (during construction phase).	Requires that the occupational health and safety, along with labor regulations defined therein are complied with during project implementation. Applicability and requirements defined in the separately prepared Labor Management Procedures for SWEEP.
15.	The Sindh Occupational Safety and Health Act, (2017)	The Act makes provisions for occupational safety and health conditions at all workplaces in the province for the protection of workers during work. Under the Act, an Occupational Safety and Health Council will be established in Sindh with secretary of Sindh government's Labor and Human Resources Department as its chairperson. The proposed council lays down penalties in case of death and injury due to violation. In case of death sub-section 01 of	The Act applies in any Project situation where worker's rights and protections are enforced. This law is applicable to construction and Project workers and will be complied	Requires that the occupational health & safety regulations defined therein are complied with during project implementation. Applicability and requirements defined further in the separately

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
		section 38 will accord 2 years' imprisonment or a fine of PKR 100,000 or both. Similarly, in case of injury the imprisonment may extend to six months or a fine up to PKR 20,000 or both.	during construction and operation phases.	prepared Labor Management Procedures.
16.	The Sindh Transparency and Right to Information Act, 2016	The purpose of this Act to provide transparency and freedom of information to ensure that all citizens have better access to public information, to make the government more accountable to citizens, to enforce the fundamental right to information in all matters of public importance, to ensure transparency in all Government matters. Transparency and access to information are essential principles of democracy which not only enable the citizens to hold the Government and their institutions accountable but also help in improving the system of governance.	This Act is applicable as the proposed Project is the public sector Project and shall be transparent for public.	Defines how the project must operate in a transparent manner to the public.
17.	Pakistan Antiquities Act, 1975	The Antiquities Act, 1975 (amended in 1990) states the following: • "Ancient" is any object that is at least 75 years old. • All accidental discoveries of artefacts must be reported to the Federal Department of Archaeology. • The Government is the owner of all buried antiquities discovered on any site, whether protected or otherwise. • All new construction within a distance of 200 feet from protected antiquities is forbidden. • No changes or repairs can be made to a protected monument, even if it is owned privately, without approval of the responsible authorities; and • The cultural heritage laws of Pakistan are uniformly applicable to all categories of sites regardless of their state of preservation and classification as monuments of national or world heritage.	Although no antiquity site has been identified within the proposed AoI. However, the law will be applicable to the Project mainly due to its two provisions: ▪ According to the law, any construction activity within 61 m or 200 ft. of protected antiquities, are prohibited. ▪ The provisions of this Act would also be applicable, if any accidental archaeological discoveries may occur during the excavation works for the construction of proposed Project.	Should there be an identified antiquity lying within 200 feet of one of the project sites, then approval must be obtained from the culture and heritage department. Further during project execution, on account of discovery of any archaeological remains, antiquities department to be intimated promptly.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
18.	Pakistan Penal Code, 1860	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.	The provisions of the Penal Code, 1860 are applicable to the Project in terms of penalties for effecting human lives and public property. It also addresses the control of noise, air emissions and effluent disposal.	Requires adherence to the law of the land, where it defines the need to comply with aspects affecting the environment and other humans.
19.	The Protection against Harassment of Women at the Workplace Act, 2010	The Protection Against Harassment of Women at the Workplace Act (2010) refers to sexual harassment at the workplace.	This Act will be applicable to the Project if women are employed for the construction of the proposed Project.	Ensure that women are not harassed at workplaces.
20.	Sindh Prohibition of Child Employment Act, 2017	Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines, or any other hazardous employment. In accordance with this Article, the Prohibition of Child Employment Act (PCEA) 2017 disallow child labor in Sindh. The PCEA defines a child as a person who has not completed his/her fourteenth years of age, and an adolescent means a person who has completed fourteenth year of age but has not completed eighteenth years of his age. No child shall be employed or permitted to work in any establishment including construction, but an adolescent can be employed or permitted to work under strict guidelines provided in the PCEA and rules. An adolescent shall not be employed in any hazardous work included in the schedule to the PCEA.	The relevance of this Act to the Project will be to prohibit child employment for construction of the proposed Project.	Does not permit child labour during project construction or operation.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
21.	Labor Laws as part of Constitution of Pakistan 1973,	The Constitution of Pakistan contains a range of provisions with regards to labor rights, in particular: • Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor. • Article 17 provides a fundamental right to exercise the freedom of association and the right to form unions. • Article 18 proscribes the right of its citizens to enter upon any lawful profession or occupation and to conduct any lawful trade or business. • Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and • Article 37(e) makes provision for securing just and human conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment. Labor law is controlled at both provincial and national levels with compulsory employment agreements containing the terms set out by the labor laws. The labor laws are a comprehensive set of laws in Pakistan dealing with the following aspects: • Contract of Employment. • Termination of Contract. • Working Time and Rest Time. • Working hours. • Paid Leave. • Maternity Leave and Maternity Protection. • Other Leave Entitlements. • Minimum Age and Protection of Young Workers. • Equality • Pay Issues.	The labor laws are relevant as it would deal with employment of labor for the construction of proposed Project. Following are the major labor laws which are applicable to the Project: • Sindh Workers Compensation Act 2015 • Sindh Minimum Wage Act 2015 • Sindh Terms of Employment (Standing Orders) Act 2015 • Sindh Bonded Labor System (Abolition) Act 2015 • Sindh Payment of Wages Act 2015 • Sindh Occupational Safety & Health Act 2017 • Sindh Factories Act 2021	Requires that the labor regulations defined therein are complied with during project implementation. Applicability and requirements defined in the separately prepared Labor Management Procedures for SWEEP.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
		• Workers' Representation in the Enterprise. • Trade Union and Employers Association Regulation; and • Other Laws.		
22.	Sindh Bonded Labor (Abolition) Act 2015	The Act is gender sensitive; an anti-discrimination clause is added to each new proposed Law in accordance with ILO requirement viz: "No discrimination shall be made on the basis of sex, religion, political affiliation, sect, colour, caste, creed, ethnic background in considering and disposing of issues relating to the enforcement of this Act". In all proposed Laws the cognizance has been changed from that of the Judicial Magistrate to the Presiding Officer Labor Courts who is a Session Judge.	This Act is applicable as the proposed project may involve the numbers of staff/worker having different religion, political affiliation, sect, colour, caste, creed, ethnic background.	Bonded labour will not be allowed or utilized for the project
23.	Land Acquisition Act, 1894 and Land Acquisition (Sindh Amendment) Act 2009	The primary law for acquisition of land for public purposes in Pakistan is the "Land Acquisition Act (LAA), 1894" (hereinafter referred as the Act). The land acquired under the Act vests in the province, and it is only thereafter that the province may transfer it to someone else. The Sindh Amendment 2009 of LAA 1894 specifically related to Section 16, Section 23, Section 24, and Section 28-A.	Neither land acquisition nor physical displacement is envisaged under this project however livelihood of waste pickers will be affected.	No land acquisition is required under the sub-project as land proposed for the cells is already owned by the Government.
24.	National Disaster Management Act, 2010	National Disaster Management Act, 2010 was passed by Parliament of Pakistan in 2010. The Act applies to whole Pakistan. The Act was passed in backdrop of 2010 Floods in Pakistan and strengthens Disaster Management system.	This Act is applicable as proper mitigation measure will be adopted by technical consultant during design stage to offset any chances of flooding during torrential rains.	Requires that the project design take into account the previous intake and data on any national disasters.
25.	Hazardous Substances Rules, 2014	The rule describes the procedure of handling, transportation and disposal of hazardous substances and hazardous waste. General safety precautions for handling hazardous substances as well as safety precautions for workers, and	This rule is applicable to the proposed Project due to involvement of hazardous waste handling, use and disposal during different	A separate approval must be obtained from the Sindh EPA if there is any permanent use of any of the hazardous

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
		notification requirements in the event of an accident are also described in these rules.	construction activities at the construction stage.	substances that are listed in the Rules.
26.	Building Code of Pakistan, 2007	The provision of Building Code of Pakistan shall apply for engineering design of building like structure and related components. The construction in violation of the building code shall be deemed as violation of professional engineering work. Moreover, a certificate for the proposed action will be obtained from Provincial Building Control Authority.	These codes shall be used in structural design of building area components constructed under this proposed Project.	Requires that the codes defined therein are used in the construction of any buildings constructed for the sub-project.
27.	The Sindh Minimum Wages Act, 2015	To provide the regulation of minimum rates of wages and various allowances for different categories of workers employed in certain industrial and commercial undertakings and establishments.	This Act will be applicable to the Project to ensure that the minimum wages and allowances should be given to the Project labor (skill and unskilled employed for the construction of the proposed Project.	Requires that the project ensure that workers are not paid below the defined minimum wage.
28.	The Criminal Law (Third Amendment, Act 2011)	The Criminal Law (Third Amendment) Act 2011 was passed by the Parliament in 2011 and assented by the President on 16th December 2011. The Act amended relevant sections in the Pakistan Penal Code and Code of Criminal Procedures. The Amendment criminalized a number of customary practices such as giving women or girls in marriage for settling a dispute), forced marriage, marriage with the Holy Quran and depriving women of inheriting property. All these offences are made non-compoundable and non-bailable under this Act.	This Act is applicable as the proposed project may involve the numbers of staff/worker having different religion, political affiliation, sect, colour, caste, creed, ethnic background.	Requires that workers of all different backgrounds, religions, cultures are treated the same without any discrimination.
29.	The Sindh Differently Able Persons (Employment,	The Act provides for the employment, rehabilitation, and welfare of differently able persons. The definition of "differently able" is any persons who on account of injury, disease, or congenital deformity, is challenged for	This Act is applicable as the proposed project will involve serious occupation health and safety issues during	Requires differently abled persons are not discriminated against during project implementation for jobs.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
	Rehabilitation and Welfare (Amendment) Act, 2017	undertaking any gainful profession or employment in order to earn his livelihood and includes a person who is blind, deaf, physically challenged or mentally challenged. In the Sindh Differently Able Persons (Employment, Rehabilitation and Welfare) Act, 2014 was amended and job quota was increased from two percent to five percent. The Act also waived admission fees at public educational institutions for people with disabilities as well as 75% of tuition fee, along with establishing reserved seats. Pakistan is a signatory of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD).	construction phase and may cause serious injury to worker/staff causing permanent disability and differently able.	
30.	The Sindh Commission on the Status of Women Act, 2015	The Act has enabled the government to constitute a Commission to be known as the Sindh Commission on the Status of Women, to exercise the powers to examine the policy, programs and other measures taken or to be taken by Government for gender equality, women's empowerment, political participation, representation, assess, implementation and make suitable recommendations to the concerned authorities. In addition, the Commission will be responsible to review all provincial laws, rules, and regulations prejudicial to the legitimate interest and rights of women and suggest accordingly.	This Act is applicable as the proposed project may involve the numbers of female staff/worker as well as local resident women along the project corridor which are directly or indirectly linked with project activities.	Requires that women are not discriminated against for jobs during project implementation.
31.	Gender Equality as part of Constitution of Pakistan 1973,	The Constitution of Pakistan contains a range of provisions regarding gender equality, in particular, provides the principle of equal rights and equal treatment to all citizens/ persons, without any distinction including on the basis of sex: • Article 3 calls upon the State to eliminate all forms of exploitation. • Article 4 provides for the right of individual to enjoy the protection of law and to be treated in accordance with the law. This applies to the citizens as well as "to every other	The articles of laws Constitution of Pakistan are relevant as it would deal with employment of male and female labor having different religion, political affiliation, sect, colour, caste, creed, ethnic background for the construction of proposed Project.	Requires that women are not discriminated against for jobs during project implementation.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
		person for the time being within Pakistan" without distinction. This article also clearly states that certain rights cannot be suspended. • Article 25 ensures equality before the law and equal protection of the law and states that there shall be no discrimination on the basis of sex alone. • Articles 25(3) and 26(2) allow the state to make special provisions for the protection of women and children. • Articles 26 & 27 provide for equal access to public places and equality of employment in the public and private sector. • Articles 11 & 37 (g) prohibit trafficking in human beings as well as prostitution. • Article 32 makes special provisions for the representation of women in local Government. • Article 34 directs the state to take appropriate measures to enable women to participate in all spheres of life and social activities. • Article 35 asks the state to protect the marriage, the family, the mother, and the child. • Article 37 (e) directs the state to make provisions for securing just and humane conditions of work ensuring that children and women are not employed in vocations unsuited to their age or sex, and for ensuring maternity benefits for women in employment. • Articles 51 & 106 provide for the reservation of seats for women in the legislatures.		
32.	Sindh Katchi Abadis (SKAA), Act 1987 & Sindh Katchi Abadis	Under the Sindh Katchi Abadi Act (SKAA) 1987, settlements can be declared as official Katchi Abadis and allows the right of urban squatters to rehabilitations.	This Act is applicable as the proposed project involves working in and near Katchi Abadis.	No regulatory requirements under project.

Table 4.2 - Main Environmental Strategies/ Policies Relevant to the Project				
Sr. No.	**Policy/Strategy**	**Brief Coverage**	**Relevance to Project**	**Regulatory Requirement from Project**
	(Amendment) Act 2009	The SKAA envisages the regularization and provision of infrastructure to all squatter settlements on government land which were established before 30 June 1997 (as per the 2009 Amendment). The SKAA was tasked to coordinate the process of awarding leases to the residents and to provide infrastructure and other basic services. It is a provincial wide agency that operates in other towns and cities as well as Karachi. The Act stipulates the transfer of government owned land to the urban squatters or allocates funds for cash assistance. The Act need to be updated and should include all *defacto* land titleholders and ownership of the existing settlements.		

4.3 Screening and Review Process – Sindh Environmental Protection Agency

The Review of Environmental Assessment Regulations, 2021 of Sindh Environmental Protection Agency (SEPA) provides the necessary details on the preparation, submission, and review of the EC, IEE, and the EIA reports. Categorization of projects for IEE and EIA is one of the main components of these regulations. Projects have been classified on the basis of expected degree of adverse environmental impact.

The proposed Project falls under the following categorization of the latest Sindh EPA Regulations:

Schedule III – Projects Requiring an Environmental Impact Assessment (EIA)
Category H – Waste Disposal & Treatment
Sub-Category (2) – Solid Waste Municipal Landfill Sites

This ESIA will also be submitted to SEPA to initiate the process of approval, prior to the commencement of any construction works.

The regulations stipulate that within ten (10) working days of the EIA study having been submitted, SEPA will confirm that the document submitted is complete for the purpose of review. During this time, should the agency require the proponent to submit additional information, it will return the EIA to the proponent for revision, clearly listing those aspects that need further discussion. Subsequently, SEPA would make every effort to complete an IEE review within thirty (30) days and an EIA review within sixty (60) days of filing.

The prescribed procedure for review of EIA by the SEPA is described in Review of EC, IEE, and EIA Regulations, 2021. Article 17(4) of SEPA Act 2014 binds the agency to communicate its approval or otherwise within a period of two months from the date that the initial environmental examination is filed, and within a period of four months from the date that the environmental impact assessment is filed complete in all respects in accordance with the regulations, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations.

Note: The report that will be developed for this assignment, will be ESIA depicting project baseline, its anticipated impact and mitigation measures. The same ESIA can be used for the Sindh EPA also in its scrutiny process given that the report will be prepared using stringent standards, which is acceptable to SEPA.

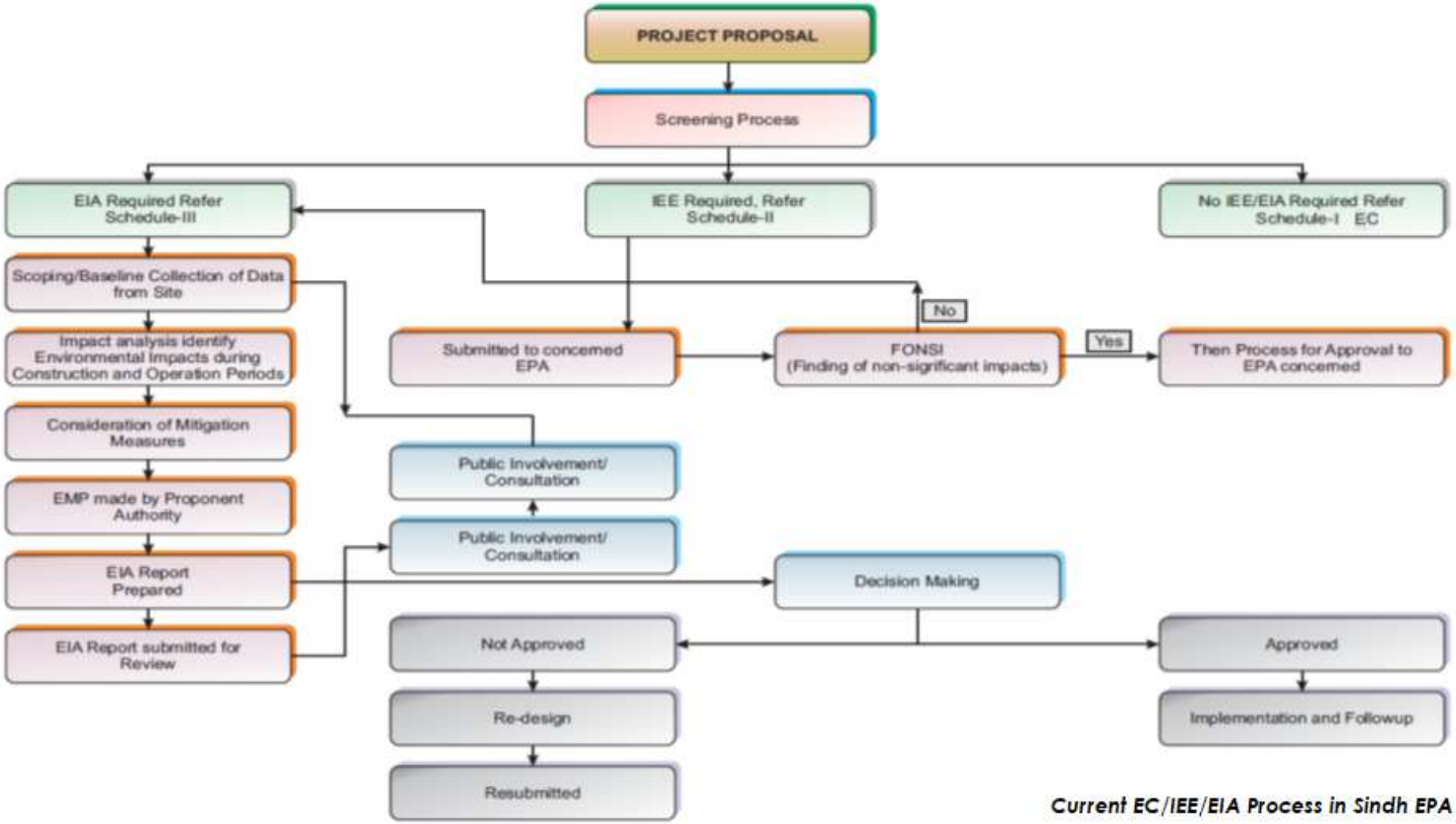


Figure 4.1 - EC, IEE, and EIA Procedures in Sindh - Pakistan

4.4 World Bank's Environment and Social Framework (ESF)

The section below discusses the application of the WB's Environment and Social Framework (ESF) with its ten Environmental and Social Standards (ESS1 To ESS10) and associated directives. Their requirements are tabulated below**.** Additionally, it also discusses the requirements relating to other guide notes from the World Bank.

Table 4.3 – Applicable World Bank ESF Objectives and Requirements

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
World Bank Environment and Social Policy for Investment Project Financing	It sets out the mandatory requirements of the Bank in relation to the projects it supports through Investment Project Financing.	The types of E&S risk and impacts that should be considered in the environmental and social assessment. The use and strengthening of the Borrower's environmental and social framework for the assessment, development and implementation of World Bank financed projects where appropriate.
ESS1 Assessment and Management of Environmental and Social Risks and Impacts	Identify, assess, evaluate, and manage environmental and social risks and impacts in a manner consistent with the ESF. Adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable groups, and they are not disadvantaged in sharing development benefits and opportunities	• Under ESS1, Environmental and Social instruments are to be prepared for the assignment, in accordance with national regulations and ESF as well as international best practices including WBG EHS Guidelines and EHS Guidelines for Waste Management Facilities. An ESMF has been prepared and disclosed by the Bank, covering the Environmental and Social screenings and considerations for all sub-projects. Once the locations of the sub-projects are finalized, site specific ESIAs/ESMPs will be prepared. • The ESIA will be disclosed both at the SWEEP's and the Bank's websites. • PIU-SWEEP shall implement an Environmental and Social Commitment Plan (ESCP) and comply with its conditions during project implementation. • Monitoring and reporting on E&S performance will be carried out during implementation.
ESS2 Labor and Working Conditions	Promote safety and health at work. Promote the fair treatment, non-discrimination, and equal opportunity of project workers. Protect project workers, with particular emphasis on vulnerable workers. Prevent the use of all forms of forced labor and child labor. Support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns.	As per the requirements of ESS2, a stand-alone Labor Management Procedures (LMP) has been prepared for the project. The LMP includes: 1. An assessment of potential labor related risks, 2. An overview of labor regulations, policies, and procedures, 3. Contract terms and conditions, 4. Working Age Regulations 5. A Mechanism for redressal of labor related grievances

Table 4.3 – Applicable World Bank ESF Objectives and Requirements

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
		A separate GBV/SEA and VAC Action Plan has been prepared under ESS1 and also informs the labour related risk mitigation measures. A GRM for labour related issues has also been outlined in the LMP. The livelihood of waste pickers living at Haji Ibrahim Goth next to dump site will be affected once. To offset such impacts a comprehensive livelihood restoration plan has been prepared after conducting need assessment survey by E&S Consultant to restore and protect livelihood of affected waste pickers
ESS-3 Resource Efficiency and Pollution Prevention and Management	Promote the sustainable use of resources, including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Requires technically and financially feasible measures to improve efficient consumption of energy, water, and raw materials.	ESIA is being prepared under this project in which necessary pollution prevention and management measures along with waste management procedures is proposed. The procedure is prepared in accordance with national regulations, international standards and best practices including WBG EHS Guidelines for Waste Management Facilities. These may include, but not necessarily be limited to, legacy environmental issues for progressive closure and rehabilitation of areas that have reached capacity at Jam Chakro. Furthermore, project alternatives will be analysed.
ESS4 Community Health and Safety	Anticipate or avoid adverse impacts on the health and safety of project-affected communities during project life cycle from routine and non-routine circumstances. Promote quality, safety, and climate change considerations in infrastructure design and construction. Avoid or minimize community exposure to project-related traffic and road safety risks, diseases, and hazardous materials. Have in place effective measures to address emergency events. Ensure that safeguarding of personnel and property is carried out in a manner that avoids or minimizes risks to the project-affected communities.	Under ESS4, the potential health and safety risks and impacts associated with the Project are to be assessed, including the necessary mitigation measures in the ESIA to be prepared for the project. Items such as traffic management plans, community health and safety measures, emergency response preparedness plans, to mitigate all health and safety risks and impacts of the project during construction and operations of the project. Furthermore, risks and impacts from exposure to waste and other pollutants, traffic accidents, risk of fire and explosion, flooding and other climate change risks will be considered.

Table 4.3 – Applicable World Bank ESF Objectives and Requirements		
World Bank ESS Policy, Standards, Directive	**Objectives**	**Requirements**
ESS5 Land Acquisition Restrictions on Land Use and Involuntary Resettlement	Avoid or minimize involuntary resettlement by exploring project design alternatives. Avoid forced eviction. Mitigate unavoidable adverse impacts from land acquisition or restrictions on land use by providing compensation at replacement cost and assisting displaced persons in their efforts to improve or restore livelihoods and living standards to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. Improve living conditions of poor or vulnerable persons who are physically displaced, through provision of adequate housing, access to services and facilities, and security of tenure. Conceive and execute resettlement activities as sustainable development programs.	Neither land acquisition nor physical displacement is envisaged under this sub-project.
ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	Protect and conserve biodiversity and habitats. Apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources.	The Project is not planned to have any activities within natural habitats, wildlife reserves, protected areas, or critical natural habitats and its buffer zones, however there are spots where project activities will have impacts on ecology. The potential biodiversity impacts identified in the lifecycle of the project shall be subject to the mitigation hierarchy of the World Bank and documented in the ESIA prepared.
ESS10 Stakeholder Engagement and Information Disclosure	Establish a systematic approach to stakeholder engagement that helps Borrowers identify stakeholders and maintain a constructive relationship with them. Assess stakeholder interest and support for the project and enable stakeholders' views to be taken into account in project design. Promote and provide means for effective and inclusive engagement with project-affected parties throughout the project life cycle. Ensure that appropriate project information is disclosed to stakeholders in a timely, understandable, accessible, and appropriate manner.	Under ESS10, a detailed Stakeholder Engagement Plan (SEP) has been prepared which identifies the key stakeholders and ensures that all stakeholders are engaged throughout the project. The document outlines the mechanisms for information sharing and disclosure and for consultation, including with women and vulnerable/ marginalized groups such as waste pickers, the poor, minorities, etc. This SEP will be a living document and shall be updated periodically during project implementation.

The World Bank undertakes environmental screening of each proposed project to define the extent and type of required environmental assessment. Projects are classified by four risk categories based on their type, location, sensitivities, and scale:

- **High**: A Project is classified as **High Risk** if the project is likely to generate a wide range of significant adverse risks and impacts (preservation areas, cultural heritage sites, traditional communal lands etc.) and are on human populations or the environment and impact is long term, permanent and/or irreversible, high in magnitude, significant adverse cumulative impacts and a high probability of serious adverse effects to human health and/or the environment.
- **Substantial**: A Project is classified as **Substantial Risk** if the Project may not be as complex as High-Risk Projects, its ES scale and impact is large to medium (temporary, predictable and/or reversible and are medium in magnitude), medium to low probability of serious adverse effects to human health and/or the environment and there are known and reliable mechanisms available to prevent or minimize such incidents.
- **Moderate**: A project is classified as **Moderate Risk** if risks and impacts on human populations and/or the environment are not likely to be significant, located away from environmentally or socially sensitive areas, impact is predictable and reversible, duration is short term and low in magnitude; low probability of serious adverse effects to human health and/or the environment and can mitigate easily.
- **Low**: A project is classified as **Low Risk** if its potential adverse risks to and impacts on human populations and/or the environment are likely to be minimal or negligible. These projects, with few or no adverse risks and impacts and issues, do not require further E&S assessment following the initial screening.

The initial risk rating for the project, as per the Project's Appraisal – Environmental and Social Review Summary, is High, with both the Environmental and Social Risk Ratings also being classified as High due to the nature of project activities involved.

4.5 World Bank Guidelines

The principal World Bank publications that contain environmental and social guidelines are listed below:

- World Bank Group General Environment, Health, and Safety (EHS) Guidelines.
- World Bank Group EHS Guidelines for Waste Management Facilities
- Social Analysis Sourcebook.

In addition to EHS guidelines, IFC/World Bank sector specific EHS guidelines will also be used. IFC/ World Bank EHS Guidelines of Infrastructure Sector will be applicable for the proposed project.

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These General EHS Guidelines will be used together with the relevant Industry Sector EHS Guidelines (Infrastructure Sector) which provide guidance to users on EHS issues. General EHS guidelines will be applicable all the project activities along with industry specific (Infrastructure Sector – Waste Management Facilities guidelines).

A comparison of the local environmental regulations, along with the WB EHS Guidelines is also attached to this report as **Annex-IV**.

5. Description of Environment

5.1 General

This section provides baseline data (physical, biological, and socio-economic parameters) related to the sub-project area. Information provided is both quantitative and qualitative, based on primary and secondary data sources, collected during site visits and desk studies.

The baseline information with relevant stakeholder consultation is required for scoping of potential environmental issues associated with the implementation of the project. On the basis of baseline information, the project interventions are assessed, and mitigation measures are proposed. The baseline information also helps to indicate the specific issues to be monitored during project execution. A map of proposed sanitary landfill cell at Jam Chakro site is shown below:

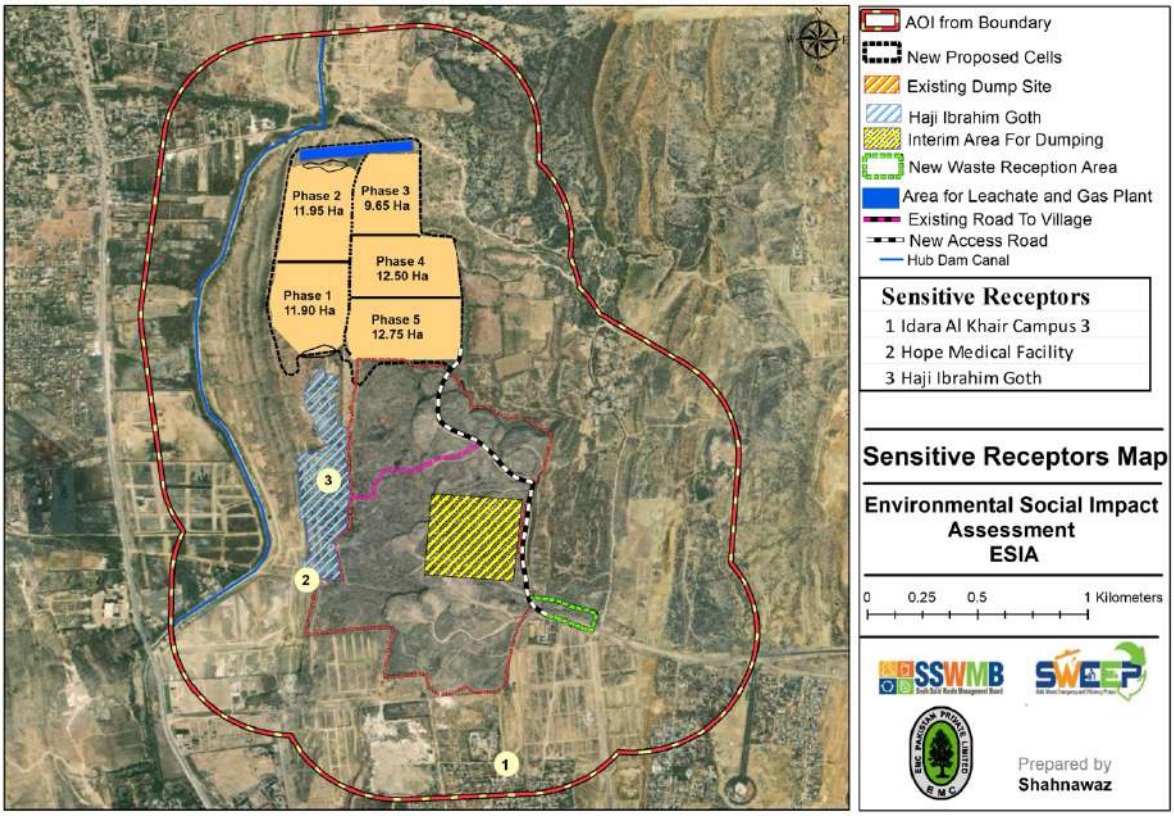


Figure 5.1 - Location of Proposed New Sanitary Landfill Cell

The existing environmental conditions of the proposed project interventions have been considered within the boundaries of AOI with respect to physical and ecological environments whereas for socio-economic aspects, surveys have been performed in the communities located in proximity to the project sites.

5.2 Reconnaissance & Field Visits

The E&S team conducted the reconnaissance visits of the landfill site during June 2022. The major objective of the visits was to familiarize with the environment in general and to define the boundaries within which the perceived impacts from each site would take place in – establish the

Area of Influence (AOI). Furthermore, stakeholder consultations and acquisition of secondary data/ information was also carried out for identification of impacts at the scoping stage.
For the primary data acquisition, the E&S team conducted detailed field visits throughout 2022, where the main objective of these visits was to obtain detailed data on the existing physical, ecological, and social aspects, along with identification of significant environmental and social impacts of the proposed sub-project. The secondary data was collected from published sources/ reports and relevant departments which was also verified through visual observations and primary data where possible. The land use map of the site is already provided in Chapter 1, where a brief description of the conditions of the site described below:

The Southern part of the Jam Chakro landfill site has been, and continues to be used, as an open dump for the disposal of municipal solid waste (MSW). The site receives waste from the GTS at Imtiaz, Sharafi Goth, and Dinga Morr and also by direct delivery from Districts Central, East, Korangi, Malir, and West, and very rarely from the South district. Two-thirds of the waste delivered to Jam Chakro in 2022 was from the Central & East districts[26].

The new sanitary landfill is to be constructed adjacent to the existing dump site at Jam Chakro in accordance with modern international standards for construction and operation. For the most part, the site comprises of unutilized (vacant) land immediately to the north of the existing open dump site at Jam Chakro. The total extent of the area allocated for the new landfill site is 184 acres of unutilized land. Access to the site will be provided through the parcel of land (65 acres) demarcated in purple to the east of the existing dump site.

The site is surrounded by hills and peaks that naturally keep the waste in, through which roads have been carved out for the transport of vehicles. The land for the Jam Chakro landfill site, including the proposed cell, is owned by the Government of Sindh, where immediately adjacent to the site on the West is an informal settlement – Haji Ibrahim Goth. Located further West of Haji Ibrahim Goth is the Hub Dam Canal, that supplies water from the Hub dam to the city of Karachi.

5.3 Area of Influence (AOI)

The Area of Influence of the site contains the Landfill site itself, and a radius of 500 m from the boundaries of the surrounding residential and commercial developments. This is where it is perceived that direct positive and adverse impacts from the sub-project will be most prominent. The AOI is depicted in **Figure 5.1.**

5.4 Mapping of Sensitive Receptors at the Site

A number of sensitive receptors have been identified within the vicinity of the AOI, including educational institutes, religious sites, and healthcare facilities, where these receptors have been identified in line with best practices and international standards. The mapping of these receptors allows for the subsequent identification of mitigation and remedial measures to ensure that project impacts, on these receptors in particular are minimized to the extent possible in terms of likelihood and severity. These are pictorially depicted in Figure 5.1.

Table 5.1 - Types of Receptors in AOI

S. No.	Settlement/ Receptor	Nature of Receptor	Sensitivity of Receptor	Proximity to Boundary of Old Dump Site	Proximity to Boundary of New Cells
1	Haji Ibrahim Goth	Informal Settlement residing next to the landfill site.	Sensitive	Approximately 900 m of the settlement is immediately adjacent to the old dump site	Approximately 130 m of the Northern most portions of the settlement is roughly

[26] Source: Weighbridge records received from PIU SWEEP

					50 m away from the outermost part of the new proposed cells, i.e., the outer embankment of the ring road.
2	Hope Medical Facility	A makeshift medical center to cater to the people of Haji Ibrahim Goth	Sensitive	Immediately adjacent to existing dumpsite	Approximately 1,030 m from the proposed cells.
3	Idara Al Khair Campus 3	A school for the children of Haji Ibrahim Goth	Sensitive	Immediately on the border of the old dumpsite	Approximately 1,300 m from the proposed cells

The receptors have been singled out as they are areas where impacts from the project's activities (directly or indirectly) may be felt more disproportionately. This could be possible as people congregate here and may be exposed to the project's impacts collectively e.g., landfill gas, leachate contamination, etc.

5.5 Physical Resources

The following sections define outcomes of the physical investigations and surveys conducted at and around the area for the proposed cells.

5.5.1 Topography

In order to understand the topography of proposed landfill cell, the Design Consultant undertook topography survey of following areas:

- Area allocated for the sanitary landfill.
- Area of the existing dump site where it lies adjacent to the area of the sanitary landfill; and
- Area through which the potential road access to the sanitary landfill may be routed.

The topographic survey, together with satellite imagery, has been used to develop a Digital Elevation Model (DEM) for the proposed landfill site and surrounding area. The DEM is reproduced in **Figure 5.2.**

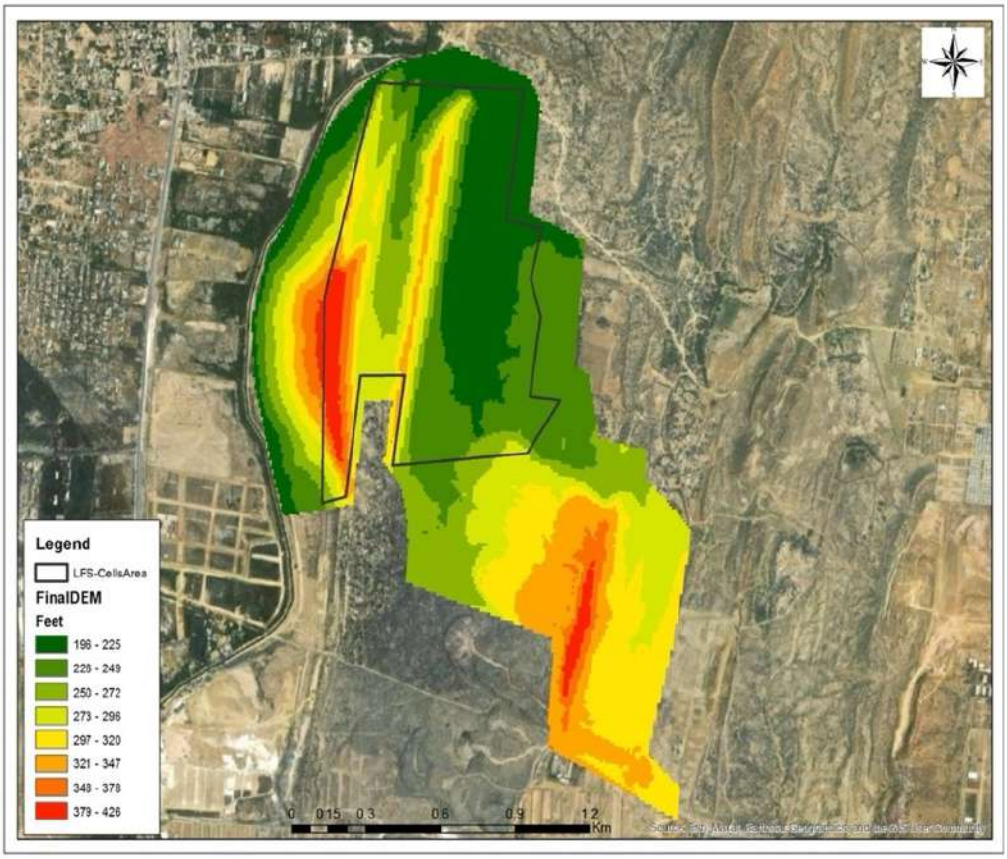


Figure 5.2 – Digital Elevation Model of the Jam Chakro Landfill Site

The western valley slopes from south to north at a gradient of approximately 1V:50H (2%). The valley floor slopes from an elevation of 275 feet at the southern end to an elevation of approximately 220 feet at the northern end over a distance of 2,750 feet. The valley floor is widest in the south and narrows progressively in a northerly direction, decreasing from 800 feet to approximately 200 feet in width.

The western valley is bounded by side slopes that range typically from 1V:3H (33%) to 1V:5H (20%) and which reach a maximum height of 426 feet along the south-western margin of the valley, approximately 150 feet above the valley floor. The western ridge declines in elevation northwards to an elevation of approximately 300 feet. On the east side of the valley the ridgeline is lower at an elevation of approximately 330-340 feet. The top of the ridgeline is more or less at a uniform height. This ridgeline forms the western margin of the eastern part of the site. The ground surface decreases at a slope of approximately 1V:3H (33%) to the east to a low-lying, slightly entrenched, shallow valley at the foot of the slope Thereafter the ground rises slightly. Overall, the ground slopes from south to north and from the east margin of the site to the valley at the foot of the slope. Ground elevation varies from about 235 feet along the eastern and southern margins of the site and declines to the north to a minimum elevation of 195 feet near the north-east corner of the site. The overall gradient from south to north is less than 1V:200H (0.5%).

In the area of the existing open dump, the ground rises to an elevation in excess of 310 feet, with high slopes in waste, greater than 60 feet high, as steep as 1V:2H (50%).

The topography of the site dictated numerous aspects that have gone into the design considerations to reduce overall E&S impact:

a) The topography of the area and the build-up dictates the flood risk of the site and the settlements around it (further described in the impacts section)
b) The overall site topography has been used to finalize the type of landfill to be developed, i.e., in the Western valley, using the natural ridge on the East & West, a semi aerobic bio-reactor landfill has been proposed where minimal excavation shall be used, and the natural slope of the area will be used to drain out the leachate. Similarly, on the eastern valley, using the topography of the area and using minimal excavation, a conventional landfill shall be developed. This is in line with World Bank's ESS 3 – Resource Efficiency & Pollution Prevention, and ESS 4 – Community Health & Safety.

5.5.2 Geology & Geo-technical Condition

Geologically, the landfill site falls under Miocene and Oligocene rock. Miocene rock is comprised of Gaj formation mainly marine shales and limestone, fossiliferous, topmost sandstone, and shales estuarine with abundant molluscan and few vertebrate fauna, early Miocene. Whereas Oligocene rock is comprised of Nari formation having fossiliferous limestone and shales in lower part and variegated shales in the upper part. The site-specific geological map is shown in **Figure: 5.3.**

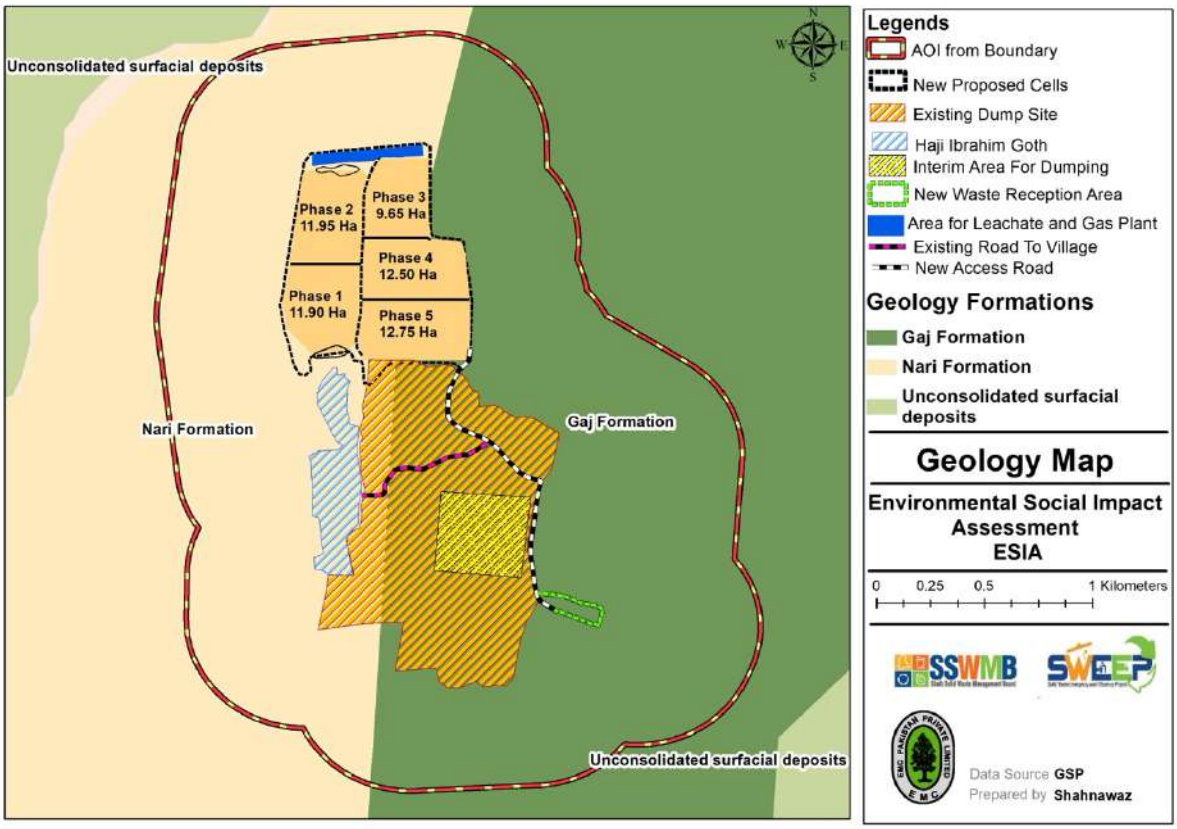


Figure 5.3 - Geological Map of the Jam Chakro Landfill Site

The geotechnical survey conducted by Design Consultant comprised of drilling of boreholes to a depth of 20 m and the excavation of trial pits to a nominal depth of 1.5 m. Bedrock was encountered at shallow depth across the whole of the site area, except in the southern part of the site in the area overlain by deposited waste in the open dump.

Three principal bedrock strata were proven during drilling:

- Yellowish brown to off-white, weak, slightly to highly weathered, moderately fractured, thickly bedded, arenaceous LIMESTONE, with occasional thin interbeds of sandstone, shale, and claystone.
- Brownish grey to yellowish brown, extremely weak to weak, slightly to highly weathered, fractured, thickly to very thickly bedded, SANDSTONE and FRIABLE SANDSTONE.
- Brown to brownish grey, extremely weak, highly weathered, and fractured, thickly bedded SHALE, and CLAYSTONE.

Extremely weak shale was intersected as thin interbeds, five (5) to ten (10) feet thick, in five (5) boreholes in the eastern and south-eastern part of the site and for the full depth drilled in three (3) boreholes along the alignment of the proposed access road east/south-east of the site of the sanitary landfill. Moisture content and unit weights are similar to those reported for the friable sandstone and sandstone.

Very weak claystone was recorded in one borehole (BH 33) in the southern central part of the site, again with moisture content and unit weights similar to those reported for the friable sandstone, sandstone, and shale.

The strata determined through investigation determines the different types of controls that must be introduced at the design stage to curb E&S impacts as:

a) Limestone and sandstone being porous rocks in the area may have allowed for percolation of leachate from the old dumpsite to the groundwater present below, contaminating it. However, during investigations, it was discovered that there is no sign of accumulation of leachate in the strata, where leachate was found to instead flow out of the site Northwards following the natural gradient.
b) Limestone and sandstone being porous rocks in the area require for proper engineering controls to be established in the form of a composite lining system that will prevent leachate generated at the landfill cells from percolating into the ground and contaminating the groundwater. This has been taken into account in line with ESS 4 – Community Health & Safety.
c) The geological strata found also dictates the stability of the area in the case of any seismic events, where the results obtained dictate that the site won materials have high frictional strength with an adequate factor of safety to be constructed at slopes of 1V:3H under both operational and seismic loads. This also fulfils requirements of any engineering controls to be required in line with ESS 4 – Community Health & Safety.

5.5.3 Soil

The soil of Karachi city is classified into two types, the loamy sandy and gravelly soils of river valleys and alluvial cones near the coastline and shallow loamy gravelly soils and rock outcrops plateau. It lies in the semi-arid zone; however, the project is consisting of lithosols soil lacking well-defined horizons, especially an entisol consisting of partially weathered rock fragments, usually found on steep slopes as highlighted in **Figure 5.4.** This will be taken into account when designing the different civil features of the site including the road, buildings, treatment plants, etc.

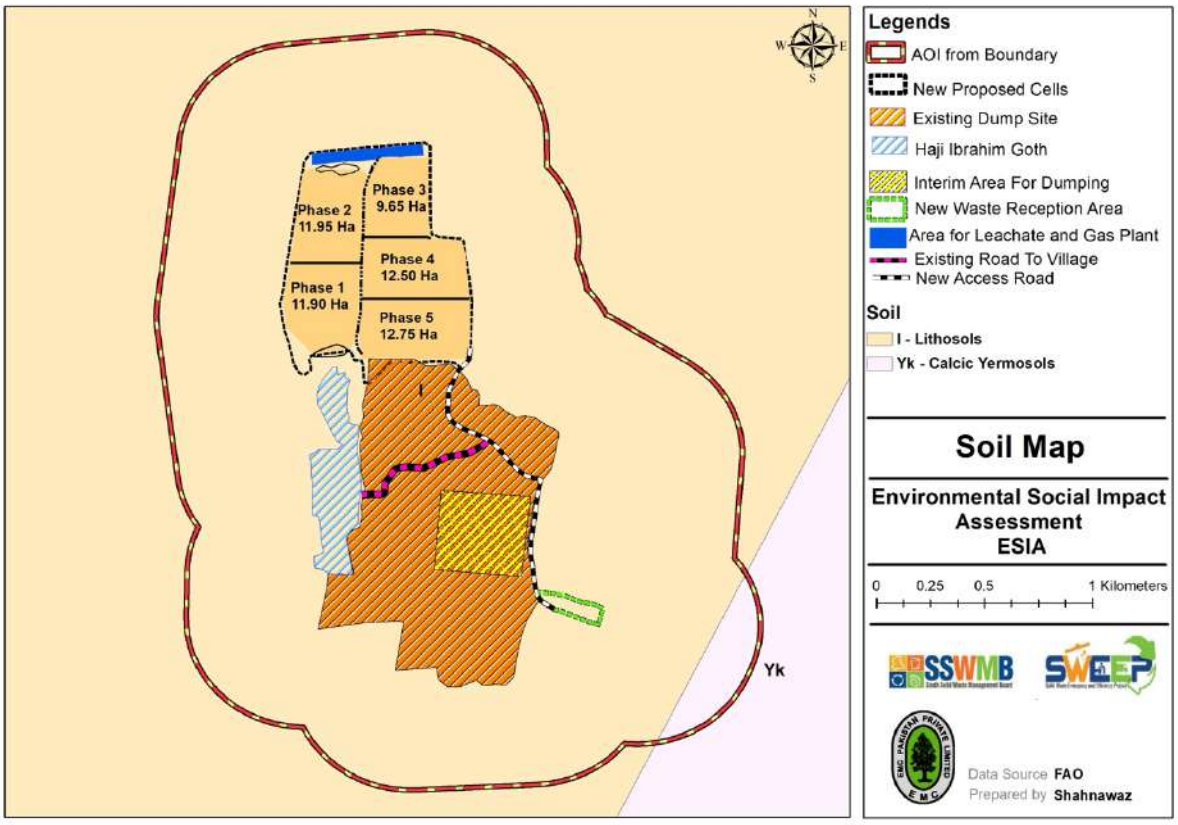


Figure 5.4 - Soil Map of Jam Chakro Landfill Site

5.5.4 Hydrogeological Conditions

Groundwater was not encountered in any of the 'shallow' boreholes constructed during the geotechnical survey. Groundwater, however, was struck in five (5) boreholes that were converted to water monitoring wells. Struck groundwater levels are summarized on **Table 5.2**.

Table 5.2 - Struck Groundwater Levels in Water Wells at the Sub-Project Site

Converted Borehole No.	Ground level (feet)	Depth to groundwater below ground level (feet)	Reduced Elevation of groundwater (feet)
1	223.58	149.93	73.65
6	219.82	125.34	94.48
11	276.71	165.02	111.69
24	274.54	155.18	119.36
31	226.25	155.18	71.07

Groundwater levels are highest in the west and decline to the east and north.

In situ permeability tests were conducted in both the limestone and sandstone bedrock, typically at three (3) depths in eight (8) locations. The results obtained are summarized on **Table 5.3**.

Table 5.3 - In Situ Permeability Results

Rock Type	Minimum Recorded Hydraulic Conductivity (cm/sec)	Maximum Recorded Hydraulic Conductivity (cm/sec)
Limestone	3.99E-05	2.74E-04
Sandstone	4.37E-05	6.87E-04

Results for both rock types are similar; for both rock types of hydraulic conductivity values decrease slightly with increasing depth. The hydraulic conductivity is relatively high and likely to be governed by the presence of extensive fractures and fissures as recorded in the borehole logs.

The hydraulic conductivity of the strata obtained dictates the potential rate of percolation for leachates and any other contaminants that may be used at the landfill site. In the case of any spills or potential contaminations, and having known the time of the contamination, potential remedial measures can be undertaken to avoid or minimize the potential of groundwater contamination given that groundwater aquifers are considerably below the ground level.

5.5.5 Seismicity

Pakistan falls into three seismic zones. Zone-III is the most severe and Zone-I is the least. Karachi is located in a moderate earthquake zone. The Karachi Building Control Authority has placed Karachi in Zone-II. Based on the actual events, past observations of fault movement and other geological activities, Karachi is situated in a region where moderate earthquakes may occur of magnitude 5.0 to 6.0 equivalent to intensity between VII and VIII on Modified Mercallis Scale (M). In addition to that Seismic provision of-2007 of Building Code of Pakistan (2007) also identified Karachi in Zone 2 B.

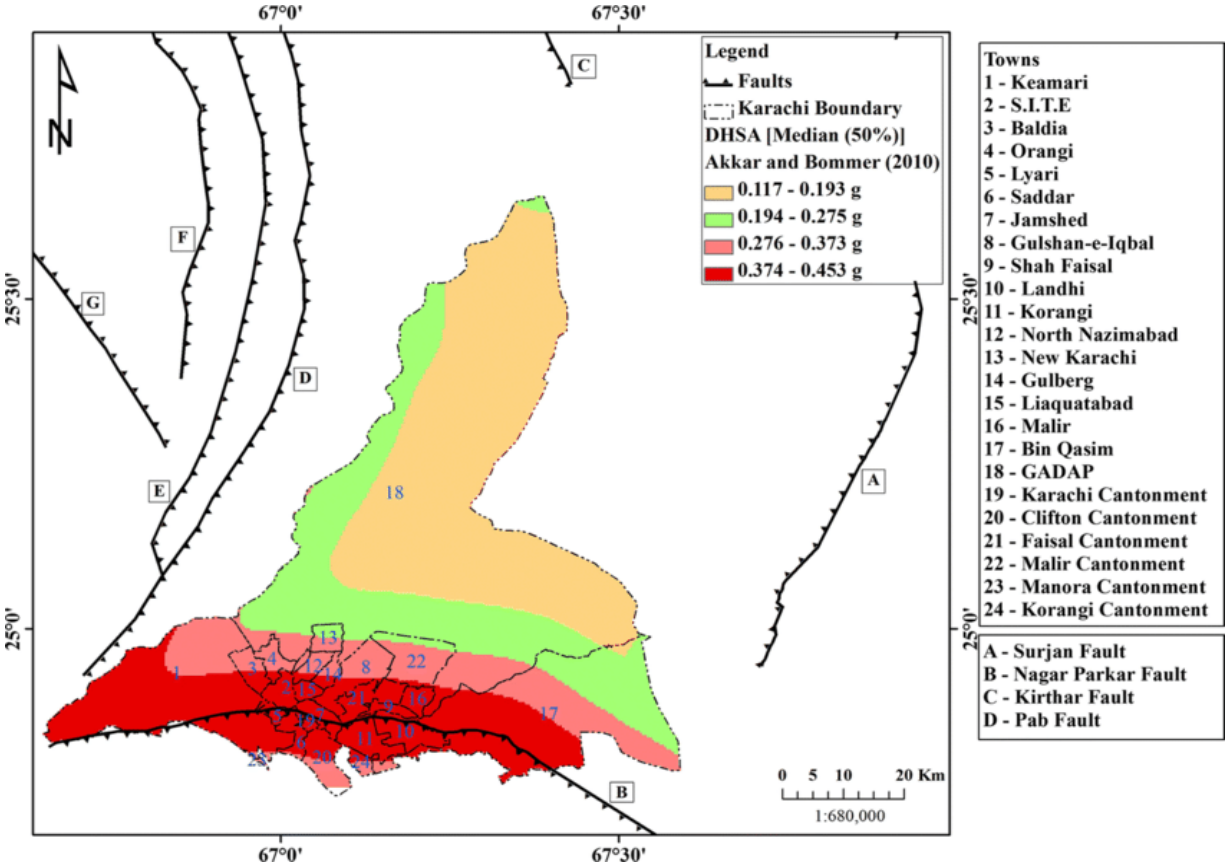


Figure 5.5 - Ground Motion Map of Karachi
(Source: Muhammad Waseem et.al. (2019). Seismic sources for southern Pakistan and seismic hazard assessment of Karachi)

On the basis of earthquakes experienced from 1970 to 2005, four fault lines have been identified in Karachi and it includes, Surjani fault, Nagar parkar fault, Kirthar fault and Pab fault. Further, Karachi is assessed to be prone to ground motions ~ 0.25 g with metropolitan areas having hazard values between 0.21 and 0.25 g for 10% probability of exceedance in 50 years (475-year return period). The deterministic seismic hazard analysis suggests maximum that peak ground acceleration (PGA) varies from 0.19 to 0.99 g in Karachi and its higher values are concentrated around the Nagar Parker fault that is controlling and hazardous for Karachi. (Fig: 5.5). The Fault line is located at the north end of the site, however, no known activity on this fault in historical times.

The geological strata found also dictates the stability of the area in the case of any seismic events, where the results obtained dictate that the site won materials have high frictional strength with an adequate factor of safety to be constructed at slopes of 1V:3H under both operational and seismic loads. This also fulfils requirements of any engineering controls to be required in line with ESS 4 – Community Health & Safety.

5.5.6 Flooding- Climate vulnerability

Although the climate of Karachi is arid and rainfall is low and highly variable, whenever torrential rain comes, and heavy rainfall occurs within a short duration surface runoff intensifies. Specially the monsoon season which cause urban flooding in city causing drainage systems to overwhelm and water flows into streets and homes. At the present time, Karachi is experiencing extreme weather that in effect brings extreme rainfall, even on August 27, 2020, Karachi had record-breaking rainfall in a single day.

The reason of flash flooding is due to lower rate of water percolation into soil in comparison to amount of rainwater falling on the surface and there are various factors that plays a part in the urban flash flooding including vanishing open spaces for public and making Karachi into a concrete jungle, which prevents water from percolating into the surface of the ground. Apart from this, the poor drainage system and encroachment of drainages are also major causes of floods in Karachi thus preventing water to discharge into sea and causing flooding.

The Hydrology of landfill site is shown in **Fig: 5.6.**

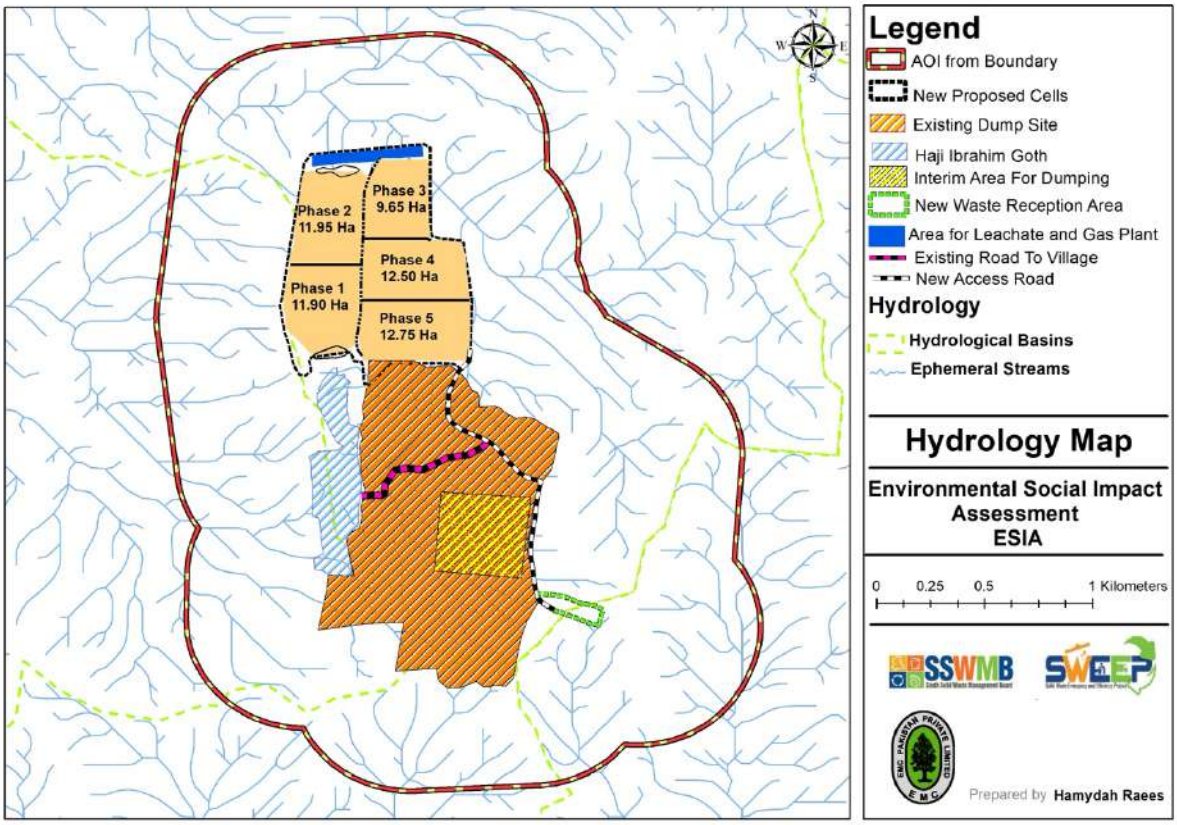


Figure 5.6 - Hydrology of Jam Chakro Landfill Site

Flooding will have an impact on the amount of leachate generated at the sites, and any potential percolation of leachate into the ground from non-landfill cell areas. A basic flood risk assessment was conducted using the DEM and hydrological map of the landfill site that was developed, where the results are depicted below:

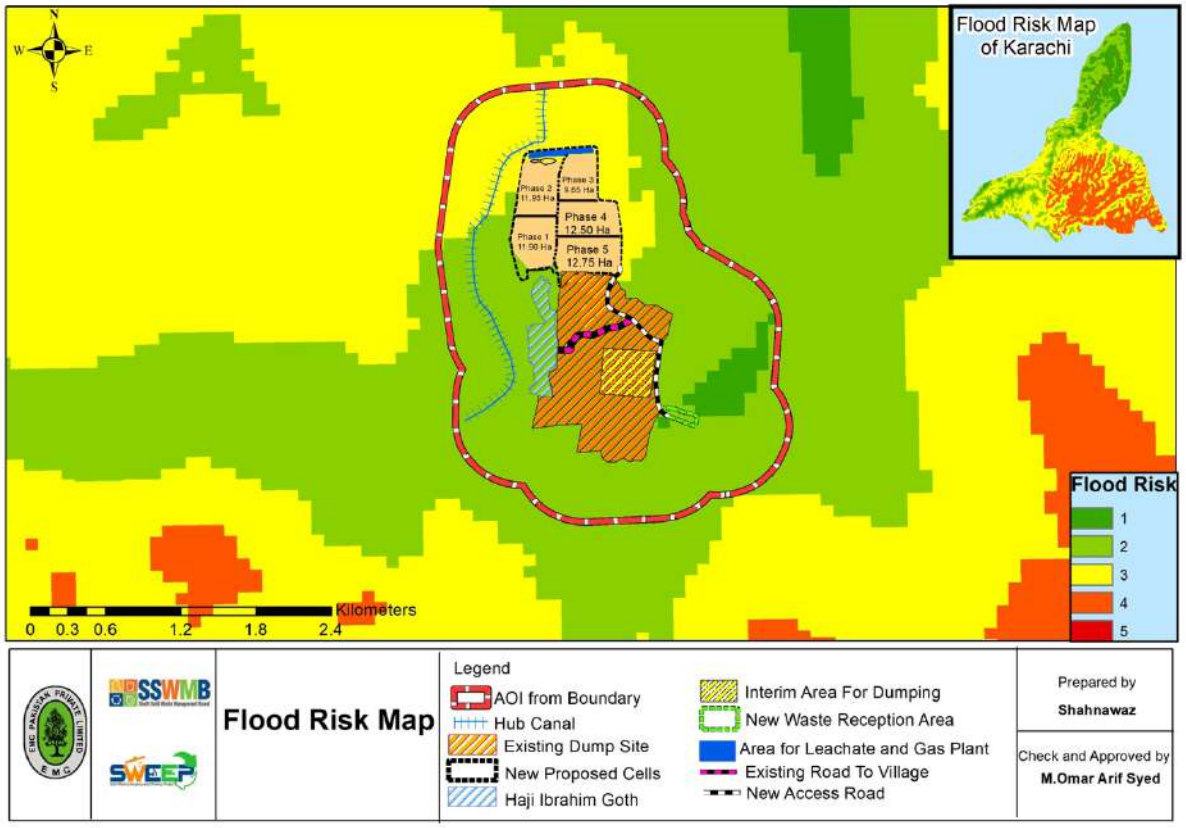


Figure 5.7 - Flood Risk Map of Jam Chakro

As such, the assessment denoted that the flood risk of the site is low. This can be corroborated as thus far during rainfall events from 2019-2023 there was no flooding witnessed at the site.

5.5.7 Climate

Karachi is located just above the tropical zone on the coast of the Arabian Sea at 24º45" to 25º15" north, and 66º37" to 67º37" east at about 20 m above sea level (airport weather station). Karachi is bounded by Hub-River (Balochistan Province) on West, Badin District on East, Dadu District on North and Arabian Sea on South. The climate of the Karachi can be characterized by dry, hot, and humid conditions and in general terms it is moderate, sunny, and humid. There is a minor seasonal intervention of a mild winter from mid-December to mid-February followed by a long hot and humid summer extending from April to September, with monsoon rains from July to mid- September. The level of precipitation is low for most of the year. Karachi also receives the monsoon rains from July to September. The humidity levels usually remain high from March to November, while very low in winter as the wind direction in winter is North Easterly.

The climatic conditions of the area determine various factors in the development and operation of the landfill that would contribute towards its E&S impacts, such as:

- The amount of leachate generated will be impacted by the rainfall events and intensities, where its evaporation from the site would be determined by the temperature and the wind speed. Given the high humidity in the city, low rainfall, and mid to high temperatures, leachate recirculation has been sought out as an option to expedite the process of decomposition, and to also naturally allow for the leachate to evaporate rather than having to treat it.
- The wind direction and speed would determine the direction and dispersion of any landfill gases that are allowed to escape into the atmosphere. Given that most of the year wind blows

from Southwest to Northeast, any landfill gas released into the atmosphere would be dispersed in that direction, mostly away from the immediately situated Haji Ibrahim goth.

5.6 Environmental Monitoring

To ascertain the environmental baseline in AOI of project area, SEPA approved environmental lab conducted environmental monitoring of ambient air, noise, drinking water, leachate water, soil analysis and wastewater. Monitoring locations are marked in **Figure 5.8** and its results are discussed in the succeeding sections. The detailed monitoring reports are also attached as **Annex-V.**

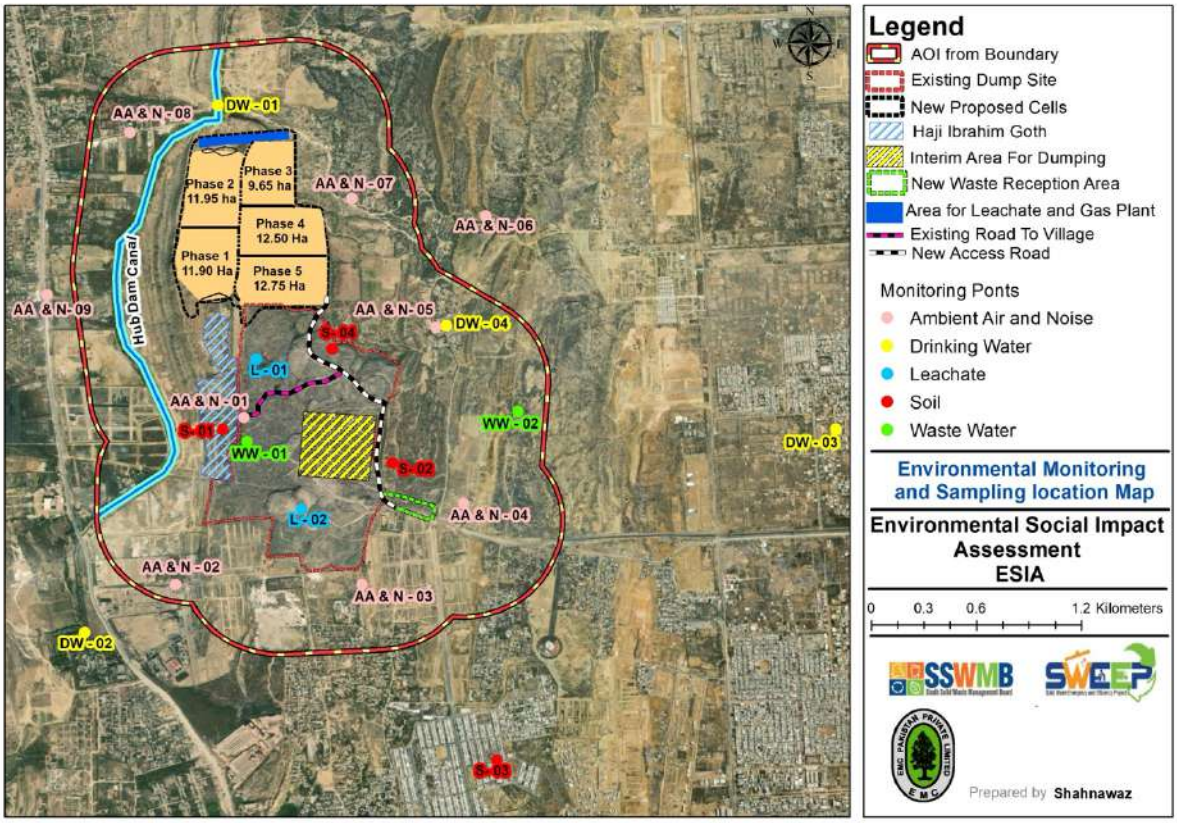


Figure 5.8 - Environmental Monitoring Points for Jam Chakro Landfill Site

5.6.1 Ambient Air Quality

For assessing the ambient air quality within the AOI, ambient air monitoring (24-hr averaging period) was conducted in 09 locations based on receptors around the landfill site, so as to have a baseline against which further impacts can be assessed during the construction and operational phases. The monitoring location names, and coordinates are as follows:

Table 5.4 - Ambient Air Quality Points at the Landfill Site

S. No.	Area	Point No.	Co-ordinates
1	Haji Ibrahim Goth	(AQ /N1)	25° 1'51.37"N 67° 1'42.23"E
2	Hassan Brohi Goth	(AQ /N2)	25° 2'8.03"N 67° 2'17.69"E
3	Ameer Baksh Goth	(AQ /N3)	25° 1'20.47"N 67° 2'4.05"E
4	North Town Residency	(AQ /N4)	25° 1'20.47"N 67° 1'29.64"E

5	Gul Muhammad Qalandari Goth	(AQ /N5)	25° 2'44.04"N 67° 1'21.28"E
6	Mango Pir	(AQ /N6)	25.04129 N 67.04082 E
7	Gadap Town	(AQ /N7)	25.042183 N 67.033960 E
8	Ali Town Society	(AQ /N8)	25.037236 N 67.018310 E
9	Near KMC Office Mango Pir	(AQ /N9)	25.026514 N 67.039699 E

The result of the ambient air monitoring is provided in below table:

Table 5.5 - Air Quality Monitoring Results of Landfill Site

Parameter	Applicable Stringent Standards*	Average Values for (AQ/ N1)	Average Values for (AQ/ N2)	Average Values for (AQ/ N3)	Average Values for (AQ/ N4)	Average Values for (AQ/ N5)	Average Values for (AQ/ N6)	Average Values for (AQ/ N7)	Average Values for (AQ/ N8)	Average Values for (AQ/ N9)
CO	5 µg/m^3	8.54	2.39	2.890	7.31	7.480	3.290	7.82	3.49	2.22
NO	40µg/m^3	31.86	11.51	8.110	26.94	26.940	31.560	26.82	31.82	11.59
NO_2	80 ug/m^3	86.77	76.38	80.940	92.16	92.160	90.510	92.36	95.53	78.94
O_3	100µg/m^3	21.38	18.4	23.050	17.31	17.310	18.140	16.79	18.87	3.11
SO_2	20µg/m^3	3.42	0.76	3.010	3.64	3.640	4.640	3.59	4.64	11.90
Lead	1.5µg/m^3	0.147	0.123	0.251	NM	0.361	0.456	0.133	0.129	0.172
VOC		7	6	8	NM	9	7	6	5	7
PM $_{2.5}$	75µg/m3	69	28.37	51.11	114.9	121.81	51.92	138.72	52.96	66.6
PM $_{10}$	150µg/m^3	171	79.1	261.43	199.58	192.72	280.51	201.34	286.17	138.56
SPM	500µg/m^3	468.27	381.34	465.24	489.1	472.30	458.42	473.64	448.26	418.56

*Note: Discussed in Chapter 04 of this ESIA report

The results showed that most of the monitored parameters are within the prescribed limits of the stringent standards. However, the red highlighted values are exceeding regulatory limits. The level of NO2 is elevated at 7 locations and CO at 4 locations indicating to the excessive use of vehicular movement and usage of generators. Similarly, the level of PM2.5 and PM10 are also raised at 8 locations which could be attributed to the development around the project site and vehicular movement on nearby roads along with the general elevated levels for these particular parameters throughout all of South Asia.

5.6.2 Noise Levels

As the AOI encompasses all three zones such as Residential, Commercial, and Industrial, thus noise monitoring was conducted at nine (9) locations in all three zones. The monitoring locations was selected to ascertain baseline noise condition in project area and impact that it will generate during construction and operational phases of project.

Table 5.6 - Noise Levels for Jam Chakro landfill Cell

		Applicable Stringent Standards*		Average Monitored Values	
		Day Time	Night-time	Day Time	Night-time
Monitoring Point	Zone	07:00-22:00	22:00-07:00	dB(A) Leq	dB(A) Leq
AQ/N 1	Commercial	**65**	**55**	65.0	55.6
AQ/N 2	Residential	**55**	**45**	63.8	55.5

Monitoring Point	Zone	Applicable Stringent Standards*		Average Monitored Values	
		Day Time	Night-time	Day Time	Night-time
		07:00-22:00	22:00-07:00	dB(A) Leq	dB(A) Leq
AQ/N 3	Residential	**55**	**45**	64.5	55.4
AQ/N 4	Residential	**55**	**45**	64.2	55.4
AQ/N 5	Industrial	**75**	**65**	64.6	55.3
AQ/N 6	Commercial	**65**	**55**	64.6	54.6
AQ/N 7	Commercial	**65**	**55**	64.4	59.4
AQ/N 8	Commercial	**65**	**55**	65.1	54.6
AQ/N 9	Commercial	**65**	**55**	63.4	53.9

*Note: Discussed in Chapter 04 of this ESIA report

The values highlighted in red above exceed the noise level standards applicable for the project. However, due to the presence of residential developments at South and Western corner of landfill AOI the most stringent standards in terms of noise were applied as per the land use of the monitoring point i.e., the standards for residential, commercial, and industrial areas. This resulted in majority of the noise quality results monitored, exceeding the permissible stringent limits which can be attributed to the construction happening around the site along with the movement of heavy vehicles.

5.6.3 Drinking Water

The different sources of drinking water available and consumed within the AOI were examined to understand the levels of potential contaminants in them. In this regard, the specific locations and sources chosen, along with the results are discussed for each site in the sections below. The potential sources identified and tested at Landfill site include:

1. Point 1 - From Masjid Al-Noor Hassan Brohi Goth (25.035657, 67.038793)
2. Point 2 - From Downstream of Site Hub Canal (25.02567, 67.020858)
3. Point 3 - From Up-stream of Site Hub Dam Canal (25.028893, 67.023786)
4. Point 4 – From Haji Ibrahim Goth piped connection by KWSB (25.035657, 67.038793)

The results from testing of these points are given in Table below:

Table 5.7 - Drinking Water Quality Analysis for Landfill Site

S. No.	Parameter	Units	Applicable Stringent Standards*	Point 1	Point 2	Point 3	Point 4
1.	Turbidity	NTU	<5	<1	<1	<1	<1
2.	Aluminium	Mg/L	< 0.2	<0.02	<0.02	<0.02	<0.02
3.	Conductivity	uS/cm	Not Specified	618	625	602	744
4.	Temperature (during sample collection)	C	Not Specified	27	27	28	28
5.	Total Chromium	Mg/L	< 0.05	0.062	0.057	0.033	0.037
6.	SAR Iodine (I)	-	Not Specified	0.041	<0.03	0.04	0.04
7.	Iodine	Ppm	Not Specified	0.02	0.02	<0.02	0.02
8.	pH Value	pH unit	6.5-8.5	6.37	6.21	8.31	7.90
9.	Color	Pt-Co	<15 TCU	04	04	<1	<1
10.	Odor	-	Non-Objectionable/ Acceptable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
11.	Taste	-	Non-Objectionable/ Acceptable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
12.	Total Suspended Solids	Mg/L	Not Specified	01	01	<1	<1
13.	Total Dissolved Solids	Mg/L	Not Specified	598	570	492	710
14.	Total Hardness	Mg/L	< 500	149.9	39.93	123.69	145.12
15.	Calcium	Mg/L	Not Specified	41.61	9.74	50.64	51.81
16.	Magnesium	Mg/L	Not Specified	11	3.78	0.62	3.30
17.	Bicarbonate	Mg/L	Not Specified	118.64	42.09	31.11	46.36
18.	Nitrate	Mg/L	< 50	1.6	1.7	0.7	0.8
19.	Nitrite	Mg/L	< 3	0.047	0.041	0.016	0.026
20.	Chloride	Mg/L	< 250	163.5	148.65	178.38	297.3
21.	Ammonia	Mg/L	Not Specified	<0.02	<0.02	<0.02	<0.02
22.	Fluoride	Mg/L	< 1.50	0.49	0.46	0.20	0.26
23.	Sulfate	Mg/L	Not Specified	27	29	08	10

24.	Phosphate	Mg/L	Not Specified	<0.02	<0.02	<0.02	<0.02
25.	Cyanide	Mg/L	< 0.05	<0.010	<0.010	<0.010	<0.010
26.	Arsenic	Mg/L	< 0.01	<0.005	<0.005	<0.005	<0.005
27.	Boron	Mg/L	< 0.3	0.10	0.11	0.07	0.05
28.	Barium	Mg/L	0.7	<1	<1	<1	<1
29.	Manganese	Mg/L	< 0.5	<0.005	<0.005	<0.005	<0.005
30.	Antimony	Mg/L	< 0.005	<0.005	<0.005	<0.005	<0.005
31.	Lead	Mg/L	0.01	<0.005	<0.005	<0.005	<0.005
32.	Copper	Mg/L	2	0.067	0.0421	<0.005	<0.005
33.	Cadmium	Mg/L	0.003	<0.003	0.042	<0.003	<0.003
34.	Nickel	Mg/L	< 0.02	<0.005	<0.005	<0.005	<0.005
35.	Mercury	Mg/L	< 0.001	<0.001	<0.001	<0.001	<0.001
36.	Selenium	Mg/L	0.01	<0.005	<0.005	<0.005	<0.005
37.	Iron	Mg/L	Not Specified	0.362	0.0421	0.038	0.086
38.	Zinc	Mg/L	3	0.051	0.063	0.012	0.027
39.	Sodium	Mg/L	Not Specified	70.286	97.413	86.470	136.478
40.	Potassium	Mg/L	Not Specified	16.642	21.416	16.566	27.688
41.	Total Coliform	Cfu/100 mL	0/100 ml	36	0	0	0
42.	Fecal Coliform	Cfu/ 100 mL	0/100 ml	0	0	0	0
43.	E. Coli	Cfu/ 100 mL	0/100 ml	0	0	0	0

*Note: Discussed in Chapter 04 of this ESIA report

From the testing conducted, it can be concluded that most of the parameters are within the limits of Applicable stringent standards, however, sample 1 exceeded the threshold values for Total Chromium, Cyanide, Barium, and the presence of coliforms, indicating potential contamination. Samples from points 2 and 3 also exhibited high cyanide, barium, while samples 4 exceeded threshold value of Chloride additional to cyanide and barium limit.

In this case, water from the Hub Dam canal is relatively undisturbed by the activities of the landfill site and is relatively safe for consumption. The water being used at Haji Ibrahim Goth, however, has elevated levels of chlorides which can cause issues through continuous consumption. Nevertheless, almost all sources of drinking water are relatively undisturbed by the activities of the landfill site due to the lack or low levels of contaminants observed.

5.6.4 Leachate Quality

To ascertain the quality of leachates at the site, along with the various concentrations of different pollutants, leachate quality testing was carried out at different points within the landfill sites. The testing of this leachate allows us to understand the different type of pollutant concentrations that may be found at the site when waste begins to produce leachate.

Table 5.8 - Leachate Quality at Landfill site

S. No.	Parameter	Units	Applicable Stringent Standards*	Sample 1	Sample 2
1.	Temperature	°C	≤3°/-	28	29
2.	pH	pH Unit	6-9/6-9	8.51	8.12
3.	Biochemical Oxygen Demand (BOD5) @ 20 °C	mg/L	80/140	8676	5365
4.	Chemical Oxygen Demand (COD)	mg/L	150/125	24100	14500
5.	Total Suspended Solids (TSS)	mg/L	200/88	8525	13900
6.	Total Dissolved Solids (TDS)	mg/L	3500/-	18770	52663
7.	Oil & grease	mg/L	10/10	<1	6
8.	Phenolic Compounds (as phenol)	mg/L	0.1-0.026	145	125
9.	Chloride (as Cl^-)	mg/L	1000/-	6644.65	25805
10.	Fluorides (as F^-)	mg/L	10/-	5.82	18
11.	Cyanide (as CN^-) total	mg/L	1.0/-	0.235	0.312
12.	An-ionic Detergent (as MBAS)	mg/L	20/-	0.185	7
13.	Sulfate (SO_4^{2-})	mg/L	600/-	2400	450
14.	Sulfide (S^{2-})	mg/L	1.0/-	0.42	8.6
15.	Ammonia (as NH_3)	mg/L	40/10	414	266
16.	Pesticides	ug/L	0.15/-	<1.00	<2.0
17.	Cadmium (Cd)	mg/L	0.1/-	<0.003	<0.003
18.	Chromium (trivalent) (Cr)	mg/L	1.0/-	0.741	0.282
19.	Copper (Cu)	mg/L	1.0/-	0.179	0.183
20.	Lead (Pb)	mg/L	0.5/-	0.141	0.363
21.	Mercury (Hg)	mg/L	0.01/-	0.01	0.012
22.	Selenium (Se)	mg/L	0.5/-	<0.005	<0.005
23.	Nickel (Ni)	mg/L	1.0/-	0.149	0.103
24.	Silver (Ag)	mg/L	1.0/-	<0.003	<0.003
25.	Total Toxic Metals	mg/L	2.0/-	1.48	0.66
26.	Zinc (Zn)	mg/L	5.0/0.2	0.437	0.448
27.	Arsenic (As)	mg/L	1.0/-	0.05	0.05

28.	Barium (Ba)	mg/L	1.5/-	9	9
29.	Iron (Fe)	mg/L	8.0/-	20.4	19.65
30.	Manganese (Mn)	mg/L	1.5/-	<0.005	<0.005
31.	Boron (B)	mg/L	6.0/-	15.25	7.9
32.	Chlorine	mg/L	1.0/-	<0.02	<0.02
33.	Total nitrogen	mg/L	-/10	210	256
34.	Total phosphorus	mg/L	-/2	1.25	64
35.	a-Terpineol	mg/L	-/0.033	0.067	0.052
36.	Chromium Hexavalent	mg/L	1.0	0.362	0.026
37.	Benzoic Acid	mg/L	-/0.12	0.47	0.23
38.	p-Cresol	mg/L	-/0.025	1	0.8
39.	Total Coliform	Cfu/100 mL	<200	122	109

*Note: Discussed in Chapter 04 of this ESIA Report.

Leachate testing was done to understand the level of treatment and type of treatment that may be utilized to effectively neutralize this environmental pollutant prior to discharge from site. Furthermore, the testing would also identify elevated parameters that if present in groundwater and soil may represent contamination from the site seeping into the groundwater, where items in red represent concentrations of contaminants found exceeding the stringent standards.

5.6.5 Groundwater

Given that all operations at the current sites take place without liner system (which is essential part of landfill site), the potential for contamination of groundwater is high due to leachate infiltration from the operations of the open dumpsite. Hence, to understand whether this scenario has taken place, the groundwater quality was sampled at the different sites and tested.

Seven boreholes from the AOI were chosen to assess groundwater quality and potential contamination, where the results obtained are given below:

Table 5.9 - Groundwater Quality Analysis of Landfill site

S. No.	Parameter	Units	Applicable Stringent Standards*	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole 5	Borehole 6	Borehole 7
1.	Aluminium	Mg/L	< 0.2	<0.02	<0.02	<0.02	<0.02	0.021	<0.02	<0.02
2.	Antimony	Mg/L	< 0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
3.	Arsenic	Mg/L	< 0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
4.	Barium	Mg/L	0.7	< 1	02	01	02	04	03	01
5.	Boron	Mg/L	< 0.3	0.11	0.29	0.39	0.21	0.26	0.20	0.21
6.	Cadmium	Mg/L	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
7.	Chloride	Mg/L	< 250	1190.22	8602.88	4594.72	8260.72	3468.5	953.18	1075.36
8.	Chromium	Mg/L	< 0.05	0.022	0.091	0.074	0.099	0.041	0.039	0.016
9.	Color	Pt-Co	<15 TCU	04	04	05	04	<1	03	03
10.	Copper	Mg/L	2	<0.005	<0.005	<0.005	0.013	0.029	0.027	0.039
11.	Cyanide	Mg/L	< 0.05	<0.010	0.047	0.147	0.129	<0.010	<0.010	<0.010
12.	Fluoride	Mg/L	< 1.50	0.37	2.17	0.91	1.56	1.37	0.4	0.51
13.	Lead	Mg/L	0.01	0.024	0.036	0.068	0.055	0.035	0.025	0.011
14.	Manganese	Mg/L	< 0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
15.	Mercury	Mg/L	< 0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001
16.	Nickel	Mg/L	< 0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
17.	Nitrate	Mg/L	< 50	0.8	1.5	2.7	2.2	11.2	1.1	1.5
18.	Nitrite	Mg/L	< 3	0.007	0.015	0.010	1.13	1.132	0.015	0.025
19.	Odor	-	Non-Objectionable/ Acceptable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
20.	pH Value	pH unit	6.5-8.5	7.95	6.99	6.89	6.68	6.52	7.15	7.40
21.	Selenium	Mg/L	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
22.	Taste	-	Non-Objectionable/ Acceptable	Objectionable	Objectionable	Objectionable	Objectionable	Objectionable	Objectionable	Objectionable

23.	Total Dissolved Solids	Mg/L	Not Specified	3230	18820	11180	11980	12880	3280	3290
24.	Total Hardness	Mg/L	< 500	700.94	3449.15	2464.4	3408.75	3378.45	587.82	627.21
25.	Turbidity	NTU	<5	11	13	15	12	09	04	05
26.	Zinc	Mg/L	3	0.067	0.059	0.077	0.067	0.043	0.049	0.062
27.	Iron	Mg/L	Not Specified	1.725	3.321	0.913	2.716	2.066	0.849	1.415
28.	Bicarbonate	Mg/L	Not Specified	214.11	265.35	216.55	362.95	265.35	452.62	402.60
29.	Calcium	Mg/L	Not Specified	140.83	580.74	398.62	576.69	582.76	137.59	146.09
30.	Conductivity	uS/cm	Not Specified	4120	20550	113920	20770	19340	4420	4195
31.	Magnesium	Mg/L	Not Specified	84.90	485.89	357.05	478.53	467.48	59.38	63.80
32.	Potassium	Mg/L	Not Specified	110	510	398	472	415.277	157	173
33.	Sulfate	Mg/L	Not Specified	75	1100	720	1010	980	440	410
34.	Temperature (during sample collection)	C	Not Specified	27	27	27	27	28	27	27
35.	Total Suspended Solids	Mg/L	Not Specified	21	23	24	20	<1	13	16
36.	Ammonia	Mg/L	Not Specified	0.47	2.51	3.21	5.71	4.7	0.15	0.17
37.	Sodium	Mg/L	Not Specified	770.98	5567	2950	5340	2053.46	610.52	690.71
38.	Phosphate	Mg/L	Not Specified	0.47	1.13	1.21	1.49	0.09	0.41	0.56
39.	SAR Iodine (I)	-	Not Specified	0.42	0.21	0.37	0.41	0.08	0.26	0.09
40.	Iodine	Ppm	Not Specified	0.06	0.09	0.10	0.08	0.04	0.03	0.06
41.	Total Coliform	Cfu/100 mL	0/100 ml	0	0	0	0	0	0	0
42.	Fecal Coliform	Cfu/ 100 mL	0/100 ml	15	0	54	42	0	21	33
43.	E. Coli	Cfu/ 100 mL	0/100 ml	0	0	0	0	0	0	0

From the above red highlighted values, it can be concluded that most of the parameters are within the prescribed limits of Applicable stringent standards however, sample from all seven (7) boreholes are contaminated with Barium, Chloride, Lead, Total hardness, and turbidity along with objectionable taste. In addition to this, samples from boreholes 1, 3,4, 6 and 7 are contaminated with fecal coliform indicating bacterial contamination of ground water resources. Elevated concentration of fluoride found in sample from borehole 2 and 4, whereas Chromium concentration is also high in bore 2,3 and 4. As such, the groundwater is unfit for consumption as is, where it will require treatment prior to human consumption. Groundwater is however not being used for consumption by the people.

As such, the contamination of the groundwater at the site cannot be directly linked back to the back to the activities of the landfill site without further detailed investigations of the legacy waste and the existing dumpsite, as during geotechnical investigations, there was no visible sign of leachate percolation into the ground observed. Furthermore, given the overall nature of Karachi city where industrial and municipal effluents are discharged into unlined drains throughout the city and solid waste is found everywhere, the groundwater of the city is already polluted, where parameters such cyanide, lead, and chromium are found to be in excess in the groundwater as is[27].

5.6.6 Municipal Wastewater Quality

For areas where it was possible, wastewater samples were also taken from municipal sources to form part of the baseline. For this purpose, sampling was conducted near landfill site.

Table 5.10 - Municipal Wastewater Quality at Landfill site

S. No.	Parameter	Units	Applicable Stringent Standards*	Sample 1	Sample 2
1.	Lead (Pb)	mg/L	0.5/-	0.187	0.173
2.	Chlorine	mg/L	1.0/-	<0.02	<0.02
3.	Turbidity	NTU	<5	47	36
4.	Chromium (trivalent) (Cr)	mg/L	1.0/-	0.246	0.143
5.	Chromium Hexavalent	mg/L	1.0	0.351	0.275
6.	Dissolved Oxygen	mg/L	Not specified	01	01
7.	Nutrient as Potassium	mg/L	Not specified	49.413	50.175
8.	Nutrient as Nitrogen	mg/L	-/10	62.615	61.413
9.	Nutrient as Phosphorus	mg/L	-/2	5.541	6.71
10.	Chloro Pesiticides	ug/L	Not specified	<1.00	<1.00
11.	Temperature	°C	≤3°/-	28	28
12.	pH	pH Unit	6-9/6-9	7.81	7.51
13.	Total Suspended Solids (TSS)	mg/L	200/88	370	325
14.	Total Dissolved Solids (TDS)	mg/L	3500/-	2530	2200
15.	Biochemical Oxygen Demand (BOD5) @ 20 °C	mg/L	80/140	558	756
16.	Chemical Oxygen Demand (COD)	mg/L	150/125	1550	2100
17.	Oil & grease	mg/L	10/10	<1	<1

[27] PCRWR (Pakistan Council of Research in Water Resources). 2002. Water Quality Status in Pakistan. Pakistan Council of Research in Water Resources, Ministry of Science & Technology, Government of Pakistan, Islamabad

18.	Phenolic Compounds (as phenol)	mg/L	0.1-0.026	1.17	2.17
19.	Sulfate (SO_4^{2-})	mg/L	600/-	595	565
20.	Sulfide (S^{2-})	mg/L	1.0/-	0.325	1.75
21.	Magnesium	Mg/L	Not Specified	39.26	34.35
22.	Nitrate	Mg/L	< 50	2.5	3.1
23.	Chloride (as Cl^-)	mg/L	1000/-	1490.84	1637.48
24.	Ammonia (as NH3)	mg/L	40/10	3.41	4.31
25.	Fluorides (as F^-)	mg/L	10/-	2.25	1.79
26.	Cyanide (as CN^-) total	mg/L	1.0/-	0.049	0.063
27.	An-ionic Detergent (as MBAS)	mg/L	20/-	0.921	0.721
28.	Arsenic (As)	mg/L	1.0/-	0.05	0.05
29.	Boron (B)	mg/L	6.0/-	4.31	5.91
30.	Barium (Ba)	mg/L	1.5/-	02	03
31.	Manganese (Mn)	mg/L	1.5/-	<0.005	<0.005
32.	Copper (Cu)	mg/L	1.0/-	0.213	0.175
33.	Cadmium (Cd)	mg/L	0.1/-	<0.003	<0.003
34.	Iron (Fe)	mg/L	8.0/-	7.15	6.41
35.	Nickel (Ni)	mg/L	1.0/-	0.078	0.075
36.	Zinc (Zn)	mg/L	5.0/0.2	0.841	0.631
37.	Sodium	mg/L	Not specified	951.35	1060.90
38.	Silver (Ag)	mg/L	1.0/-	<0.003	<0.003
39.	Mercury (Hg)	mg/L	0.01/-	<0.001	<0.001
40.	Selenium (Se)	mg/L	0.5/-	<0.005	<0.005
41.	Total Toxic Metals	mg/L	2.0/-	1.047	0.816

*Note: Discussed in Chapter 04 of this ESIA Report.

The quality of this wastewater is documented to have a baseline against which effluents being generated and disposed from the site can be checked against the applicable local regulations, where the items in red represent concentrations of contaminants that exceed the stringent standards.

5.6.7 Soil Quality

Lastly, to understand the possibility and extent of contamination to the soil at the site, soil quality testing was conducted, where the results for landfill site is given below.

Table 5.11 - Soil Quality at Landfill site

S. No.	Parameters	Units	Applicable Stringent Standards*	Sample 01	Sample 02	Sample 03	Sample 04
1.	Aluminum (Al)	ma/Ka	1,100,000	3245	3268	3500	3300
2.	Arsenic (As)	ma/Ka	3.0	2.8	2.9	2.1	3.1
3.	Cadmium (Cd)	ma/Ka	100	<0.5	<0.5	<0.50	<0.50
4.	Chromium (Cr)	ma/Ka	6.3	312	299	450	360
5.	Copper (Cu)	mg/Kg	47,000	18	20	27	22
6.	Lead (Pb)	mg/Kg	800	15	11	18	15
7.	Nickel (Ni)	mg/Kg	11,000	12	13	13	15
8.	Zinc (Zn)	mg/Kg	350,000	32	26	45	38
9.	Tin (Sn)	mg/Kg	700,000	0.2	0.2	0.1	0.1

10.	Mercury, Hg	mg/Kg	46	<0.05	<0.05	<0.05	<0.05
11.	TPH C6-C9	ma/Ka	2,200	27	27	43	30
12.	TPH C10-C36	ma/Ka	440	255	288	325	310
13.	Mt8E (Methyl-tert-butyl ether)	ma/Ka	210	<5.0	<5.0	<5.0	<5.0
14.	TPH C37-C40	ma/Ka	3,500,000	23	38	48	38
15.	Acenaphthene	ma/Ka	45,000	<1.0	<1.0	<1.0	<1.0
16.	Benzo(a)pyrene	ma/Ka	2.1	<1.0	<1.0	<1.0	<1.0
17.	Chrysene	mg/Ka	2,100	<1.0	<1.0	<1.0	<1.0
18.	Fluoranthene	mg/Kg	30,000	<1.0	<1.0	<1.0	<1.0
19.	Flourene	mg/Ka	30,000	<1.0	<1.0	<1.0	<1.0
20.	Indeno(1,2,3-cd) pyrene	mg/Ka	21	<1.0	<1.0	<1.0	<1.0
21.	Pyrene	mg/Kg	23,000	<1.0	<1.0	<1.0	<1.0
22.	Benzo (k) Fluoranthene	mg/Kg	21	<1.0	<1.0	<1.0	<1.0
23.	Benzene	mg/Kg	5.1	<5.0	<5.0	<5.0	<5.0
24.	Bromobenzene	ma/Kg	18	<5.0	<5.0	<5.0	<5.0
25.	Bromodichloromethane (THM)	ma/Kg	1.3	<5.0	<5.0	<5.0	<5.0
26.	Bromoform (THM)	ma/Ka	86	<5.0	<5.0	<5.0	<5.0
27.	n-butylbenzene	ma/Ka	58,000	<5.0	<5.0	<5.0	<5.0
28.	tert-butylbenzene	ma/Ka	120,000	<5.0	<5.0	<5.0	<5.0
29.	ChloroBenzene	ma/Kg	1,300	<5.0	<5.0	<5.0	<5.0
30.	Chloroform (THM)	mg/Kg	1.4	<5.0	<5.0	<5.0	<5.0
31.	Chloromethane	mg/Kg	460	<5.0	<5.0	<5.0	<5.0
32.	'Dibromochloromethane (THM)	ma/Kg	39	<5.0	<5.0	<5.0	<5.0
33.	1,2-dibromo-3-chloropropane	mg/Kg	0.064	<5.0	<5.0	<5.0	<5.0
34.	Dibromo methane	ma/Kg	99	<5.0	<5.0	<5.0	<5.0
35.	1,2-dibromoethane (ED8)	ma/Kg	0.16	<5.0	<5.0	<5.0	<5.0
36.	1,2-dichlorobenzene	ma/Ka	9,300	<5.0	<5.0	<5.0	<5.0
37.	1,3-d, chlorobenzene	ma/Ka	-	<5.0	<5.0	<5.0	<5.0
38.	1,4-dichlorobenzene	ma/Ka	11	<5.0	<5.0	<5.0	<5.0
39.	1,1-dichloroethane	ma/Ka	-	<5.0	<5.0	<5.0	<5.0
40.	1,2-dichloroethane	mg/Kg	2.0	<10	<10	<10	<10
41.	1,2-dichloropropane	mg/Kg	11	<5.0	<5.0	<5.0	<5.0
42.	1,3-dichloropropane	mg/Kg	23,000	<5.0	<5.0	<5.0	<5.0
43.	cis-1,3-dichloropropene	mg/Kg	8.2	<5.0	<5.0	<5.0	<5.0
44.	Hexachlorobutadiene	mg/Kg	5.3	<5.0	<5.0	<5.0	<5.0
45.	tsopropylbenzene (Cumene)	mg/Kg	9,900	<5.0	<5.0	<5.0	<5.0
46.	n-propyl benzene	mg/Kg	24,000	<5.0	<5.0	<5.0	<5.0
47.	Styrene (Vinyl benzene)	mg/Kg	35,000	<5.0	<5.0	<5.0	<5.0
48.	1,1,2,2-tetrachloroethane	mg/Kg	2.7	<5.0	<5.0	<5.0	<5.0
49.	Toluene	ma/Ka	47,000	<5.0	<5.0	<5.0	<5.0
50.	1,2,3-trichlorobenzene	ma/Ka	930	<5.0	<5.0	<5.0	<5.0
51.	1,2,4-trichlorobenzene	ma/Ka	11	<5.0	<5.0	<5.0	<5.0
52.	1,1,1-trichloroethane	ma/Ka	36,000	<5.0	<5.0	<5.0	<5.0
53.	1,1,2-trichloroethane	ma/Ka	5.0	<5.0	<5.0	<5.0	<5.0
54.	Trichloroethane (Trichloroethylene, TCE)	mg/Kg	6.0	<5.0	<5.0	<5.0	<5.0
55.	1,3,5-Trimethylbenzene	mg/Kg	1,500	<5.0	<5.0	<5.0	<5.0
56.	1,2,4-Trimethylbenzene	ma/Ka	1,800	<5.0	<5.0	<5.0	<5.0

57.	a-Xylene	ma/Ka	2.8	<5.0	<5.0	<5.0	<5.0
58.	Benzene (BTEX)	ma/Ka	5.1	<5.0	<5.0	<5.0	<5.0
59.	Toluene (BTEX)	mg/Ka	47,000	<5.0	<5.0	<5.0	<5.0
60.	Ethylbenzene (BTEX)	ma/Ka	25	<5.0	<5.0	<5.0	<5.0
61.	a-Xylene (BTEX)	mg/Ka	2,800	<5.0	<5.0	<5.0	<5.0
62.	rn/p-xylene	ma/Ka	2,400	<5.0	<5.0	<5.0	<5.0
63.	Trichloroethene	mo/Ko	6.0	<5.0	<5.0	<5.0	<5.0
64.	1,2,3-trichloropropane	ma/Ko	0.11	<5.0	<5.0	<5.0	<5.0
65.	Anthracene	ma/Ka	230,000	<1.0	<1.0	<1.0	<1.0
66.	sec-butylbenzene	mg/Ka	120,000	<5.0	<5.0	<5.0	<5.0

*Note: Discussed in chapter 04 of this ESIA Report
Items highlighted in yellow indicate limitations with respect to the instrumentation available, where the results obtained may be less than or exceed the permissible limits identified.

Out of the 4 soil samples taken, 3 were taken from the landfill site, and 1 from an area outside of the AOI. Given that chromium was found exceeding the stringent standards in all 4 samples, it can be attributed to the anthropogenic footprint in the area as a whole and the subsequent deterioration of the environment.

5.7 Ecological Environment

In order to compile the biodiversity in the vicinity of the proposed project location, the data and information were obtained from secondary data from published literature and consultations with the concerned quarters.

Information regarding the field based (first hand) ecological profile of study area was gathered through desk study, consultations with concerned field formations of provincial departments of forestry, wildlife sectors and field visit to obtain the information regarding flora and fauna.

5.7.1 Ecological Context

The ecological zone is located in the Indus Eco Region which covers about 65% of the land area of the Sindh province. Being included in the Indus Eco-region, the flora and fauna of the project site are linked with the Indo-Malayan bio geographical origin. With regards to the micro-ecological response, the flora and fauna of greater Karachi can be divided into three edaphic regions:

- The coastal landscape and the muddy coastal swamps
- The coastal sand dunes, and
- The barren undulating landscape of calcareous rocky terrain

The above-mentioned contrasting edaphic conditions support different kinds of flora and fauna due to variable ecological conditions. However, ecologically, the waste disposal activities and associated infrastructure at the landfill site result in significant habitat loss and fragmentation. The natural vegetation and ecosystems that existed in the area before the establishment of the landfill have been disrupted and replaced by waste materials. As a result, the biodiversity at the Jam Chakro landfill site is likely to be very limited.

5.7.2 Habitat Classification

In general, Karachi is an urban environment. The natural fauna and flora-based ecosystems and species are less significant and less in number. Due to disturbances and absence of favourable habitat, the faunal frequency is observed to be low in the project area.

Based on the field evaluation and assessment, departmental consultation and secondary data sources, the proposed project area is categorized as "Modified Habitats" that contains a large proportion of non-native species and human interference which has substantially modified the primary ecological functions and species composition of the project area.

5.7.3 Legal Status of the Project Sites

Landfill site is not designated as a forest land under the provision of Sindh Forest Act 2012.

5.7.4 Flora

Most of the area was already disturbed with a huge habitat destruction. During survey it was found that due to the anthropogenic activities around project area, there have been direct or indirect threats to environment and habitat destruction over large area of landfill site. The major reasons of such habitat destruction are movement of heavy vehicles coupled with unplanned practice of fire to the waste which has also burnt nearby critically endangered species *Commiphora wightii* and other native flora.



Figure shows the habitat destruction at the landfill site



Figure shows how unplanned fire has destroyed the biodiversity and niche

Trees

Trees observed in the AOIs of the project sites by the E&S team during site surveys are listed below, along with the International Union for Conservation of Nature (IUCN) status for each species.

Legend	
Symbol	**Meaning**
X	Observed in AOI
--	Not observed in AOI
No.*	Specific number of trees observed in AOI

Table 5.12 - Trees in the Project AOIs

S#	Species	Common Name	IUCN Status	Landfill site
	Threatened Flora			
1.	***Commiphora wightii***	Guggul	Critically endangered	667
	Total threatened flora			**667**
	Trees			
2.	*Alstonia scholaris*	Blackboard tree	Least concern	---

3.	*Azadarichta indica*	Neem	Not evaluated	X
4.	*Prosopis glandulosa*	Honey mesquite	Not evaluated	X
5.	*Senegalia senegal*	Gum Arabic tree	Not evaluated	X
6.	*Vachellia nilotica*	Babul	Not evaluated	X
7.	*Parkinsonia aculeata*	Palo verde	Least concern	---
8.	*Ficus virens*	White fig	Least concern	---
9.	*Cordia sinensis*	Boran	Least concern	---
10.	*Corymbia citriodora*	Safeeda	Least concern	X
11.	*Ficus benghalensis*	Fig tree	Not evaluated	---
12.	*Polyathia longifolia*	False ashoka	Not evaluated	---
13.	*Mangifera indica*	Aam, Mango	Data Deficient	---
14.	*Millettia pinnata*	Indian beech	Least concern	---
15.	*Morus alba*	Shahtoot	Least concern	---
16.	*Phoenix dactylifera*	Khajoor	Least concern	X
17.	*Cocos nucifera*	Coconut palm	Not evaluated	---
18.	*Conocarpus lancifolius*	Cono	Near Threatened	X
19.	*Moringa oleifera*	Suwanjra	Least concern	---
20.	*Ficus religosa*	Peeple	Not evaluated	---
21.	*Ficus benjamina*	Weeping fig	Least concern	---
22.	*Syzygium cumini*	Jamun	Least concern	---
23.	*Melia azedarach*	Bakain	Least concern	---
24.	*Cordia myxa*	Lasura	Least concern	---
25.	*Manilkara zapota*	Chiku/ sapodela	Least concern	---
26.	*Tamarix aphylla*	Lai	Not evaluated	X
27.	*Tamarindus indica*	Imli		---
28.	*Thespesia populnea*			---
29.	*Pithecellobium dulce*	Jungle jalebi	Least concern	X
30.	*Peltophorum pterocarpum*	Copperpod	Not Evaluated	---
31.	*Plumeria obtusa*	White champa	Least concern	---
32.	*Delonix regia*	Gul e mohar	Least concern	---
33.	*Guaiacum Officinale*	Lignum vitae	Endangered	---
34.	*Leucaena leucocephala*	White lead tree	Not evaluated	---
35.	*Terminalia catappa*	Tropical almond tree	Least concern	---
36.	*Ziziphus jujuba*	Beer	Least concern	---
Total Trees Within Landfill site				**---**
Total Trees with in AOI				**10**

Shrubs & Herbs

Shrubs and herbs observed in the site's AOIs by the E&S team during field visits are presented below, alongside the IUCN status for each item.

Table 5.13 - Shrubs and Herbs in the Project AOIs

S#	Species	Common Name	IUCN Status	Landfill site
1.	*Abutilon indicum*	Country mallow	NE	X
2.	*Acalypha wilkesiana*	Copperleaf	NE	---
3.	*Achyranthus aspera*	Devil's horsewhip	NE	X
4.	*Barleria acanthoides*	---	Not evaluated	X
5.	*Barleria hochstetteri*	---	NE	X
6.	*Bougainvillea spectabilis*	Gul	NE	

7.	*Calotropis procera*	Aak	Not evaluated	X
8.	*Capparis decidua*	Kirrir	Least concern	X
9.	*Caesalpinia pulcherrima*	gulmohar		---
10.	*Euphorbia caducifolia*	Thohar	Not evaluated	X
11.	*Jatropha gossypiifolia*	Diesel plant		
12.	*Grewia tenax*	White crossberry	Least concern	X
13.	*Haloxylon stocksii*	Saxaul	Least concern	X
14.	*Ocimum tenuiflorum*	tulsi	NE	---
15.	*Phagnalon daravazicum*	---	NE	X
16.	*Prosopis juliflora*	Devi/ vilayatikikkar	Not evaluated	X
17.	*Prosopis glandulosa*	Honey meaquite	LC	X
18.	*Ricinus communis*	Haran	NE	---
19.	*Salvadora alii*	Khabar	Data deficient	---
20.	*Salvadora oleoides*	Khabbar	Data deficient	X
21.	*Salvadora persica*	Khabbar	Least concern	X
22.	*Suaeda fruticosa*	Láani	Not evaluated	X
23.	*Tamarix aphylla*	Lai	Not evaluated	X
24.	*Maytenus senegalensis*	Hekel, Malkangni	Not evaluated	X
25.	*Mimosa hamata*	Alay	NE	X
26.	*Salicornia sp.*	glasswort	NE	---
27.	*Salsola imbricata*	Saltwort	Not evaluated	X
28.	*Ziziphus nummularia*	Beer	Not evaluated	X
29.	***Abelmoschus esculentus***	Bhindi/ okra		X
30.	*Amaranthus viridis*	Chull	Not evaluated	X
31.	*Aerva javanica var. javanica*	Booh	Not evaluated	X
32.	*Blepharis sindica*	Bhangri	Not evaluated	X
33.	*Capsicum annuum*	mirchi	LC	X
34.	*Corchorus capsularis*	White jute	NE	---
35.	*Convolvulus prostatus*	---	NE	X
36.	*Convolvulus glomeratus*	---	NE	X
37.	*Cressa cretica*	Rudranti	Least concern	X
38.	*Chenopodium album*			---
39.	Crotalaria burhia	Saniya	Not evaluated	--
40.	*Cyamopsis tetragonoloba*	Guaar	NE	X
41.	Datura alba	Devil's trumpet	NE	X
42.	*Eclipta prostrata*	False daisy	Least concern	X
43.	*Euphorbia granulata*	---	NE	
44.	*Fagonia indica*	Dhamasa	Not evaluated	X
45.	*Glinus lotoides*	Jima	NE	X
46.	*Heliotropium rariflorum*	Jamandar ka landa	Not Evaluated	X
47.	*Heliotropium europium*	---	---	X
48.	*Inulla grantoides*	---	---	X

49.	*Lagenaria siceraria*	Loki/kadu		X
50.	*Leucas urticifolia*	Kubabhal	NE	X
51.	*Rhynchosia minima*	Least snout bean	LC	
52.	*Senna holosericea*	Sana mukhi	Not evaluated	X
53.	*Sesuvium sesuvioides*	Sea pursalnes	NE	X
54.	*Sida ovata*	Oval leaf	NE	X
55.	*Portulaca oleracea*	little hogweed	Least concern	X
56.	*Peristrophe bicalyculata*	---	NE	
57.	*Phylla nodiflora*	Frog fruit	NE	X
58.	*Solanum surattense*	kundiari, 'Momoli, Mokri	Not evaluated	X
59.	*Solanum nigrum*	Bengan	NE	---
60.	*Solanum lycopersicum*	Tomato	NE	X
61.	*Sonchus aspera*	Prickly sow-thistle	NE	X
62.	*Spinacia oleracea*	Palak	NE	---
63.	*Trianthema portulacastrum*	Black pigweed	NE	X
64.	*Trianthema triquetra*	---	NE	X
65.	*Tribulus terrestris*	Tekundi	Least concern	X
66.	*Trichodesma indica*	Indian borage	Not evaluated	X
67.	*Zygophyllum simplex*	Hurium	Not evaluated	X
68.	*Cyperus rotundus*	Nutgrass	Least concern	X
69.	*Cenchrus ciliaris*	Dhaman	Least concern	X
70.	*Chloris barbata*	Ganni, Jargi	Not evaluated	X
71.	*Dactyloctenium aegyptium*,	---	Not evaluated	---
72.	*Desmostachya bipinnata*	Dabh/drabh	Least concern	X
73.	*Dichanthium annulatum*	Marvel grass	Not evaluated	X
74.	*Phragmites australis*	Kaano	Least concern	X
75.	*Typha domingensis*	Booh	Least concern	X
Total Shrubs and Herbs within AOI				58

Grasses

Grasses observed in the project sites AOIs by the E&S team during surveys are listed below along with the IUCN status for each of these items.

Table 5.14 - Grasses in the Project AOIs

S#	Species	Common Name	IUCN Status	Landfill site
1.	*Cyperus rotundus*	Nutgrass	Least concern	X
2.	*Cenchrus ciliaris*	Dhaman	Least concern	X
3.	*Chloris barbata*	Ganni, Jargi	Not evaluated	X
4.	*Dactyloctenium aegyptium*,	---	Not evaluated	---
5.	*Desmostachya bipinnata*	Dabh/drabh	Least concern	X
6.	*Dichanthium annulatum*	Marvel grass	Not evaluated	X

7.	*Phragmites australis*	Kaano	Least concern	X
8.	*Typha domingensis*	Booh	Least concern	X
Total Grasses within AOI				07



Succulent plant *Euphorbia caducifolia* around the vicinities of the landfill site



Condition of IUCN's Critically endangered shrub *Commiphora wightii* in Hilly and rocky regions of the Landfill site



The close-up of the Commiphora wightii at the hilly and rocky region of the Landfill site



Vachellia nilotica a native tree in the AOI

5.7.5 Fauna

The landfill site being a disturbed and heavily anthropogenic environment, is not a suitable habitat for a diverse range of fauna species. However, some opportunistic and adaptable species may be observed in and around the dumpsite due to the availability of food and shelter resources. These species typically have adaptations that allow them to survive in disturbed or urbanized environments. Albeit the ecological conditions within the landfill, including the presence of pollutants and limited resources, make it challenging for a diverse range of fauna species to thrive.

Monoculture of Feral dogs

In garbage areas, the survey team also observed the feeding of cows (Bos Taurus), goats (Capra hircus) and crows (Corvus sp.) and feral dogs which were not only promoting the mono-culturing of a species which eventually increases the population of a single species within that specific region but also those feral dogs can be a threat to native fauna of the region as after feeding and increasing their population they move to wild and harm other native animals. Feeding animals like cows and goats can be a factor in the transmission of diseases.

The mammalian species and avi-fauna that are found within and AOI of landfill site is described in preceding sections.



Figure Shows the feeding of animals in the project area



Figure Shows an increased population of feral dogs due to feeding of waste material

Mammals & Reptiles

The mammals and reptiles observed at the site during the surveys, along with their IUCN classifications are given below:

Table 5.15 - Mammals & Reptiles found in Project AOIs

S. No	Common Name	Scientific Name	IUCN Status
1.	Small Indian Mongoose	*Herpestes javanicus*	Least Concern
2.	Indian Grey Mongoose	*Herpestes edwardsi*	Least Concern
3.	Indian hare	Lepus nigricollis	Least Concern
4.	House rat	Rattus	Least Concern
5.	Five-striped Palm Squirrel	Funambulus pennantii	Least Concern
6.	Long-eared desert Hedgehog	Hemiechinus collaris	Least Concern
7.	Indian gerbil	*Tatera indica*	Least Concern
Reptiles			
8.	Common Krait	Bungarus caeruleus	Least Concern
9.	Indian Cobra	*Naja naja*	Least Concern
10.	Garden lizard	*Calotes versicolor*	Least Concern
11.	Sindh Gecko	*Crossobamon orientalis*	Least Concern
12.	Saw-scaled viper	*Echis carinatus*	Least Concern

Birds

In the project site and their AOIs, no endangered bird species exist. The proposed project is also not falling in migratory bird flyway (migration corridor). The environment is not thriving for birds due to pollutants, nevertheless, the site has attracted certain bird species due to the availability of food resources and favourable nesting sites.

Table 5.16 - Birds of the Project AOIs

S. No	Common Name	Scientific Name	IUCN Status

1.	Black Kite	*Herpestes javanicus*	Least Concern
2.	House Crow	*Herpestes edwardsi*	Least Concern
3.	Common Myna	Acridotheres tristis	Least Concern
4.	House Sparrow	Passer domesticus	Least Concern
5.	Rock Dove	Columba livia	Least Concern
6.	Cattle Egret	*Bubulcus ibis*	Least Concern
7.	*Red-vented Bulbul*	*Pycnonotus cafer*	Least Concern
8.	*Indian Robin*	*Saxicoloides fulicata*	Least Concern
9.	*Long Billed Vultures*	*Gyps Indicus*	Critically Endangered

National Sanctuaries/ Protected Areas

In Pakistan, there are several areas of land, devoted to the preservation of biodiversity through the dedication of national parks and wildlife sanctuaries. However, no protected areas are found in or near the project AOIs. No endangered fauna exists in the project area.

Horticulture

No significant horticulture practices were reported nearby within the AOIs of the sites.

5.8 Socio-Economic Environment

The social baseline described below provides a comprehensive review of the socio-economic conditions of the AOIs of the project site, which has been drafted through detailed surveys and consultations conducted (See Chapter 1). This social baseline provides an overview of the socio-economic conditions of the people who reside and work in the AOIs, and also includes an assessment of public utilities and social services (education and health facilities) as per public opinion.

5.8.1 Demography

The Jam Chakro landfill site is situated in outskirts of Karachi and is located in district West. The land is government-owned, and the site is being operated by the SSWMB. District West is a blend of urban and rural settlers residing in varied la ndforms, including hills, islands, agricultural plains, and industrial zones. It is an industrial and commercial district enjoying diverse land use occupations. The residents from a diverse array of ethnic and linguistic backgrounds, including those who speak Urdu, Pashto, Balochi, Punjabi, Sindhi, Saraiki, and Hindko.

Table 5.17 - Demographic Change in District West and Manghopir Sub-Division (1998-2017)

1998 Census Population	2017 Census Population	%Change (1998-2017)
District West		
1,052,046	2,080,893	98
Manghopir sub-division		
118,267	717,753	607
Source: Pakistan Bureau of Statistics 2017 (PBS)		

The total population of District West was 1,052,046 in the 1998 census which increased to 2,080,893 in the 2017 census showing an increase of 98% with a growth rate of 5%. The total population of the Manghopir sub-division was 118,267 according to the 1998 census which increased to 717,753 in the 2017 census showing an increase of 506% having a growth rate of 27% per annum.

5.8.2 Economics

In district West, people are mainly working in trade and business, the other major portion of the population consists of labour class including skilled and unskilled labour. There are large numbers of people involved in the construction and industrial business. The remaining small portion of the population are employed in government departments and private companies. In project area, there are two villages one is Haji Ibrahim Gotha and Haji Umar Goth. Most of the residents of Haji Ibrahim Goth are waste pickers. They salvage items from waste and earn their livelihood, male and female of Haji Ibrahim Goth are both associated with this business, as part of socio-economic survey conducted by E&S consultant it can be concluded that all of the household fall below the poverty line.

5.8.3 Education

The education facilities available in the District West are not commensurate with the number population, albeit a large number of schools, colleges, technical colleges have been opened up in the district by the government as well as by private organization. Hamdard University (Madinatul Hikmat) founded by the late Hakeem Muhammad Saeed is promoting knowledge in the field of Medicine, Computer Science and Business Administration is one of the leading institutes in the district.

Educational institutes are available in the project area. The major NGO working in the neighbourhood is Al-Khair Khidmat Foundation which has established three schools in different goths of the town namely, Al-Khair 1, Al-Khair 2, and Al-Khair Secondary School, where some villagers send their children. From the socio-economic survey of Jam Chakro it can be ascertain that more than 95% of inhabitants of Haji Ibrahim goth are illiterate.

5.8.4 Health

There are no major health facilities in the villages, except Hamdard Hospital, which has a dispensary and hospital to take care of the nearby villagers which is 7 Km away from there. The villagers also go to the Jinnah and Abbasi Shaheed hospitals for better treatment. The major diseases reported in this area are Diabetes, Diarrhoea and Malaria. There are a couple of small family clinics near the premises of the proposed project namely Umer Clinic and Danish Clinic which can only cater to a limited number of patients and ailments. The NGO HOPE also arranges weekly medical camps at the village.

5.8.5 Utilities

In project area, electricity and gas is not available in the villages. Some villagers have small solar panels which they use as an alternate energy. There are no gas connections in the villages, so people use wood for meeting their cooking and heating needs. Boring water is also used, and quality of that water is satisfactory. The main water board line enters the area from where every village is connected for water supply by the concerned authority. Hub Dam Canal also passes through the area which is a picnic spot for the local families during summers. The villages do not have proper sewerage system for disposal of domestic waste. There is no proper solid waste disposal service in the area. In general practice, villagers dispose their waste in an open area and burn it when waste piled up.

5.8.6 Accessibility

The site can be easily access through Surjani Town link road, that is connecting at Powerhouse Chowrangi Surjani. The link road runs in between the residential land, though it is barren for most of the part for now, however residential society are constructing at rapid pace. Traffic flow is low, and road is already in use by dumping trucks to offload trash in landfill.

5.8.7 Socio-Economic Profile of Waste Pickers

A census survey was conducted by ESIA consultant in Haji Ibrahim Goth, where the livelihood of most of the resident is associated with Jam Chakro dumpsite. The survey was conducted in August 2022 and socio-economic conditions are described in preceding sections.
The following table shows the covered households with overall populations and occupation wise. In addition to that it also shows literacy status of the area.

Table 5.18 - Summary of Findings

Entities	**No and % age**
Total Residential Households	723
Total Commercial Structures	63
Total Population	3,448
Total No. of Adult Males (Above 15)	949
Total No. of Adult Females (Above 15)	963
Total No. of Non-Adult Males (Below 15)	808
Total No. of Non-Adult Females (Below 15)	726
Total No. of Transgenders	02
Literacy Rate (% of total population)	77% Illiterate (74% of overall Males & 80% of overall Females)
Livelihood Practices	
Waste Pickers in the family	1,067 (31%) i.e., 841 Males, (48%) and 226 Females (13%).
Non-working women staying at home	838 (24%)
Jobless	78 (2%)
Labourer	42 (1%)
Other Occupations	1425 (41%)

Out of 3,448 individuals, only 1,067 (31%) individuals in Haji Ibrahim village were engaged in the waste picking/scavenging activities in the area. The male ratio is high 48%, whereas 13% women were engaged in the waste picking. Similarly, majority of the women in the area (49%) were women staying at home and not contributing towards income generating activities. These women are engaged in kitchen and domestic chores, care of children, fetching the water form canal and cleaning the houses. Labor is still the major source of income, whereas a few run their own small enterprises in the village.

For the last few years, development in the surrounding areas has created job opportunities like sweepers, sanitary workers, and security guards, for the villagers.

Table 5.19 - Gender Wise Occupation of Household Family Member (Overall)

		Overall		Gender					
				Male		Female		Transgender	
		Count	%	Count	%	Count	%	Count	%
Base: All Household Family Members Data		**3,448**	**100%**	**1,757**	**100%**	**1,689**	**100%**	**2**	**100%**
Occupation	Waste Picker/Scavenger	1,067	31%	841	48%	226	13%	0	0%
	Housewife/ House worker	838	24%	0	0%	838	49%	0	0%
	Student	247	7%	170	10%	76	4%	1	50%
	Jobless	78	2%	76	4%	2	0%	0	0%
	Labor	42	1%	38	2%	4	0%	0	0%
	Business/Trading	21	1%	20	1%	1	0%	0	0%
	Begging	11	0%	9	1%	2	0%	0	0%
	Job/Employment	10	0%	9	1%	1	0%	0	0%
	Sweeper	10	0%	10	1%	0	0%	0	0%
	Daily Wage Labourer	6	0%	6	0%	0	0%	0	0%
	Older Age (who is unable to earn)	6	0%	6	0%	0	0%	0	0%
	Cottage Craft/Handicrafts	4	0%	0	0%	4	0%	0	0%
	Driver	4	0%	4	0%	0	0%	0	0%
	Financially Supported by relative or someone	4	0%	0	0%	4	0%	0	0%
	Biryani Seller	3	0%	3	0%	0	0%	0	0%
	Housekeeping/Janitorial Services	2	0%	1	0%	1	0%	0	0%
	Rilli Making	1	0%	0	0%	1	0%	0	0%
	None	1,096	32%	558	32%	537	32%	1	50%

Figures are column percentages, where some respondents answered to having more than one job|
Source: Sweep Household Survey Data

Out of 3,448 individuals, majority of household family members Individuals 2,642 (77%) in village were not educated, with 74% males and 80% females were illiterate. Female literacy ratio is bit higher than the male literacy ratio. Several reasons were mentioned for not attending the school by respondents; most people mentioned inability to afford education expenses. Other reasons included frequent migrations, poverty, lack of school facilities, and the proximity of educational facilities from the village.

Table 5.20 - Gender Wise Literacy Level

		Overall		Gender					
				Male		Female		Transgender	
		Count	%	Count	%	Count	%	Count	%
Base: All Household Family Members Data		3448	100%	1757	100%	1689	100%	2	100%
Qualification	Illiterate	2642	77%	1294	74%	1347	80%	1	50%
	None (Child underage)	464	13%	228	13%	236	14%	0	0%

	Primary	297	9%	201	11%	95	6%	1	50%
	Middle	30	1%	22	1%	8	0%	0	0%
	Secondary	10	0%	7	0%	3	0%	0	0%
	Madrassa	3	0%	3	0%	0	0%	0	0%
	Inter	2	0%	2	0%	0	0%	0	0%
Figures are column percentages | Source: Sweep Household Survey Data									

Out of 3,448 individuals, majority of the individuals in the area have a very low-income level with 33% of households reporting having a monthly income up to Rs. 15,000 while 22% reported having income above Rs. 15,000. Many households reported that monthly expenditure slightly exceeds the Rs, 15,000 amount. Most of the monthly household expenditure is spent on food, health services and medicines.

Table 5.21 - Average Monthly Earning Family Members (Overall)

		Overall		Gender					
				Male		Female		Transgender	
		Count	%	Count	%	Count	%	Count	%
Base: All Household Family Members Data		3448	100%	1757	100%	1689	100%	2	100%
Monthly Income	None/ No response	2245	65%	805	46%	1438	85%	2	100%
	Up to Rs. 5,000	134	4%	84	5%	50	3%	0	0%
	Rs.5,001 - 10,000	511	15%	372	21%	139	8%	0	0%
	Rs.10,001 - 15,000	482	14%	427	24%	55	3%	0	0%
	Rs.15,001 - 20,000	37	1%	33	2%	4	0%	0	0%
	Rs.20,001 - 25,000	27	1%	27	2%	0	0%	0	0%
	Rs.25,000 & above	12	0%	9	1%	3	0%	0	0%
Figures are column percentages | Source: Sweep Household Survey Data									

Based on the collected data, people are settled here in large numbers (49%) for the past 21 to 30 years, whereas 32% of them settled here within the last 11 to 20 years. 10% households reported to be settled here for the past 31 to 40 years. The main purpose of settling here was livelihood and shelter.

Table 5.22 - Household Settling Period

		Total	
		Count	%
Base: All Households		723	100%
Household Settling Period	01-05 Years	16	2%
	06-10 Years	31	4%
	11-20 Years	237	33%
	21-30 Years	348	48%
	31-40 Years	71	10%
	41 & above	20	3%
Figures are column percentages | Source: Sweep Household Survey Data			

The household survey shows that the Jogi Shaikh and Kachi Shaikh are equally present (36%) and 14% are Kohli Hindu residing in the village. There is only Sindhi ethnic group present in the village.

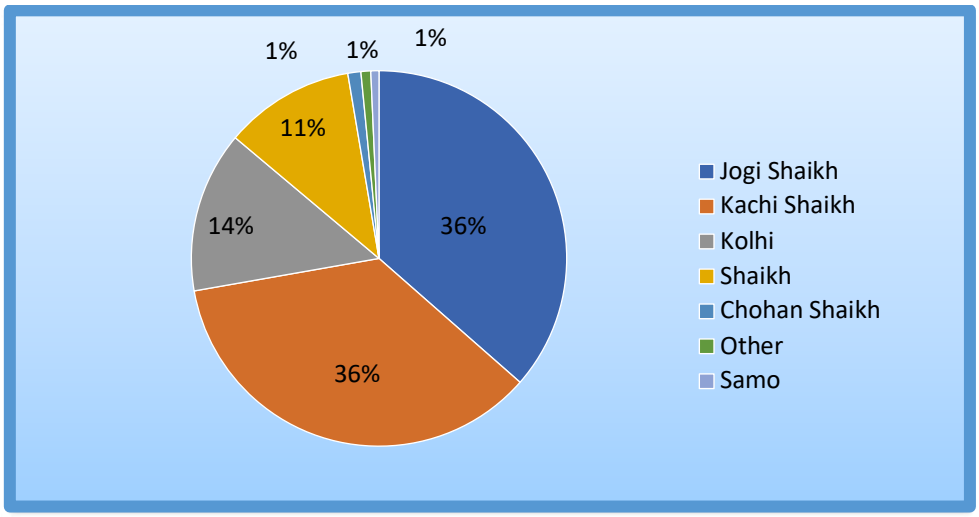


Figure 5.9 - Household Cast

The household survey suggests the religious composition of the settlement, majority of households were Muslim (80%), whereas (20%) are Hindus. It indicates that this area is peaceful as far as communal violence is concerned as a large number of Hindus residing in the area. Based on collected data, it was evident that the people live as a community, in peace and harmony and with respect of each other's religion.

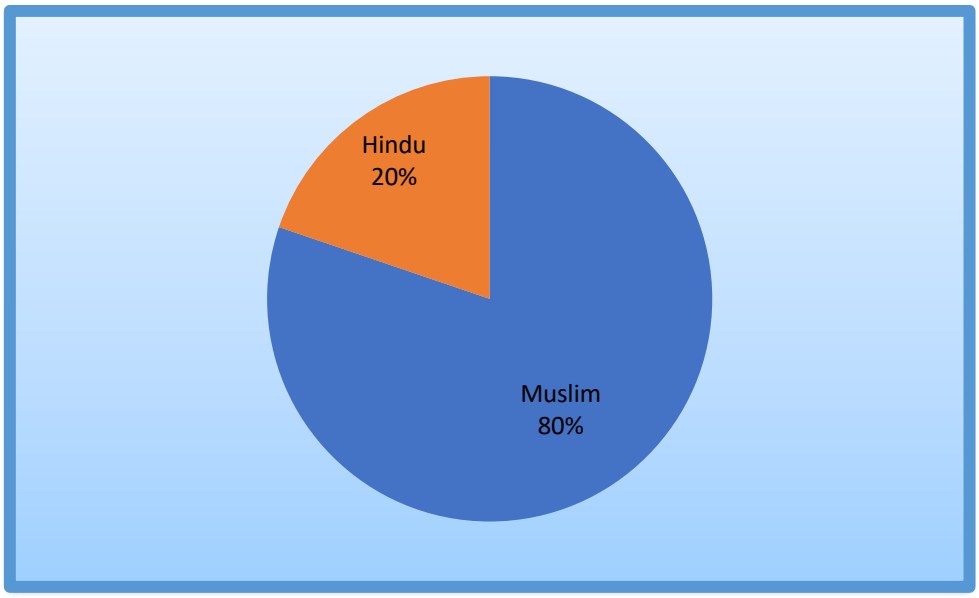


Figure 5.10 - Household Religions

The household survey reported that the family composition is somewhat balanced. Around (33%) households reported having 3-4 family members, whereas 31%, 1-2 family composed. Only 13% household reported 7 and more family members. The majority of household reported living in nuclear families do not prefer to live in joint families.

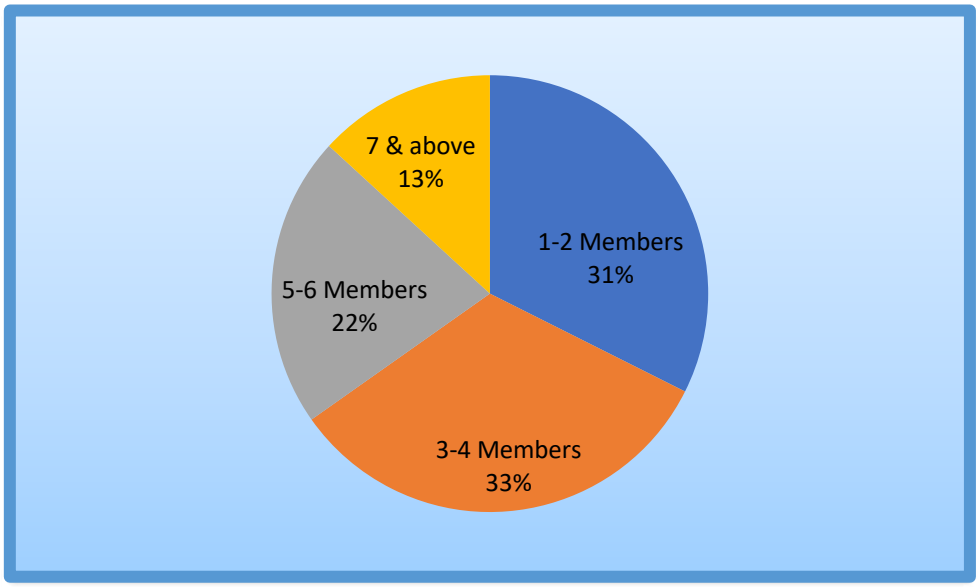


Figure 5.11 - Households Family Composition

Around 4% of the surveyed household reported having a person with disability. This group was considered as a vulnerable group in the village. Some of them are head of household so someone supported financially to arrange for food for the family.

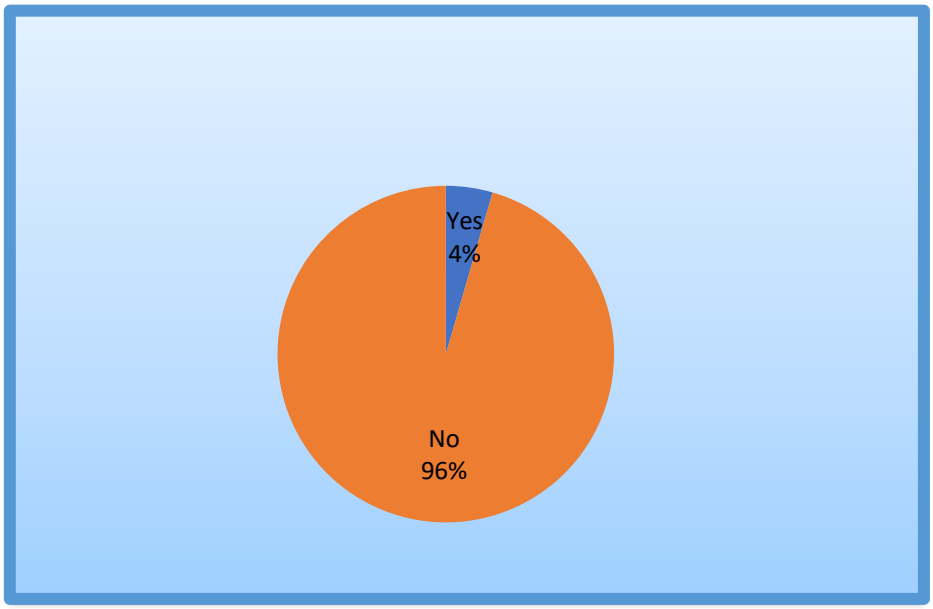


Figure 5.12 - Disabled Persons Present in Household

The survey reported that only 5% of the population rears livestock in the village. The goat easily survives in the local conditions, so people mainly keep goats. People bearing the livestock on sharing basis. Some people also take care and graze animals of other people as partners, who pay them for the caring of the livestock and when livestock is sold then they receive 50% of the income.

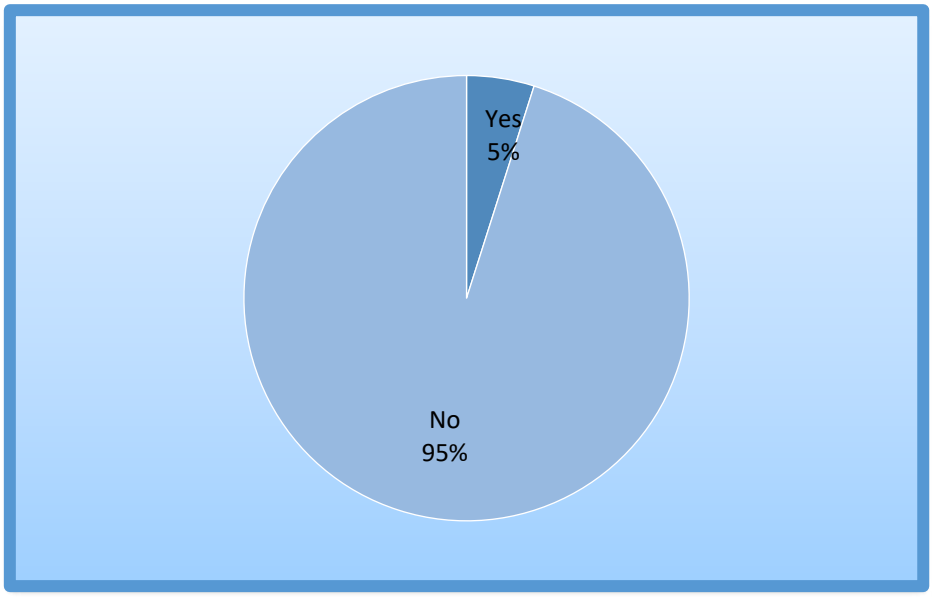


Figure 5.13 - Livestock Rearing Practices by Household

The survey reported that only 4% households have assets like solar panels, battery, mobile phones, TV, whereas 96% household were deprived form these kind of assets.

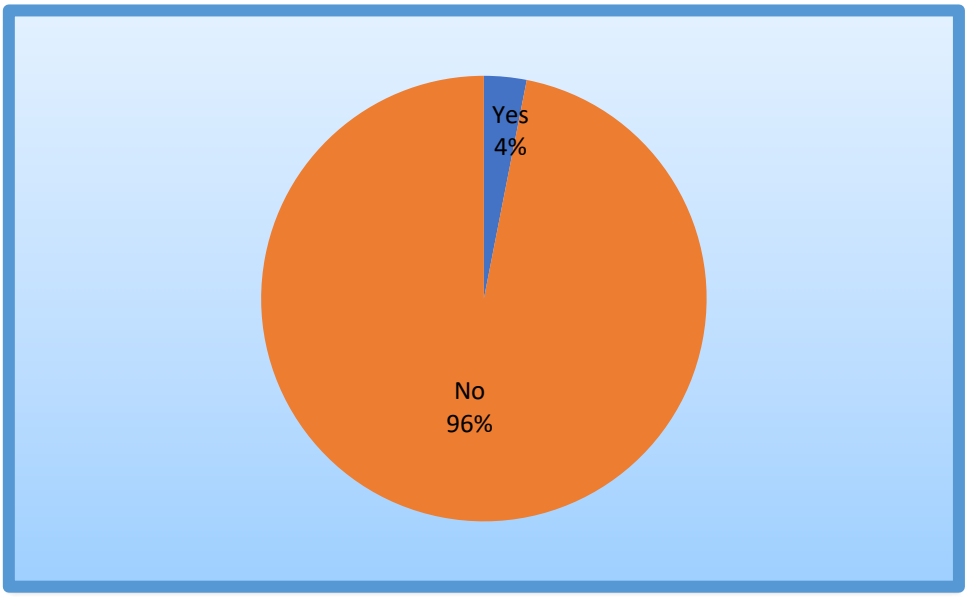


Figure 5.14 - Access to Capital Goods

Around 14% surveyed people owned transportation facilities, whereas 86 % use privately owned transport like rickshaws, and pick-up vans. The main transport asset is motor bike. In emergency they use privately owned transport like Suzuki pick-ups and cars, run by outsiders.

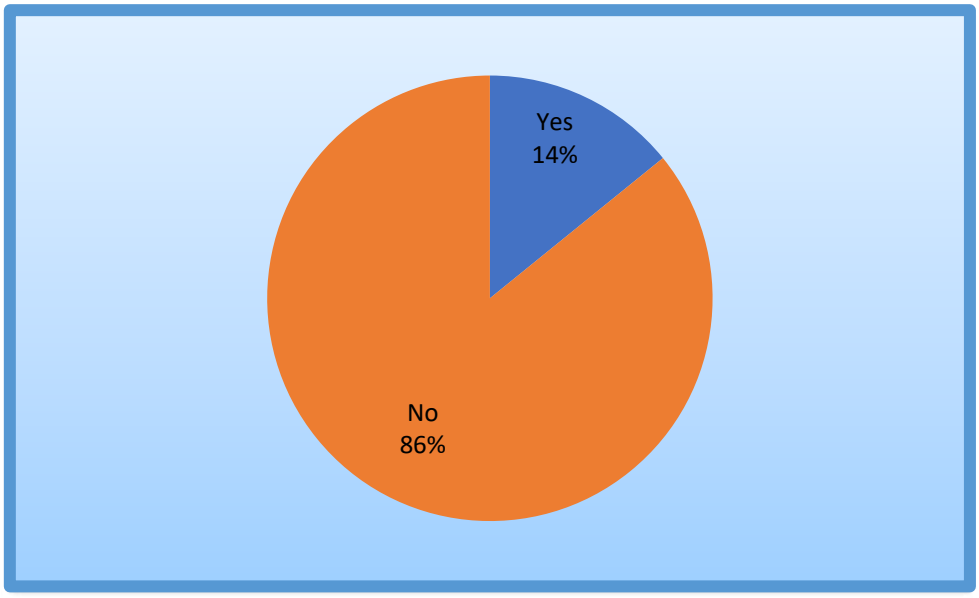


Figure 5.15 - Transport Facilities owned by Households.

The most commonly reported source of drinking water among the surveyed households is Hub Canal with 95% people, followed by water board pipeline (6%) and only (5%) reported to get water from tankers. Most of households reported that quality of water as not drinkable.

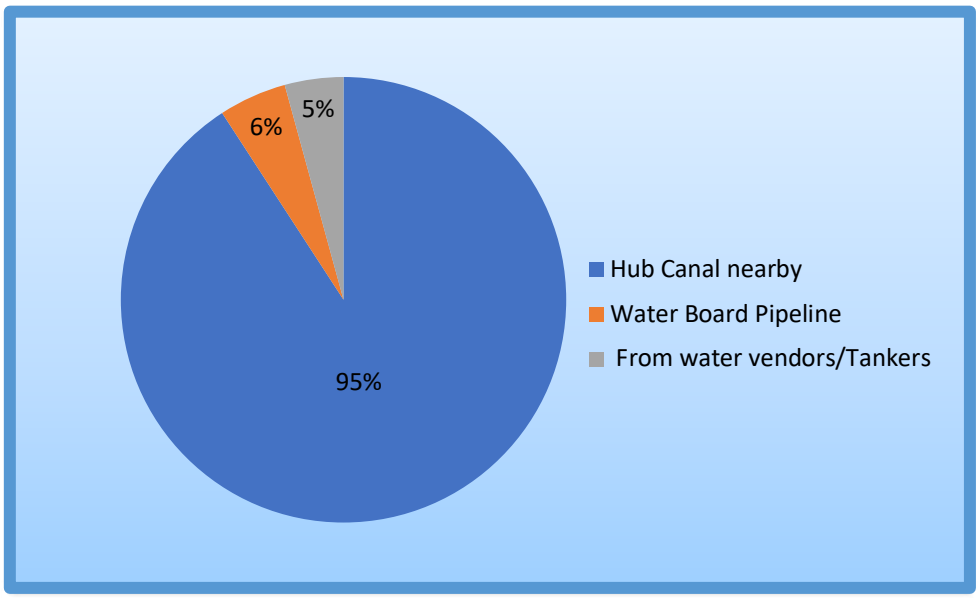


Figure 5.16 - Source of Water
Note: Multiple responses hence the total can be more than 100

The household surveys show that around (83%) have not access the electricity, whereas 15% household use solar panels and batteries as alternative source of energy. Only 3% households reported Kunda system (illegal way) for electricity.

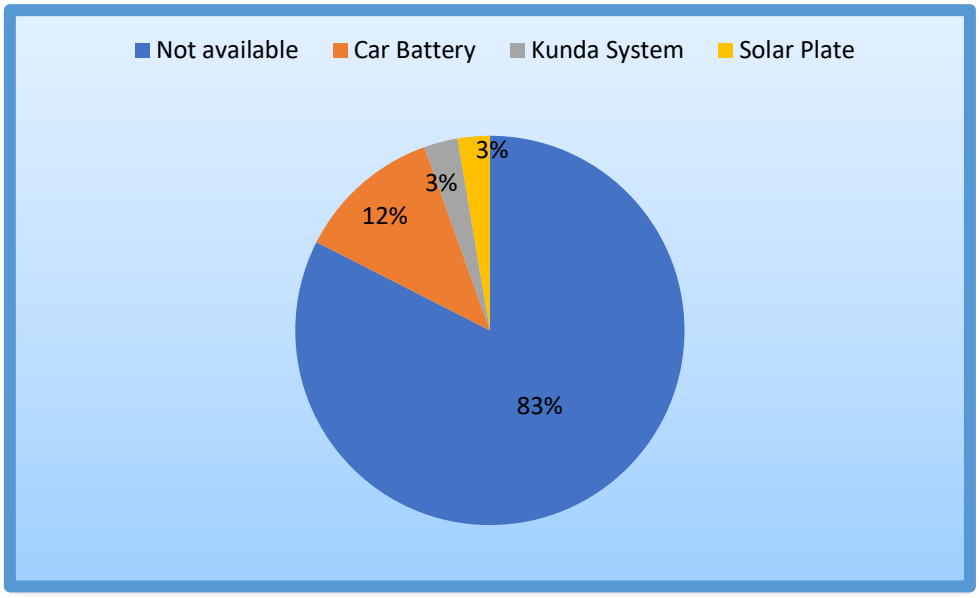


Figure 5.17 - Sources of Electricity

The household surveys reported they have no gas so (100%) households use wood for cooking purpose. Women reported that it is very difficult cooking during rainy season.

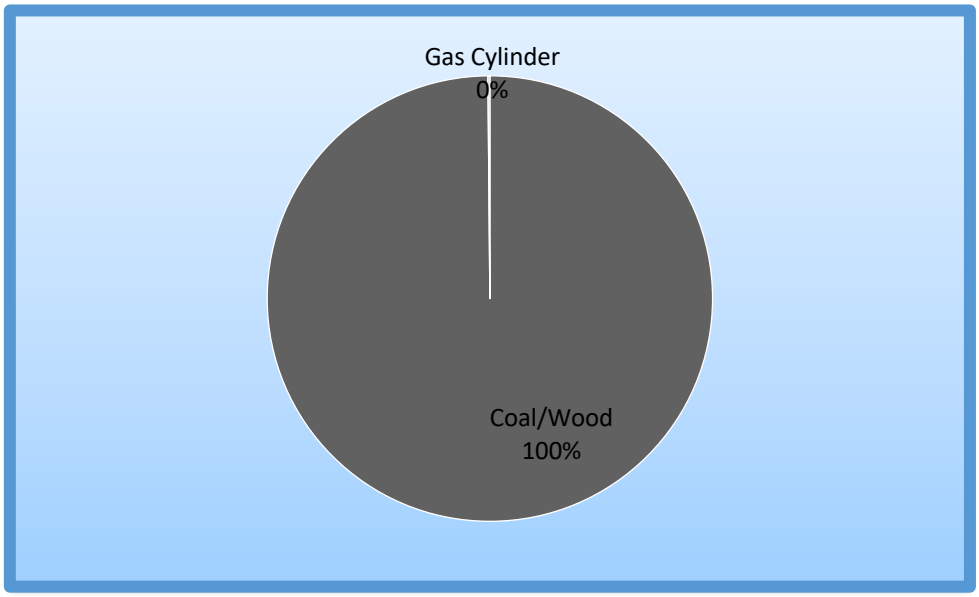


Figure 5.18 - Source of Cooking Fuel

The household surveys reported that around 72% used mobile on sharing basis whereas 23% use their privately-owned mobile phones. Only 3% households reported owning smart phones while 2% used smart phone on sharing basis. Only 1% household reports that they don't have access to any kind of mobile phones.

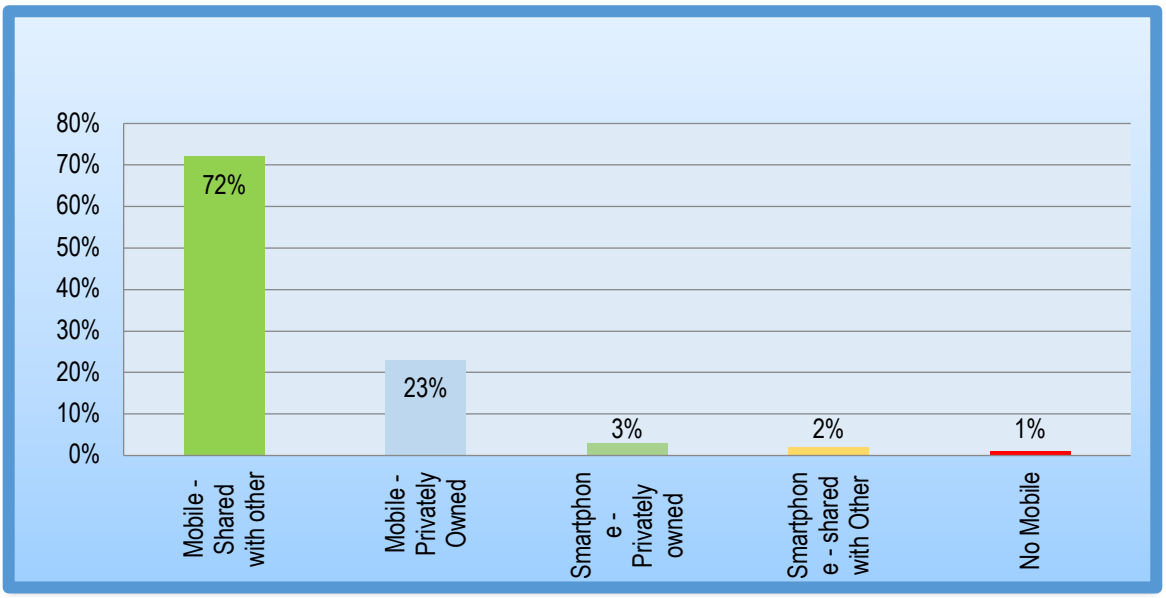


Figure 5.19 - Means of Communication

There was no proper sewerage system in the surveyed village. Around 47% of the surveyed household reported open defecation due to unavailability of latrines in their houses. Only 53% households reported having pit latrine. There was no flush latrine found in the village.

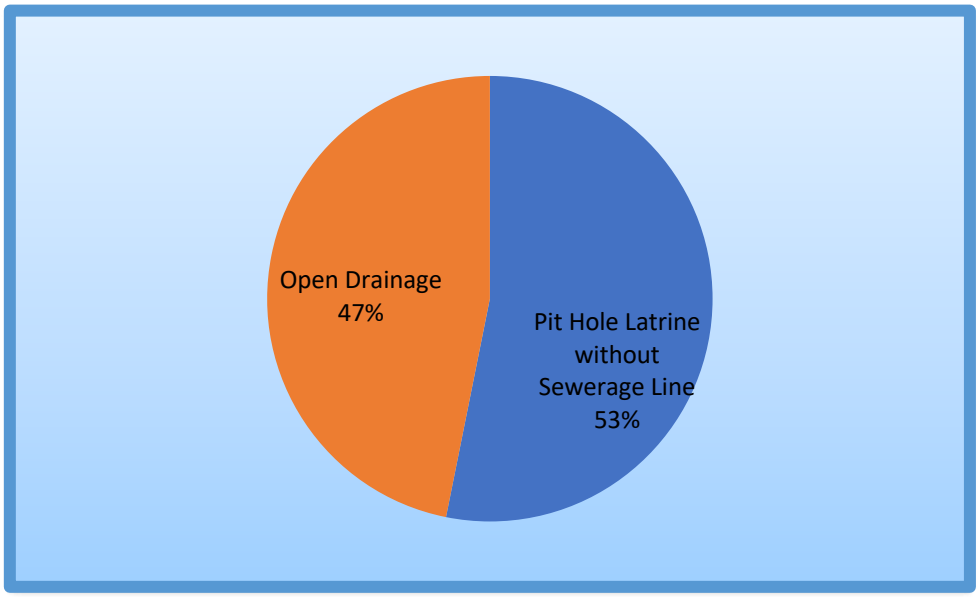


Figure 5.20 - Household Sewerage System

There is no solid waste management system in the surveyed area. Around 85% surveyed households dump their waste near their houses at the landfill site while 11% burn it and only 6% throw the landfill site far from the home. There is no access to municipal waste collection unit at village level.

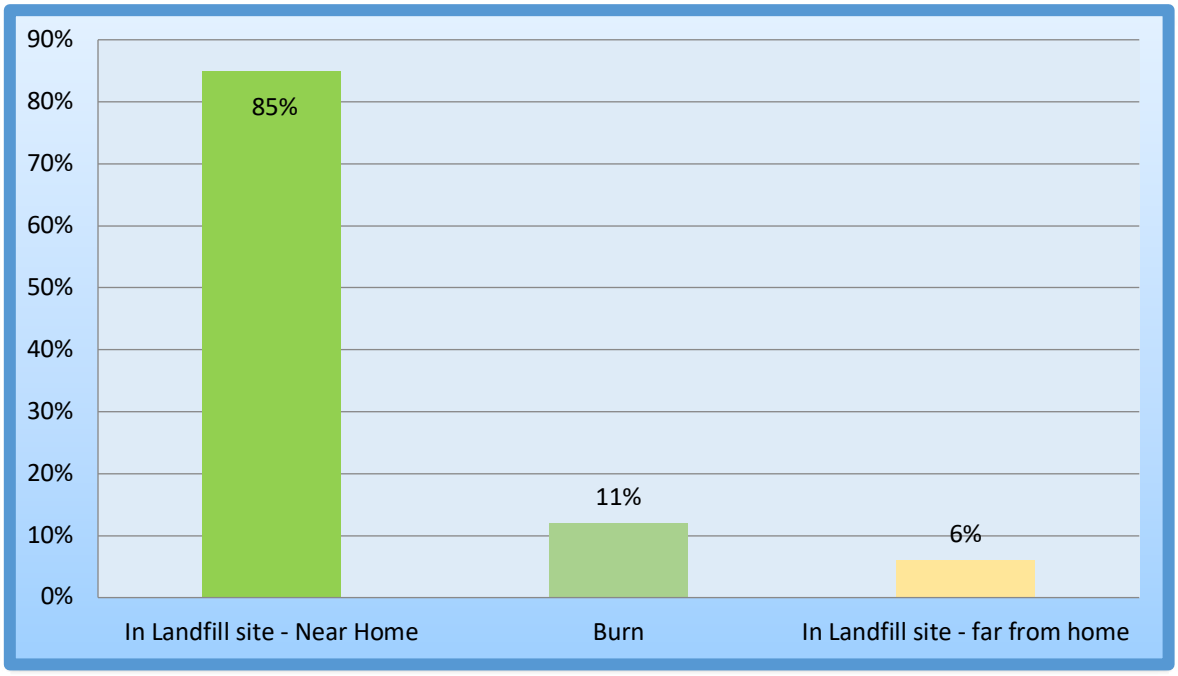


Figure 5.21 - Garbage Disposal Methods

The household surveys suggests that 100% local residents have access to the schools run by Idara Al-Khair, whereas 1% send their children to religious, government schools and vocational institutes. The area people are very poor so they cannot afford the expenses of private schools, so they prefer to send their children to Idara Al-Khair school.

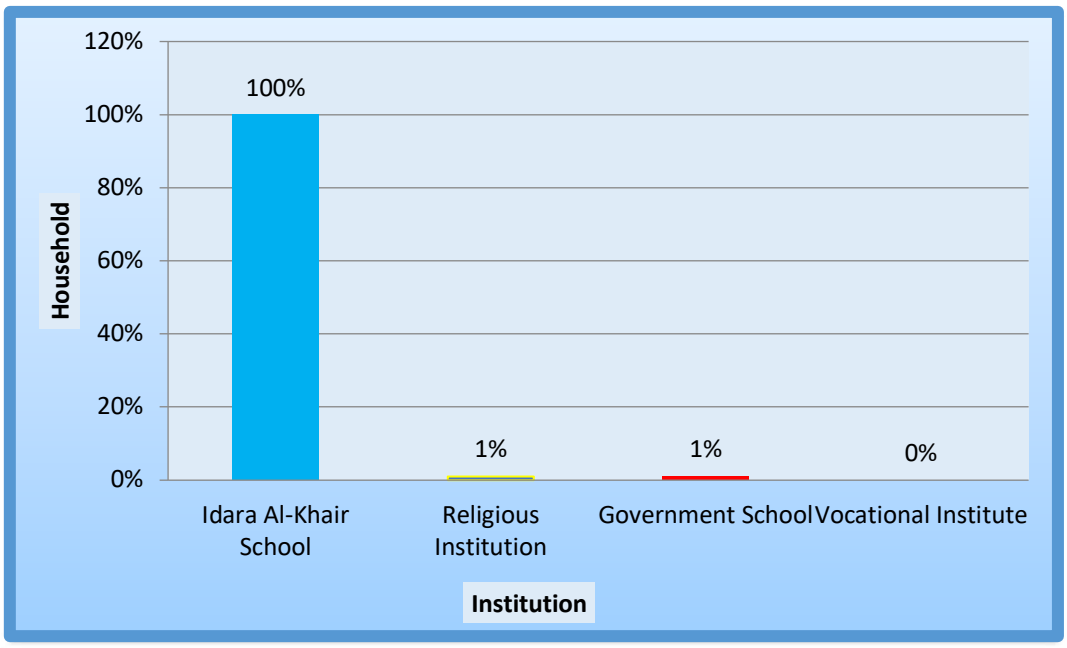


Figure 5.22 - Educational Facilities Utilized

The most prevalent health issues reported in the area include common flu fever, cough, asthma, malaria, and diarrhoea. The most commonly used health facilities in the area are hospitals followed by a dispensary run by Idara Alkhair on weekly basis, and a weekly medical camp run by the NGO HOPE.

Around 98% households reported having access to private dispensary and clinics for getting better treatment, whereas 6% access reported as having to access government facilities as they cannot afford the private hospital/clinics expenses. Only 3 households reported to go homeopathic individuals for treatment.
The area people were not satisfied with the medical services available in the area.

Table 5.23 -Health Facilities Availed by Households

		Total Individuals	
		Count	%
Base: All Households		723	100%
Health Facilities availed by Household	Private dispensary/clinic	710	98%
	Government dispensary/clinic	40	6%
	Homeopathic	2	0%
	Hakim	1	0%
Figures are column percentages			
Multiple responses hence the total can be more than 100			
Source: Sweep Household Survey Data			

Around 18% households reported to availing the loan facility, whereas 82% did not avail any loan ever. In order to meet increased expenditures, most households have to take loans. The major reason reported for taking loans was to cover the expenses incurred on medical treatment (65%) while 12% mentioned marriages of children. Around 9% cover food expenses and basic necessities followed by fetching the water and business purpose. The majority of loan size (36%) is 20,000 not more whereas 9% households reported loan size is more than 100,000.

Table 5.24 - Loan Taking & Payments

		Total	
		Count	%
Base: All Households		723	100%
Any Payable loan? Yes /No	Yes	128	18%
	No	595	82%
Amount of Loan	Up to Rs.25,000	48	38%
	25,001 - 50,000	45	35%
	50,001 - 75,000	8	6%
	75,001 -100,000	15	12%
	100,000+	12	9%
Source of Loan	Relative	29	23%
	Friend	5	4%
	Shopkeeper	2	2%
	Bank	3	2%
	Neighbour	9	7%
	From Landlord	10	8%
	Local Lender (Kabari shop)	64	50%
	Showroom	6	5%
Outstanding Loan	None	1	1%
	Up to Rs.20,000	46	36%
	20,001 - 40,000	32	25%
	40,001 - 60,000	26	20%
	60,001 - 80,000	9	7%
	80,001 - 100,000	2	2%
	100,000+	12	9%
Markup on Loan (%)	None	104	83%

	Up to 5%	5	4%
	06 - 10%	5	4%
	11 - 30%	7	6%
	>30%	5	4%
Purpose of loan	Treatment/Medical	83	65%
	Marriage	15	12%
	Household Food Expense	11	9%
	Fetching Water	5	4%
	For Business	4	3%
	Pay of Bike Instalment	5	4%
	House repairing	5	4%

The surveyed households reported (100%) have no legal status of ownership of houses and shops so they only settled in the village with the permission of the *Wadera* (landlord/ influential village head).

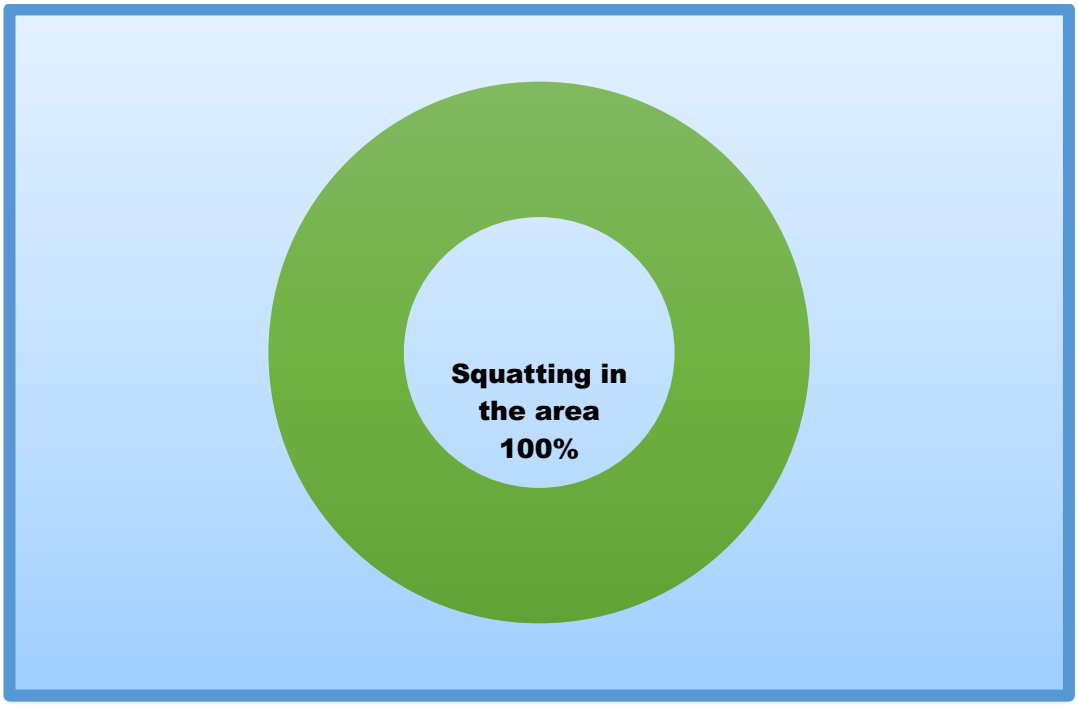


Figure 5.23 - Households Land Ownership Status

The survey of households reported that overall (100%) households are single story.

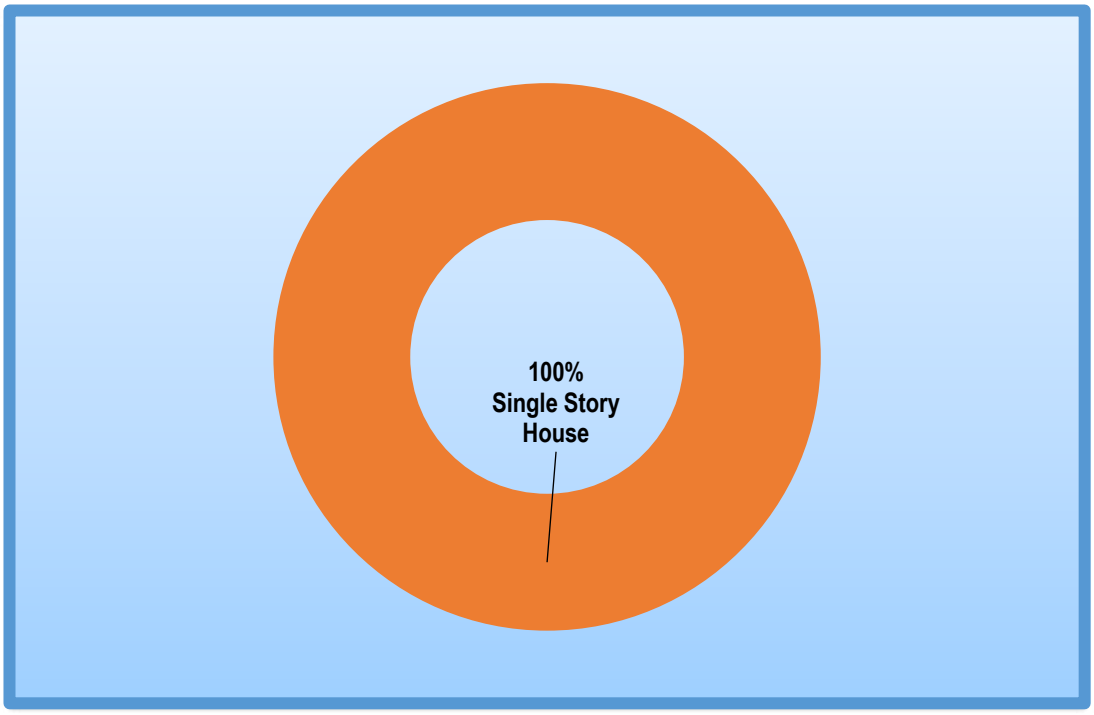


Figure 5.24 - Category of Structure

Based on data collected (98%) households reported that made house by straw, cloth and plastic covered, whereas 1% household reported Pacca and *Katcha* houses in the village.

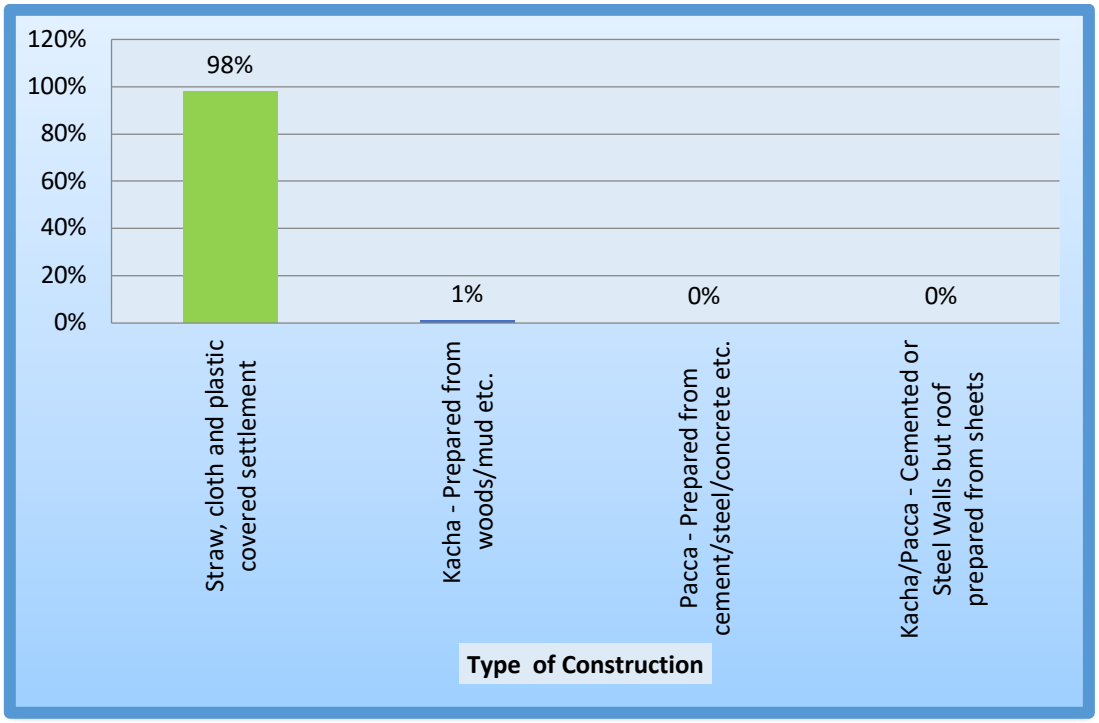


Figure 5.25 - Household Construction Type

5.8.8 Training Needs Assessment (TNA) at Jam Chakro

The training needs assessment (TNA) of all Affected people of Jam Chakro LFS was conducted at Jam Chakro. The main objective was assessing the trainings/skills required for livelihood restoration and to mitigate the livelihood impacts during operations of the landfill site. A training need assessment (TNA) of all waste pickers) was undertaken at Jam Chakro.
The objective of TNA was to:

- Identify and plan measures to be taken under the LRP.
- Identify residents/participants' capacities and vulnerabilities.
- By undertaking the need assessment to identify their preference for alternative livelihood options.

It is anticipated that the required skills would aid in the creation of jobs or self-employment, assisting participants in generating income. Increased economic independence and quality of life, especially for women would lead to an improvement in their standard of living, which would serve as a deterrent to the acceptance of antisocial behaviour like domestic abuse.



Figure 5.26 - Needs Assessment Survey Pictures (March 2023)

Data Analysis of TNA

All APs were surveyed and asked about their aspirations for skill training requirements. Below tables represents the counts based on age and gender, training skills required / proposed by APs themselves and options of skills that were offered to APs to learn.
While asking their present skills, most of the APs are only know the waste picking while few of them know different trades as given in the table.

Table 5.25 - Livelihood Practices of Waste Pickers at Haji Ibrahim Goth

	Total Respondents		Gender			
			Male		Female	
	Count	%	Count	%	Count	%
Base: Total Respondents	1067	100%	841	100%	226	100%
Only Waste Picking	1025	96%	804	96%	222	98%
Mason	17	2%	17	2%	0	0%
Labor Work	11	1%	11	1%	0	0%
Driving	4	0%	4	0%	0	0%
Tailoring /Sewing/Cutting of Fashion Dresses	4	0%	0	0%	4	2%
Mechanic (Bike/Car)	2	0%	2	0%	0	0%
Cooking/Food Stalls/Catering Services	2	0%	2	0%	0	0%
Painter	1	0%	1	0%	0	0%
Livestock Management	1	0%	1	0%	0	0%

Figures are column percentages.
Multiple responses hence the total can be more than 100.
Source: SWEEP: Training Need Assessment Data

From the surveys conducted, 90% of the females wished to gain the tailoring /sewing/cutting of fashion dresses skill set. The males mostly proposed the labor work especially construction labor or mason and driving. Some of them were also interested in learning more vocational skills for example tailoring, electrician and mechanic. Very few of the APs had shown interest in business-oriented / self-employed skillsets.

Details are given below in the table.

Table 5.26: Requested Training Skill(s) by Gender (age 15 and above)

Base: Respondents Aged 15 & above	**Total Respondents**		**Gender**			
			Male		Female	
	Count	%	Count	%	Count	%
	960	**100%**	**769**	**100%**	**191**	**100%**
Driving	211	22%	211	27%	0	0%
Tailoring /Sewing/Cutting of Fashion Dresses	177	18%	6	1%	172	90%
Mason	130	14%	130	17%	0	0%
Mechanic (Bike/Car)	63	7%	63	8%	0	0%
Livestock Management	63	7%	59	8%	4	2%
Electrician	60	6%	60	8%	0	0%
Plumber	40	4%	40	5%	0	0%
Painter	39	4%	39	5%	0	0%
Carpenter/Wood worker	33	3%	33	4%	0	1%
Tire Repairing	31	3%	31	4%	0	0%
Mobile phone repairing	30	3%	30	4%	0	0%
Kitchen garden & Flower Nursery	25	3%	25	3%	0	0%
Cooking/Food Stalls/Catering Services	20	2%	18	2%	2	1%
Rug Making	12	1%	3	0%	9	5%
Poultry Farming	9	1%	7	1%	2	1%
Computer related trainings	9	1%	9	1%	0	0%
None (Respondent demand Jobs only)	5	1%	3	0%	2	1%
Hairdresser	3	0%	3	0%	0	0%

Figures are column percentages.
Multiple responses hence the total can be more than 100.
Source: SWEEP: Training Need Assessment Data

Key Findings of TNA

The surveyed women chose the traditional skills over contemporary due to certain societal factors like male headed family background and were not interested in male dominated occupations. Another factor is the poverty which did not trigger the entrepreneurial options.
The surveyed males were also chosen mostly daily waged occupations from which, at the end of the day, they can have money to spend it and feed their families. The reason again is the poverty. Mostly the men were reluctant not to become self-employed or to start small businesses as it takes some time in establishing and generating revenues.

5.8.9 Livelihood Restoration Plan

The objective of this Livelihood Restoration Plan (LRP) is to provide a detailed plan to livelihood restoration options for the people affected due to the Landfill site development at Jam Chakro and GTS sites. LRP covers the alternative livelihood options for the affected waste pickers whose livelihood will either permanently or temporarily be vanished due to the construction of the landfill site. This livelihood restoration plan is also attached to this ESIA as **Annex-VI**.

Impact on Livelihood During Construction Phase of LFS

During the construction of the proposed landfill cell, the impact on the livelihood of waste pickers at the landfill site is not anticipated. The dumpsite will be utilized as status quo and waste pickers will have access to waste in given areas of the LFS. Major construction will take place over barren areas that fall under the LFS boundary, and the waste will not be dumped in the proposed landfill cell during construction.

Impact on Livelihood During Operation Phase of LFS

In the operations phase of an engineered landfill cell, all the waste coming from GTS sites will be transported to the established cell. The cell will be a closed accessed site and there will be no chance for the waste pickers to salvage material/recyclables at the new landfill cell. There will be a restriction on land use which was meant to be a source of livelihood for 31% of the population of Jam Chakro. There will be economic displacement resulting from the loss of access to dumpsites for 31% of the population, who are currently involved in waste picking at Jam Chakro dumpsite although they have and will have access to waste during the construction phase but in the operation phase, they will not have access. Therefore, 1,067 waste pickers at Jam Chakro are considered Affected Persons (APs).

APs will be facilitated in getting jobs in different sectors subject to their skills and interest and in this regard, liaison will be created to support and facilitate APs in getting relevant jobs for all including women and other vulnerable groups.

Counselling services, and gender-sensitive educational and skills training opportunities for children withdrawn from waste picking will be organized with other INGOs working for waste picking children.

Further, the detail related to data of APs & training need assessment, implementing arrangements, roles & responsibilities of PIU, LRP Implementing firm/s, Grievance redressal procedure for livelihood restoration, budget and monitoring & evaluation are discussed in LRP. An indicative transition plan has also been prepared and added to this report as **Annex-VII.**

6. Anticipated Impacts & Mitigation Measures

This chapter presents the overall risks and impacts (both beneficial and adverse) of pre-construction/ planning and design, construction, and operational phases of the proposed sub-project on the physical, ecological, and socio-economic environment. In addition to this, it also covers the mitigation measures of the identified potential adverse environmental and social impacts.
The E&S impacts arising from each phase of the proposed sub-project have been identified and assessed based on field data, secondary data, expert opinions, and examining similar projects. These include effects on physical, biological, and socio-economic environment.

The risk of each E&S impact was assessed using a semi-quantitative analysis. The risk was computed using the formula below:

RISK = MAGNITUDE OF IMPACT X SENSITIVITY TO RECEPTORS

a) Impact Magnitude

The potential impacts of the subproject have been categorized as major, moderate, minor, or nominal based on consideration of parameters such as:

- Duration of effect
- Spatial extent of the impact
- Reversibility
- Likelihood
- Legal standards and established professional criteria.

The magnitude of each potential impact for each of the sites has been identified according to the categories outlined in Table 6.1 below:

Table 6.1 - Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration of potential impact	Long term (beyond the project life)	Medium Term Lifespan of the project (within the project life span)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond next project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Environmental or social parameter needs a year or so with some responsesto come back to baseline	Baseline returns naturally or with limited response within a few months	Baseline remains constant
Legal standards and established professional criteria.	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but violates international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions. (Certain)	Happens under worst case (negative consequences) or best case (positive impact)	Occurs under abnormal, exceptional, or emergency	Unlikely to happen

Parameter	Major	Moderate	Minor	Minimal
		working conditions (Likely)	conditions (occasional)	

6.1 Receptor Sensitivity

The sensitivity of a receptor has been determined based on a review of the population (including proximity/ numbers/ vulnerability) and the presence of features on the site or the surrounding area. For each potential impact of the subproject at the sites, sensitivity of the receptors was determined using the criteria outlined in Table 6.2.

Table 6.2 - Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no ability to absorb proposed changes or minimal opportunities for mitigation.
Severe	Vulnerable receptor with little or no ability to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some ability to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good ability to absorb proposed changes or/and excellent opportunities for mitigation

Following the assessment of magnitude, the quality and sensitivity of the receiving environmental or potential receptor has been determined and the significance of each potential impact established using the impact significance criteria matrix as shown below. Most of the potential impacts can be mitigated by implementation of various types of mitigation measures. However, some residual environmental impacts may remain after mitigation.

Magnitude of Impact	Sensitivity of Receptors			
	Very Severe (4)	Severe (3)	Mild (2)	Low (1)
Major (4)	16	12	8	4
Moderate (3)	12	9	6	3
Minor (2)	8	6	4	2
Minimal (1)	4	3	2	1

Score	Impact Significance
1	Negligible
2 – 4	Low
5 – 8	Medium
9 – 12	Substantial
> 12	High

6.2 Risk Assessment

The results of the E&S risk assessment conducted for the existing risks at the dumpsite and the development of the sanitary engineered cell at Jam Chakro are presented below:

Table 6.3 - Summary of E&S Risk Assessment of the Existing Dumpsite at Jam Chakro*

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
ESS 1: Assessment & Management of Environmental Risks & Impacts					
Adequate Coverage of Project Risks & Impacts along with definition of mitigation measures	Operations (Current Conditions) & Closure/ Capping	High	Currently, the dump site is operating in an un-engineered manner, where pollutants from leachates, landfill gas and the indiscriminate burning of waste are allowed to escape to the atmosphere.	No immediate mitigation measures that can be applied, where long term, only closure is the most feasible mitigation measure, where detailed design studies have been initiated on the closure/capping of the existing dump site and a tentative cost of 07 million US Dollars has also been estimated for the activity and different methods such as bio-mining, capping, are being explored. Following closure, the residual risk would be medium where the continuous robust monitoring of the capped site would be required.	Medium
ESS 2: Labor and Working Condition					
Occupational Health and Safety Occupational Health and Safety	Operations (Current Conditions)	High	Currently, the people working at the existing dump site in any capacity include: • Mostly the waste pickers who reside at Haji Ibrahim Goth and work in an informal manner at the dumpsite through picking recyclable items out of the incoming waste, • Waste truck drivers who have to navigate through the site to dump their wastes at different areas. • SSWMB workers who overall manage the operations of the dump site. With pools of leachates formed throughout the site, a lack of proper, paved roads, the trucks and people sharing the same roads,	Currently, there are no measures being practiced by the SSWMB or the people at the site, where some immediate measures that can be implemented to improve OHS conditions include: • Provision of Personal Protective Equipment to the waste pickers at site • Designating particular locations of the dumpsite where waste is dumped, and people can pick waste, where the entry and egress of vehicles is observed to avoid any accidents. Alongside this place temporary controls and measures for dealing with leachate and landfill gas.	Substantial

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			and waste dumps being lit on fire to reduce volumes, the overall occupational health and safety conditions of working at the site are extremely hazardous.	With the provision of these mitigation measures, the risk factor still remains high as the dumpsite would still be there, with people still having to traverse through it to get around, introducing OHS risks. Alongside these mitigation measures presented, a detailed Labor Management Procedures has been developed to manage the risks of child labor, forced labor, SEA/SH, labor disputes and occupational health and safety. The LMP details the approach that will be implemented to meet the national requirements and the objectives of the World bank ESS2: Labour and working Conditions and WB ESS4: Community Health & Safety. Similarly, a Gender Action plan has also been developed highlighting provisions of gender to be taken into account. Through the application and implementation of the provisions of the LMP, and the GAP the residual risk of these impacts will still be substantial due to the presence of the dump site.	
	Closure/ Capping	Substantial	At the time of capping, it is planned to start capping from the western part of the site, i.e., the part of the dumpsite adjacent to the settlement (an area that roughly shares a 900 m border with the settlement).	A detailed Labor Management Procedures has been developed to manage the risks of child labor, forced labor, SEA/SH, labor disputes and occupational health and safety. The LMP details the approach that will be	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			This in itself would have OHS risks as work would be taking place in a highly polluted area. Hence, the risk is substantial.	implemented to meet the national requirements and the objectives of the World bank ESS2: Labour and working Conditions and WB ESS4: Community Health & Safety. Similarly, a Gender Action plan has also been developed highlighting provisions of gender to be taken into account. Through the application and implementation of the provisions of the LMP, and the GAP, and the closure of the dump site the residual risk of these impacts will be medium.	
Labor risks	Operations (Current Conditions), Closure/Capping	Substantial	Workers and people at Haji Ibrahim Goth may be exposed to labor risks such as child and forced labor, GBV, discrimination, SEA/SH, and labor exploitations.		Medium
ESS 3: Resource Efficiency and Pollution Prevention Management					
Soil Contamination	Operations (Current Conditions)	High	The existing dumpsite spreads over more than 200 acres, where waste is being dumped into an excavated area with no protective lining. Furthermore, the soil and sand that is being swept up from the street every day is also being deposited at the dump site, leading to considerable soil contamination from current operations.	No such mitigation measures can be proposed currently. Risk to be accordingly studied and measures to be designed by the consultant studying the closure of the dump site.	-
	Closure/ Capping	Medium	The closure of the dump site will involve the potential treatment and remediation of any contamination found including soil.	Following closure, the risk of soil contamination should be low given that monitoring of the various pollutants being generated e.g., leachate and landfill gas is carried out and any issues addressed accordingly.	Low
Pollution of Water Resources	Operations (Current Conditions) &	Substantial	As understood from the environmental investigations conducted of the site, surface water resources around the site have not been polluted. However, some	No such mitigation measures can be proposed as such currently. Risk to be accordingly studied and measures to be	-

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
	Closure/ Capping		pollutants. (e.g., barium, chloride, fluoride, and lead) with elevated concentrations in the leachate generated on site, have also exhibited elevated levels in the groundwater quality found in the area. Further detailed investigations are required at the site to understand the impact of the site on the groundwater of the area. Nevertheless, with no protective liners, percolation and movement of leachate and pollution generated may lead to groundwater and surface water quality deterioration, which is a substantial risk.	designed by the consultant studying the closure of the dump site. Given that the overall groundwater quality of the city is deteriorated due to indiscriminate dumping of wastes and discharge of effluents from industries and municipalities into unlined canals, remediation/ closure must be planned accordingly.	
Air Pollution	Operations (Current Conditions)	High	Currently, the sources of air pollution at the site include: • Extensive burning of wastes at the site by waste pickers to reduce volume of waste and find recyclable items. • Generation of landfill gas at the site and lack of capture/control mechanisms • Movement of heavy vehicles at the site in the form of garbage disposal trucks All of these items pose a high risk of extreme air quality deterioration, particularly the burning of wastes as the highest quantity of waste arriving at the site is single use plastic (polyethene bags), which when burned produce toxic pollutants such as microplastics,	Some immediate mitigation measures that can be implemented include: • Spreading awareness on the burning of wastes and providing alternatives. • SSWMB oversight on not allowing burning of waste, and immediately putting out any fires identified. The risk after this should be substantial, and as such will require the closure of the site as a long term solution.	Substantial

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			bisphenols, and phthalates, all toxins that can disrupt neurodevelopment, endocrine, and reproductive functions in humans.		
	Closure/ Capping	Medium	The closure of the dump site will involve identification of measures for the capture and management of landfill gas. This will also put an end to the indiscriminate burning of waste at the site.	Following closure when landfill gas is managed, monitored, and controlled, and the risk of indiscriminate burning of waste is also reduced, then the risk of air pollution should be low.	Low
Noise	Operation (Current Conditions)	Medium	Noise is produced due to the operation of machinery and other equipment. Sources of noise currently include the movement of trucks that bring in waste to the dump site.	Some mitigation measures here include: • Working during specified hours after contractors have submitted work schedules and they have been shared with the stakeholders in the AOI. • Regular maintenance of machinery, equipment and vehicles shall be carried out. Through the application of these mitigation measures and those detailed in the impacts chapter, the risk can be considered to be low.	Low
	Closure/Capping	Substantial	Machinery that will be used during the closure of the site may include heavy machinery such as bulldozers, excavators, stabilizers, concrete mixing plant, pneumatic drills, and other equipment. This may cause disturbance to the activities in the mosques, schools, hospitals, and households within AoI.	Some mitigation measures here include: • Informing stakeholders within the AOI of commencement of work • Working during specified hours • Regularly checking and ensuring that machines are well maintained. • Using plantations as natural barriers to noise propagation, particularly near the safety zone between Haji Ibrahim goths	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
				Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium.	
ESS 4: Community Health and Safety					
Traffic & Vehicular Movement	Operation (Current Conditions)	Substantial	Currently, there are no separate routes or roads for vehicles and movement of humans, where narrow paths have been carved out of the existing dumpsite for the movement of both. This has the potential of creating accidents and issues for the people, particularly waste pickers at the site.	Some immediate mitigation measures include: • Designating particular locations of the dumpsite where waste is dumped, and people can pick waste, where the entry and egress of vehicles is observed to avoid any accidents. Alongside this place temporary controls and measures for dealing with leachate and landfill gas. • Providing people with PPEs • Monitoring the speed of vehicles in the area The application of these measures should reduce the risk to medium.	Medium
	Closure/Capping	Substantial	During closure, there will be heavy machinery and vehicles on site in line with the technology chosen which may be a source of harm to the people. After closure, however, there should be no more vehicular movement on site, unless it is for the monitoring being conducted.	Some mitigation measures here include: • Using of vehicles in designated areas and avoiding roads that are used by the population. • Parking of vehicles in the designated areas • Erection of fencing or barriers around the population at Haji Ibrahim Goth to reduce risk of accidents. Further mitigation measures are to be defined after the study for capping is completed. Nevertheless, the adoption of these risks should reduce the risk of traffic related	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
				accidents during capping to medium, and then post capping to low.	
Community Health and Safety Risks	Operations (Current Conditions)	High	Current community health and safety risks include: • Exposure to dusts and air emissions from the existing dump site including from the indiscriminate burning of wastes that produces harmful emissions. All of these items pose a high risk of extreme air quality deterioration, particularly the burning of wastes as the highest quantity of waste arriving at the site is single use plastic (polyethene bags), which when burned produce toxic pollutants such as microplastics, bisphenols, and phthalates, all toxins that can disrupt neurodevelopment, endocrine, and reproductive functions in humans, particularly vulnerable populations such as children and the elderly. • Exposure to hazardous materials and wastes including industrial waste and medical waste that currently finds its way to the site through third party contractors. • Continued contamination of soil, groundwater aquifers, and air from the open dumpsite, through the unmitigated and un-engineered dumping of wastes.	There are certain mitigation measures that the operations team at the existing dump site can apply to improve community health and safety conditions whilst operations continue at the dumpsite: • Disallow people from burning waste at the site, where if burning waste is found, then it is immediately extinguished using the appropriate firefighting equipment. • Avoid dumping wastes near the community at Haji Ibrahim Goth and the pathways they use for travel. • Cover and contain waste that using a layer of soil or other appropriate materials to minimize the dispersion of pollutants into the air. • Carry out fumigations at the site to reduce the risk of vectors and disease transmission to the extent feasible during the development of the new cells, along with the potential odor generation and propagation. Nevertheless, to truly reduce the risk from the existing dump site, the appropriate long term measure would be to carry out a detailed study for the capping/ closure of the dumpsite along with any potential rehabilitation of the site deemed necessary.	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			• Leachate management and potential for contamination of surface water resources and groundwater resources. • Transmission of diseases through vectors at the community in Haji Ibrahim Goth and the nearby areas in the AOI. The overall community health and safety risks under the current conditions are high.	The closure/ capping of the site should look into the following items to effectively reduce community health and safety risks: • Usage of appropriate cover materials that includes impermeable layers of materials with appropriate thickness in line with the conditions identified at the site. • Designing proper gas venting and collection systems to prevent gases from migrating into surrounding areas. • Designing of appropriate leachate control and treatment mechanisms to prevent the migration of contaminated leachate into surrounding surface and ground water. • Designing of appropriate drainage systems to control surface water runoff and to prevent erosion. • Designing of appropriate monitoring wells around the closed site to regularly assess the groundwater quality. • Establishment of security measures to prevent unauthorized access to the closed site. • Development of a post closure monitoring plan to assess the long	

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				term effectiveness of the closure and capping measures. • Development and communication of emergency response plans to address any unforeseen events or issues that may arise after closure. If these items are considered during the design of the closure/ capping of the site, and implemented, then following closure, the risk of these items should be low.	
	Closure/ Capping	Medium	Following closure there will still be needs to monitor the effectiveness of the closure through monitoring of the landfill gas, and leachates.	Following closure, with the use of a robust monitoring mechanism, the overall risk towards community health and safety should be low.	Low
Social Conflict, GBV, SEA/SH	Operation (Current Conditions), Closure/ Capping	Substantial	Currently, there are no procedures defining the risks of SEA/SH and GBV, along with a potential mechanism for aiding survivors. Furthermore, during the closure phase, conflicts may arise between labor force and local community, including the risk of SEA/SH and GBV.	A Gender Action plan has been developed highlighting provisions of gender to be taken into account and the different risks and their mitigation measures along with a grievance redress mechanism that will work to reduce this risk to medium.	Medium
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources					
Biodiversity Flora	Operations (current conditions), Closure/ Capping	Substantial	Currently the risks to biodiversity include: • Deterioration of the critically endangered plants of Commiphora wightii on site • Goats and cow in large numbers are observed to graze on the organic matter	The capping will take care of the grazing of animals, however, will require that the Commiphora wightii are relocated before that to ensure that no plants are disturbed from capping. The residual risk should then be low.	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			on site, where pollutants from the waste are ingested, and diseases may be introduced in the animals which are passed on as part of the food cycle.		
ESS 8: Cultural Heritage					
Chance Find Procedures	Operations (current conditions), Closure/ Capping	Low	There are no notified sites of cultural heritage or importance in the area.	Chance finds procedures have been established and added in the **Annex-VIII** should any items of archaeological and cultural value be identified. The residual impact should then be low.	Low
ESS 10: Stakeholder Engagement and Information Disclosure					
Stakeholder engagement	Operations (current conditions), Closure/ Capping	Substantial	The project-affected population and sensitive receptors may not be aware of the proposed project and particularly the measures being taken place at different times of the project, which would be an issue given the close proximity of their siting to the site and the dependence of 1/3 of the population on waste picking activities.	A stakeholder engagement plan has been prepared in line with ESS-10 highlighting the stakeholders in the area, and their consultation preferences and frequencies. If the SEP is implemented, then the residual risk should be medium.	Medium

*Note: This Risk Assessment for the existing dumpsite and its closure has been conducted prior to the respective detailed design studies, where the table may be revised in line with the findings of the studies.

Table 6.4 - Summary of E&S Risk Assessment of the Sanitary Engineered Landfill Cell at Jam Chakro

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
ESS1: Assessment & Management of Environmental & Social Risks & Impacts					

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Adequate Coverage of Project Risks & Impacts along with definition of mitigation measures for Development of New Sanitary Landfill Cell	Construction & Operation	High	Conducting an inadequate assessment or not conducting an assessment that does not cover the guidelines of the World Bank's ESF and local regulations. This would be a high risk.	The ESIA prepared for the cell covers all risks in detail in line with the project's construction and operation phases. Furthermore, the following associated Environmental & Social instruments have also been prepared in line with the requirements of the ESF: 7. Environmental & Social Management Framework 8. Resettlement Framework 9. Stakeholder Engagement Plan 10. Labor Management Procedures 11. Gender Action Plan 12. Livelihood Restoration Plan (given that no physical involuntary resettlement is involved). Following proper implementation of the measures provided in this ESIA and the associated instruments, the residual risk should be low.	Low
ESS 2: Labor and Working Condition					
Occupational Health and Safety	Construction	Substantial	Construction workers are exposed to occupational health and safety risks and hazards when performing construction activities such as operation of heavy equipment and machines, labor works, civil works, and others, along with working near polluted areas.	A detailed Labor Management Procedures has been developed to manage the risks of child labor, forced labor, SEA/SH, labor disputes and occupational health and safety. The LMP details the approach that will be implemented to meet the national requirements and the objectives of the World bank ESS2: Labour and working Conditions and WB ESS4: Community Health & Safety. Similarly, a Gender Action	Medium
	Operation	Medium	Workers are exposed to occupational health and safety hazards during O&M activities including the disposal and compaction of		Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			waste, laying of top cover, leachate management, etc.	plan has also been developed highlighting provisions of gender to be taken into account. Furthermore, a sanitation plan and a health & safety manual have been attached as **Annex-IX** and **Annex-X** respectively. Through the application and implementation of the provisions of the LMP, and the GAP the residual risk of these impacts will be low to medium.	
Labor risks	Construction, Operation	Substantial	Workers may be exposed to labor risks such as child and forced labor, GBV, discrimination, SEA/SH, and labor exploitations.		Medium
ESS 3: Resource Efficiency and Pollution Prevention Management					
Resource Efficiency	Construction	Medium	Non-renewable materials such as water, crushed aggregates, sand, cement, and fuel will be used during construction where these materials cannot be used again.	Some mitigation measures that may be used here include: • Use of efficient and well-maintained machines • Implement energy and water conservation measures. • Training workers on energy & water conservation measures A resource conservation plan has also been attached as **Annex-XI** to this report. Through the implementation of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be medium.	Medium
Soil Contamination	Construction	Medium	Given that the area where the cell is planned is virgin land, the chance of existing soil contamination is low, however, the soil will be subject to minor trimming and cutting, and potential erosion from movement of machinery. Erosion may increase during	Some mitigation measures that may be used here include: • Using Safety Data Sheets during handling and storage of chemicals	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
			intense rainfall events, and contamination may be caused by oil and chemical spills or uncontrolled runoff from equipment washing yards.	• All maintenance of heavy equipment and vehicles to be done in an area with designated lined flooring • Controlling runoff volumes and intercepting before leaving sites Through the application of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be low.	
Pollution of Water Resources	Construction	Medium	Runoff from the construction works area may contain increased loads of sediments, suspended solids and other contaminants which will increase the pollution load of the available water resources in the project area. The following are the potential sources of pollution of water sources: • Discharge of untreated wastewater from contractors' camps and construction site • Oil and chemical spills • Dumping of wastes from contractors' camps and construction site	Some mitigation measures that may be used here include: • Wastewater from washing of vehicles or equipment will not be directly discharged in any water source or the storm drainage. • Provision of sanitary toilet facilities in the constructors' camp • All the effluents will be discharged into existing sewerage system as per the requirements of stringent environmental quality standards. • Septic tanks will be constructed to provide primary treatment after which the wastewater will be discharged into existing sewerage network system with the prior approval of KWSB. Through the application of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be low to medium.	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Air Pollution	Construction	Substantial	The use of vehicles, heavy equipment and generator sets will emit gaseous air pollutants such as carbon monoxide (CO), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2). Earthmoving activities and excavation will generate dusts. This may cause nuisance and respiratory stresses to vulnerable groups such as children and elderly.	Some mitigation measures that may be used here include: • Regular water sprinkling on the site and access roads will be carried out to suppress excessive dust emission(s). The frequency of water sprinkling will be increased in summer season as per the requirement. • The vehicles carrying construction materials and the construction material storage areas will be covered with tarpaulin. • Excavated materials will always be covered. Through the application of these mitigation measures, and those detailed in the impacts chapter, the risk can be considered to be medium.	Medium
	Operation	Medium	During the operational phase of the landfill, the western valley will work as a semi aerobic landfill and the eastern valley as a conventional landfill, meaning only the eastern valley will produce methane in considerable quantities for concern. Nevertheless, as per engineering calculations provided in the project description chapter above, it is not estimated that there will be considerable amounts of landfill gas being generated, where appropriate engineering controls	Some mitigation measures that may be used here include: • All vehicles, machinery, equipment, and generators used during construction activities will be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions and subsequent impacts. • Personal Protective Equipment's (PPEs) like masks, goggles which are suitable for specific jobs will be provided to workers and visitors.	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			have been defined to capture and properly deal with the gases also.	Through the application of these mitigation measures and those detailed in the impacts chapter, the risk can be considered to be low to medium.	
Noise	Construction	Substantial	The noise may be produced due to the operation of construction machinery and other equipment. Sources of noise during construction are heavy machinery such as bulldozers, excavators, stabilizers, concrete mixing plant, pneumatic drills, stone crushers, asphalt plants and other equipment. This may cause disturbance to the activities in the mosques, schools, hospitals, and households within AoI.	Some mitigation measures here include: • Informing stakeholders within the AOI of commencement of work • Working during specified hours after contractors have submitted work schedules and they have been shared with the stakeholders in the AOI. • Regular maintenance of machinery, equipment and vehicles shall be carried out. Through the application of these mitigation measures and those detailed in the impacts chapter, the risk can be considered to be medium.	Medium
	Operation	Medium	The operation of the landfill including the movement of machinery and disposal of waste is what will contribute to noise.	Some mitigation measures here include: • Working during specified hours • Regularly checking and ensuring that machines are well maintained. • Using plantations as natural barriers to noise propagation, particularly near the safety zone between Haji Ibrahim goths. This is further elaborated upon in the tree plantation plan attached as **Annex-XII.** Through the application of these measures and those detailed in the impacts chapter, the risk can be considered low to medium.	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
Construction Wastes	Construction	Medium	Domestic solid wastes will be generated by the workers in the contractors' camps. Improper storing of kitchen and food wastes may attract rodents and other pests. Construction wastes will be generated. These wastes can also be hazardous. Improper storage and disposal of these wastes may cause pollution to soil and in water if dump in water bodies.	Some mitigation measures here include: • Having the contractor develop and implement a site-specific waste management plan. • Designation of specified areas for different kinds of waste • Prohibiting burning of waste • Recycling items to the extent possible A waste management plan has also been prepared and attached as **Annex-XIII**. Through the application of these measures and those detailed in the impacts chapter, the risk can be considered low to medium.	Low
ESS 4: Community Health and Safety					
Traffic	Construction	Substantial	The landfill site will still have incoming waste vehicles, where construction vehicles for the new cell will also be on site. Given that both will be in separate areas of the site, the routes to these sites will still have some overlap and may lead to traffic congestion. This may also lead to people who use the masjid, graveyard, and schools to have accessibility issues.	Some mitigation measures here include: • Contractor to Conduct a traffic survey prior to mobilization at site to identify traffic load and possible traffic congestion. • Finalize a site-specific traffic management plan. • Inform stakeholders in the AOI about traffic disruptions. • Construction vehicles to be parked in designated areas. A guide traffic management plan has been attached as **Annex-XIV** to this report. Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium adverse.	Medium
	Operation	Medium	During operations, and after the development of the ring road/ access road,	Some mitigation measures here include:	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
			and designated areas for waste disposal, parking, and washing, along with the implementation of an overall traffic management plan, it is expected that overall traffic impacts will be low.	• Using of vehicles in designated areas and roads • Parking of vehicles in the designated areas Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium.	
Community Health and Safety Risks	Construction	High	Community health and safety risks include (i) Exposure to dusts and air emissions from the construction site may cause respiratory distress most especially to the vulnerable groups such as children and the elderly (ii) Exposure to hazardous materials and wastes, (iii) site stability of new cell and existing dump, (iv) flood risk, (vi) fugitive emissions, (vii) continued contamination of soil, groundwater aquifers, and air from the open dumpsite, (viii) leachate management. The community may also be exposed to communicable diseases, vector-borne diseases, and water-borne diseases due to the influx of workers.	Some mitigation measures here include: • The construction activities will be planned and managed in close consultation with these stakeholders to minimize the vulnerability of above impacts on these sensitive receptors, where construction sites will be fenced. • Special arrangements will be ensured to the accessibility and safety of the educational institutes which cater to toddlers and young kids. • The speed of the vehicles will be controlled (at 30 to 40 km/hr) to reduce the probability of severe accidents, debris flows and dust emission which can harm the educational and health institutions. • Development of a buffer zone between Haji Ibrahim Goth and the landfill cell and development, where plantations will be carried out to act as a natural barrier. A community health & safety plan is attached to this report as **Annex-XV** along with emergency preparedness and response procedures attached as **Annex-XVI**.	Substantial

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium to substantial.	
	Operation	Substantial	The community health and safety risks during operations include (i) continued exposure to landfill gas and subsequent impacts (asphyxiation in closed areas, etc.), (ii) leachate management, (iii) flood risk, (iv) site stability, (v) and attraction of vermin.	Some mitigation measures here include: • Monitoring of landfill gas and water quality at different areas of sensitive receptors • Ensure efficient working of the gas processing plant. • Measures for these have been incorporated in the engineering design, where plantations in the buffer between the cell and the settlement at Haji Ibrahim Goth will serve as a barrier between vermin. Subsequently, despite the low amounts of leachate and landfill gas estimated, appropriate engineering controls have been introduced to minimize this impact. Through the application of these measures and those detailed in the impacts chapter, the risk can be considered medium to substantial.	Medium
Vibration	Construction	Medium	Construction activities may generate vibration that may cause structural damage to the nearby buildings and may also cause disturbance to the activities of the community within AoI.	The setback from the village to the nearest area where construction is taking place is considerable enough such that through attenuation, the vibration reaching the village should be minimal. The residual impact is low	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
	Operation	Medium	Operational Activities will involve the movement of heavy machinery involving the disposal of waste	The setback from the village to the nearest area where construction is taking place is considerable enough such that through attenuation, the vibration reaching the village should be minimal. The residual impact is low.	Low
Social Conflict, GBV, SEA/SH	Construction	Substantial	During the construction phase of the project, conflicts may arise between labor force and local community, including the risk of SEA/SH and GBV, which is a substantial risk.	A Gender Action plan has been developed highlighting provisions of gender to be taken into account and the different risks and their mitigation measures. Through the application and implementation of the provisions of the GAP the residual risk of these impacts will be medium adverse. Furthermore, a Grievance Redress Mechanism has been developed including GBV/SEA/SH measures which will be used and maintained during construction and operations.	Medium
Security Personnel	Construction & Operation	Substantial	With the presence of a sizable population present at Haji Ibrahim Goth right next to the site, the deployment of security personnel with arms during construction and operation for the protection of site and construction materials will be required. The abuse of power by these security personnel is an issue that will have to be proactively dealt with. This is a substantial risk.	Mitigation measures here include: • Conduct training, equipping, and monitoring of such security workers in line with Good International Industry Practices and applicable laws, along with on how to deal with the community. • No use of force to be allowed in providing security except for preventive and defensive purposes in proportion to the nature and extent of the threat. • Background checks to be done on security personnel prior to hiring to ensure there are no past transgressions.	Low

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
				• Review any and all allegations of unlawful or abusive acts of security personnel and take action as necessary to prevent recurrence and, where necessary, report unlawful and abusive acts to authorities. Following this, the residual risk should be low.	
ESS 5: Land Acquisition, Restriction on Land Use, and Involuntary Resettlement					
Resettlement & Livelihood Restoration	Operation	Low	There is no land acquisition or physical displacement/involuntary resettlement involved, however, around 1,067 waste pickers reside next to the site at Haji Ibrahim Goth and earn their livelihoods from waste picking at Jam Chakro. Given that the new site will be access controlled, these people will no longer be allowed to continue picking waste at the site.	No physical resettlement or relocation involved, where only livelihood loss is foreseen under the subproject. As such, a separate livelihood restoration plan has been prepared capturing these impacts and tailoring appropriate mitigation measures to ensure the affected persons are able to learn new skills and find new livelihoods. Furthermore, a transition plan for the waste picking community at Haji Ibrahim Goth has also been developed and added as **Annex-VII**. Through the application of the LRP, the residual impact should be low.	Low
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources					
Biodiversity Flora	Construction	Medium	It is estimated that from activities, around 07 grasses, 58 shrubs, 10 trees, and 667 plants of Commiphora wightii will be removed. Commiphora wightii is a critically endangered plant as per the IUCN Red List and is found only in South Asia. These plants cannot be removed as is and must be moved to another suitable location outside the cell area (or into the buffer area).	The Commiphora Wightii will be relocated and replanted to the buffer zone area between the new cells and the settlement at Haji Ibrahim Goth. This will be done in collaboration with the community to promote ownership of the plantations and ensure care of the buffer zone. Successfully doing this will allow for the residual impact to be medium to substantial	Medium

Environmental and Social Risks and Impact	Risk Assessment				
	Project Phase	**Risk Rating**	**Description**	**Mitigation Measure(s)**	**Residual Risk Rating**
				adverse as it is greatly possibly for some plants to not survive the relocation.	
ESS 8: Cultural Heritage					
	Construction	Low	There is no designated cultural heritage site within the AOI of the project.	A chance find procedure has been developed and attached to the **Annex-VIII** for implementation.	Low
ESS 10: Stakeholder Engagement and Information Disclosure					
Stakeholder engagement	Construction	Substantial	The project-affected population and sensitive receptors may not be aware of the proposed project, which would be an issue given the close proximity of their siting to the site.	A stakeholder engagement plan has been prepared in line with ESS-10 highlighting the stakeholders in the area, and their consultation preferences and frequencies after detailed rounds of consultations with the people at Haji Ibrahim Goth. Once the SEP is implemented, then the residual risk should be low to medium.	Medium

6.3 Assessment of Potential Impacts and Mitigation Measures (Design/Pre-Construction Stage)

6.3.1 Siting & Selection of Landfill Site

Impacts

Due to release of environmental pollutants from landfill such as Greenhouse gases, Volatile organic compounds and leachate, landfill must be carefully located considering its impacts on near-by receptors.

Given the close proximity of settlements such as Haji Ibrahim Goth (Informal Settlements) located 120 m away from the perimeter of landfill area, the adequate safety zone cannot be provided, thus adverse impacts are envisaged on the community. In addition to that, hub canal supplying water from hub dam to Karachi is also passing near the proposed landfill site, distance varies from 30m to 292m, having potential for water contamination.

The other aspects to consider while designing of landfill sites are soil condition and its proximity to fault lines, the proposed landfill site soil is composed of limestone and fissured sandstone which would be incompetent as barriers to leachate and gas migration, further north end of proposed landfill site is located on fault line which could allow unpredictable movement of leachate and gases.

Mitigation Measures

The Design Consultant in its Diagnostic report conducted a very comprehensive study on site assessment criteria for landfill, the location and suitability for the proposed landfill site has been assessed against following International and National guidelines:

- The World Bank (WB) Guidance for sanitary landfill design and siting criteria.
- International guidance criteria as stipulated in the US EPA guidelines for the solid waste disposal facilities.
- Pakistan EPA Guideline for Solid Waste Management

Based on above mentioned guidelines, a site assessment of proposed landfill site against sitting guidelines has been undertaken and additional requirement where needed are stipulated in **Table 6.5.**

Table 6.5 - Site Assessment Against Siting Criteria

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
Distance to nearest settlement(s)	The land area should not be in areas where adequate buffer zones are not possible or areas immediately upwind of residential area in the prevailing directions.	Part D-1, 2.6. (2)			No	Maximize buffer zone adjacent to Haji Ibrahim Goth. Also provide screening measures and odour control measures.	The nearest recognized and legal human settlement is 65 m away from the perimeter of the proposed landfill area. Other residential areas are located just outside of the 250 m limit, with the exception of Haji Ibrahim Goth which lies within the stipulated 250 m limit. The latter settlement lies adjacent to the existing open dump and has developed in parallel with the dump site. However, the side of Haji Ibrahim Goth that is exposed to the new cell comprises of lesser houses (perimeter of 130 meters).
	No residential development should be adjacent to the perimeter of	Part D-1, 2.6. (10)					

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	the site boundary						
	No residential development within 250 meters from the perimeter of the proposed landfill cell development		Page No 5				
	Any House Scheme within a radius of 300 m may have high impact	Part D-1, 3.2,3.2.4. (4)					
Distance to surface water including water bodies, including dams	No private or public drinking,	Part D-1,2.6. (7), (8)	Page No 5	Page 12 (8)	No	No additional requirements	Distance to hub canal varies from 30 m to 292 m, however, from the water quality monitoring conducted, there is no

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	irrigation, or livestock water supply wells within 500 meters downgradient of the landfill boundaries, unless alternative water supply sources are readily and economically available and the owner(s) gives written consent to the potential risk of well						contamination of the canal water from activities of Jam Chakro site.

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	abandonment.						
Distance to an environmentally sensitive area (ESAs)	No significant protected forests are within 500 m of the landfill cell development area		Page No 5		Yes		There is no Protected Forest
	No Environmental Endangered Species breeding areas or protected living areas are present within the		Page No 5		Yes		There is no Endangered species

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	site boundaries						
	No environmentally significant wetlands of important biodiversity or reproductive value is present within the potential area of the landfill cell development.	Part D-1,2.6, (5)	Page No 5	Page 10 (3)	Yes		There is no Wetlands available in the perimeter of the proposed landfill
Distance to a religiously sensitive area	Avoid siting within 1 km of socio-politically		Page No 6		No	No additional requirements	The site is located adjacent to the existing open dump site which lie in closer proximity to schools than the proposed sanitary landfill

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	sensitive sites where public acceptance might be unlikely (i.e., memorial sites, churches, and schools) and avoid access roads that would pass by such culturally sensitive sites.						
General description of the soil type (based on available information)	No underlying limestone, carbonate, fissured or	D-1, 3.2,3.2.3, (4)	Page No. 5		No	No additional requirements	The site is underlain in part by limestone and by fissured sandstone. Landfill design will need to take into account medium permeability strata beneath the site

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	other porous rock formations which would be incompetent as barriers to leachate and gas migration, where the formations are more than 1.5 meter in thickness and present as the uppermost geologic unit above sensitive						

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	groundwaters.						
Distance to airports	If the Landfill site is located within 10 km of an airport so asks for approval from concerned Authorities	D-1,2.6, (22)		Page No 9 (1) Airport runway used Turbo aircraft limit 10000 Feet; 5000 Feet of any airport runway used only by Piston type aircraft	Yes exceeds requirements.	No additional requirements	Airport is 19.6 Km away from landfill site, and it shows that the landfill has no impacts on Airports
	No siting within 3 km of a turbojet airport, 1.6 km of piston type airport or 8 km From the nearest turbojet airport		Page No. 5				

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
Distance to soil cover site	Availability on-site of suitable soil cover material to meet the needs for intermediate (minimum of 30 cm depth) and final cover (minimum of 60 cm depth), as well as bund construction (for the Cell method of landfill). Preferably, the site would have		Page 5	Page No 13 - the lower layer of soil should be at least 2 feet thick with a hydraulic conductivity of no greater than 1 x 10-7 cm/sec. The leachate collection system must be designed	No		The site is underlain in part by limestone and by fissured sandstone. Landfill design will need to take into account medium permeability strata beneath the site

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	adequate soil to also meet daily cover needs (usually a minimum of 15 cm depth of soil). However, daily cover needs can be alternatively met by using removable tarps, other relatively inert materials (i.e., compost residuals), or by			to keep the depth of the leachate over the liner to less than 30 centimeters.			

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	removing the previously laid daily soil cover at the start of each day for reuse at the end of the same day. For purposes of siting, assume that at least 1 cubic meter of daily, intermediate, and final compacted soil cover is needed for every 6 cubic meters of						

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	compacted refuse. In most developing countries with highly organic wastes and warm climates, compacted refuse (after one year of natural consolidation and decomposition within warm and wet climates) achieves a density of						

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	800-1000 kg/cubic meter.						
100 years flood plan	No siting within a floodplain subject to 10-year floods and, if within areas subject to a 100-year flood, must be amenable to an economic design which would eliminate the potential for washout		Page 5	Page No 10 (4)	Yes		As per the flood risk assessment conducted above, the chance of flooding in the area as per data of the last 10 years, is very low.

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
Depth to groundwater (m) based on available information	Groundwater's seasonally high table level (i.e., 10 years high) is at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development. A minimum depth of 1 meter of relatively impermeable soils above	D-1,2.6.(4)	Page 5	Page No 14	Yes		Depth to groundwater exceeds 50 m. In addition, the groundwater is unsuitable for human consumption

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	the groundwater's seasonable high level exists (preferably, less than 10-9 meters/second permeability when undisturbed). If these criteria are not met, use of impermeable clay and/or plastic liners may be required to						

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	protect groundwater quality						
Major electrical transmission line	No major lines of electrical transmission crossing the landfill cell development area unless the landfill operation would clearly cause no concern or rerouting is economically feasible.	D-1,2.6.(9)	Page No 5		Yes		Major transmission line lies west of the landfill site at distance 638 m
Gas supply pipeline	No gas line crosses the landfill cell	D-1,2.6.(9)	Page 5		Yes		Gas pipelines are buried in the area of the open dump; none are recorded in the area proposed for the sanitary landfill

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	development area unless the landfill operation would clearly cause no concern or rerouting is economically feasible.						
The capacity of the landfill	Adequate land area and volume to provide sanitary landfill capacity to meet projected needs	D-1,2.6. (1) 25 Years	Page No 4 (10 Years)		No		Without waste diversion the site may not last for a minimum of 10 years
Seismic Impact Zones	No significant seismic risk	D-1,2.6. (12)	Page 5	Page No 10 (5)	Yes	https://doi.org/10.1007/s110	Karachi has experienced no earthquake related damage in the recorded history of

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
	within the region of the landfill which could cause destruction of berms, drains or other civil works, or require unnecessarily costly engineering measures, otherwise side slopes may need to be adjusted to be gentler than the maximum of 2.5:1					69-019-03755-5	past~175 years. intermediate seismic hazard value of 0.16-0.24 g (Zone IIB)

Location Standards/Guidelines	Setback Requirements	Regulatory Requirements or Guideline Reference			Does site meet or exceed the minimum Requirements	Required Additional Evaluation?	Notes
		Pakistan EPA Guideline for Solid Waste Management	World Bank Guideline for Sanitary landfill design and sitting criteria	US EPA Guidelines for Solid waste Disposal Facilities			
Proximity to fault line(s)	There should be no Fault Lines or significantly Fractured geological structures that would allow unpredictable movement of gas or leachate is within 0.5 km of the perimeter of the proposed landfill development	D-1,2.6, (13)	Page 5	Page No 10 (4) Fault areas prohibited within 200 Feet	No		Fault line is located at the north end of the site, but no known activity on this fault in historical times

However, these limitations should be viewed in the context of the existing development of an extensive open dump site adjacent to the proposed site of the sanitary landfill. Significant environmental impacts that might be anticipated from waste disposal activities are already present in the surrounding location and have not precluded continuing urbanization of the area. From a socio-economic perspective there is already resilience built into the surrounding communities; the adoption of sanitary landfilling, as against open dumping of waste, should lessen the impacts of waste disposal on the surrounding communities.

More critical are the technical constraints associated with a limited site capacity, the nature of the bedrock strata and the proximity to the fault line at the northern end of the site. In the absence currently of alternative sites, the choice is between extending the open dump prolonging unsanitary methods of waste disposal or developing a sanitary/engineered landfill. The nature of the bedrock strata can be overcome by appropriate site engineering that focuses on the prevention of leachate migration from the base of the sanitary landfill. For the fault line, there is no known activity on this fault and appropriate seismic design standards will be adopted for all site infrastructure.
Albeit with site sitting constraints, the site is deemed suitable to be developed as a regional sanitary landfill, though with limited site life, based on the following considerations:

- While the sanitary landfill site lies close to the Hub Dam Canal, there is no history of flooding recorded at the site arising from stormwater flows from the surrounding land.
- There are no protected sites of historical, archaeological, religious, or cultural significance within 1 km of site.
- The site has served as a waste dumping site for many years, with most of the site covered by existing waste deposits. The sites do not impact any adjacent agricultural land.
- The site does not impact any wetlands and protected or endangered flora and fauna habitats.
- The site's location does not lie within the exclusion zone of major transportation networks, such as airports and airspace restrictions.
- Landfill site is of adequate size to be re-developed as a short-term modern landfill site, with sufficient space to incorporate buffer zones around the site margin and with room for all required infrastructure, including, but not limited to, roadways, support facilities (for example, parking) and stormwater drainage.
- The landfill site has good access to major road networks for transportation of MSW by road from the transfer stations; and
- The natural ground beneath surface waste has adequate bearing capacity for constructing the landfill and supporting infrastructure.

Residual Impacts
Through the implementation of the above mitigation measures, the residual impact is likely to be moderate adverse.

6.3.2 Design of Landfill Cell

Impacts

From Landfill carbon dioxide and methane are the main gas components that are generated once waste undergoes decomposition, if gas collection system is not designed properly these gases can release into atmosphere contributing to air pollution and climate change.
A poorly designed landfill can also emit foul odours and release particulate matter and volatile organic compounds (VOCs) into the air. These emissions can contribute to air pollution, leading to respiratory issues and other health problems for nearby communities especially people living at. The unpleasant odours can also reduce the quality of life for residents in the vicinity of the landfill. Leachate generation which is the liquid residuals of a landfill resulting from a combination of the physical, chemical, and biological processes that transfer pollutants from the waste materials is

also one of the main environmental concerns during landfill operations, if appropriate design measures are not taken, then it may infiltrate and contaminate soil and ground water.

Provision of adequate buffer zone from landfill is also one of the important design constituents, and as per World Bank guideline for Sanitary landfill design criteria, no residential development within 250 meters from the perimeter of the proposed landfill cell development shall be undertaken. However, in case of proposed sanitary landfill site Haji Ibrahim goth located around corner of Jam Chakro dumpsite is within the 250 m radius.

Apart from above mentioned design technicalities, the nature of the bedrock strata and the proximity to the fault line at the northern end of the site do not meet the IFC guidelines of landfill site sitting criteria, therefore, appropriate site engineering that focuses on the prevention of leachate migration from the base of the sanitary landfill to be consider.

Mitigation Measures

The following design related measures will be implemented to ensure the landfill operation does not result in unanticipated, long term and potentially irreversible impacts:

- The nearest recognized and legal human settlement is 170 from the perimeter of the proposed landfill area. Other residential areas are located just outside of the 250 m limit, with the exception of Haji Ibrahim Goth which lies within the stipulated 250 m limit. However, the settlement is not legally covered land and has developed in parallel with dumpsite. Nevertheless, additional control measures are proposed in the design of landfill site to reduce Odor and nuisance impacts and those are:
  - Construction of buffer zone all around the site perimeter, the buffer zone will include perimeter boundary wall for access and litter control,
  - Vegetative planting for screening, litter, and odour control (further details provided in the tree plantation plan attached as **Annex-XII**)
  - Internal roads to the waste disposal area, plant areas and for site maintenance; and
  - Stormwater drainage to prevent run-on into the site and to capture run-off from any restored surface of the waste disposal area.

- To control leachate infiltration the Design Consultant has proposed following components in lining system:

  - The proposed lining system is consistent with the requirements for engineered barriers in municipal solid waste landfills adopted internationally (for example, Subtitle D of the Resource Conservation and Recovery Act, US Environmental Protection Agency). It will be composed of Geo-composite clay liner (GCL) which is a 4 – 6 mm thick consisting of a layer of sodium activated bentonite sandwiched between two non-woven, needle punched geotextiles, the intrinsic permeability of which is $<1\times10^{-9}$ ms^{-1} and will be produced in conformity with National Standard Material Specification 595 (US EPA).
  - The bentonite clay layer of the GCL will swell and become self-sealing in the unlikely event that it becomes damp from any seepage of leachate through the primary HDPE membrane installed above the GCL.
  - A 2 mm High Density Polyethylene (HDPE) Membrane will be placed above GCL with an intrinsic permeability of approximately 1×10^{-13} ms^{-1}. The HDPE geomembrane will be textured on the underside in order to increase interface stability between the GCL and the HDPE geomembrane and/or the side slopes of the landfill were laid over bedrock surfaces.
  - A second liner geo textile with a proposed weight of 1,200 grams/m2, will be placed immediately above the geomembrane for liner protection prior to the placement of the overlying leachate collection gravel and pipework. This geotextile is heavy duty but deemed necessary given the proposed thickness of waste to be placed in the landfill.

- For leachate collection, a gravel layer, 30 cm thick will be placed above the basal lining system in order to facilitate the drainage of leachate towards the leachate collection pipes. Perforated pipes shall be 2/3rd slotted and placed on the prepared, profiled, and sealed basal lining system, these pipes shall be laid in a herringbone pattern and will lead into a main collection pipe which will be connected to sumps and further to the leachate collection tanks.
- It has been proposed to re-circulate leachate to the waste mass which will be achieved by a combination of mobile tanker and spray bar in the active waste deposition area and by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level. If leachate re-circulation does not prove to be completely effective, anaerobic digestion for leachate treatment has been proposed, the sludge produce from this process are an excellent quality compost with commercial value.
- When two meters of waste layer will be deposit in the first cell a 30m × 30m grid of perforated gas recovery pipes will be installed and will be bought up as waste filing progresses. The gas well will be extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome will be installed at the top of the well, the gas collection wells //domes will then be connected to gas treatment plant, the details of which are discusses in Chapter 02 of this report.

Residual Impacts

Through the implementation of the above mitigation measures, the residual impact is likely to be moderate adverse.

6.3.3 Seismicity

Impacts

The project is located in Seismic Zone 2B, where 2B (upper limit of moderate damage) represents the peak horizontal ground acceleration from 0.16g to 0.24g. In this zone, the designing of various types of structures shall be done on the basis of Peak Ground Acceleration. A low to moderate intensity earthquake can adversely impact the developments. Additionally, on the northern end the project lies on fault line, although there is no known seismic activity recorded on this fault line, even then all project infrastructure to design considering appropriate design measures.

Mitigation Measures

- A thorough geotechnical analysis is necessary to understand the soil conditions and potential ground movement during seismic events. This analysis should include assessing soil liquefaction potential, soil stability, and slope stability. These findings help in determining appropriate design parameters.
- The design of landfill slopes should consider seismic loading conditions. Stability analysis should be performed to ensure that the slopes can withstand potential ground shaking. Additionally, erosion control measures, such as reinforced vegetation or erosion blankets, should be implemented to prevent slope failures and soil displacement during seismic events.
- Seismic condition to be considered while designing landfill leachate collection and treatment system, gas collection system and liner or barrier system.

Residual Impacts

With the implementation of the above mitigation measures, the residual impact is likely to be minor adverse.

6.3.4 Locations for Labour camps and ancillary facilities

Impacts

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

Mitigation measures

In order to prevent a nuisance, specific locations shall be designated for development of the labour camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc.
The use of proper planning while identifying locations for the labour camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labour camps being set up roadside next to the construction sites.

Residual Impacts

Considering the above mitigation measures, the residual impact is minor adverse.

6.3.5 Resettlement and Livelihood Loss

Impacts

Although, physical resettlement of any individual or structure is not involved in this subproject, however, livelihood of waste pickers living in Haji Ibrahim Goth (Community living next to jam Chakro dump site) will be affected. As highlighted in Census report drafted by E & S Consultant, a total of 1,067 waste pickers of Haji Ibrahim Goth livelihood are associated with waste picking/scavenging activities in the area.

The waste pickers are classified as Vulnerable, living below the poverty line with 95% of waste pickers reportedly having a monthly income up to Rs. 15,000 while only 5% reported having an income above Rs. 15,000. Through the upgradation of these sites, these waste pickers may lose their only source of income and be left with devastating livelihood loss impacts. The current dumpsite has reached its operational capacity hence it will be capped in future, meaning it will not be possible for waste pickers to earn their livelihood from salvage items. Similarly, the newly constructed landfill cell will have its boundary wall limiting access to waste pickers, thus it is important to restore livelihood of waste pickers to offset project generated impacts.

Mitigation Measures

To mitigate the livelihood impacts during construction & operations of the landfill site a training need assessment (TNA) survey was conducted at Jam Chakro by E&S Consultant, with main objective to assess the trainings/skills required for livelihood restoration and to mitigate the livelihood impacts during operations of the landfill site. The details are presented in Livelihood Restoration Plan developed for this sub-project.

It is anticipated that training program would aid in the creation of jobs or self-employment, assisting participants in generating income. Increased economic independence and quality of life, especially for women would lead to an improvement in their standard of living, which would serve as a deterrent to the acceptance of antisocial behaviour like domestic abuse. The Project GRM would also be implemented to allow for grievances to be aired and resolved as they arise.

Furthermore, a transition plan for the waste picking community at Haji Ibrahim Goth has also been prepared and added to the report as **Annex-VII**.

Residual Impacts

With the implementation of the above mitigation measures, the residual impact is likely to be minor to moderate adverse.

6.3.6 Flood Risk

The contouring of the proposed landfill cell is such that the landfill site is surrounded by hills/ peaks that naturally keep the waste in, therefore there are chances of surface run off especially the risk of urban flooding, Hub Canal also passes through western boundary of landfill site and flooding can occur due to sudden ingress of water or if water in canal is discharge more than its intended capacity. Although chances of occurring such incident is low. In addition to that, internal flooding can also occur in Landfill in the event of heavy rainfall, if proper storm water drainage system is not in place, then flooding can increase the probability of erosion due to the movement of water over the site and because infiltration of high volumes of water can adversely affect the structural integrity of the waste increasing the likelihood of mechanical failure of the landfill. The risk of flooding is nevertheless low as identified by the flood risk assessment conducted.

Mitigation Measures

- In order to intercept surface run-off water drains will be constructed around the perimeter of the landfill along the periphery of the ring road proposed.
- An Emergency Response plan for flooding situations to be prepared and staff to be trained on it.
- Ensure that stormwater drains are also connected to septic tanks so that they do not increase the risk of leachates being exposed into the environment.

Residual Impacts

- With the implementation of the above mitigation measures, the residual impact is likely to be minor adverse.

6.3.7 Stability & Closure of Old Dump Site & Potential Remediation

Impacts

During construction of the new cell, the dump site will continue to operate as is given that the waste generated from the city will still have to be disposed of. However, once the new cells are completed, the old dump site should be dealt with immediately as:

- With Haji Ibrahim Goth lying at the foothills of the old dump site, and that too with most of the village exposed to the dump site (roughly along 650-690 metres), the stability of the slopes of the dump site with the depositions of waste will pose a risk to the village and its people should the site prove to be unstable.
- With the waste in the dumpsite still lying open, exposed to the atmosphere, the site would continue to be a nuisance in terms of environmental emissions, particularly any air emissions, and soil contamination that is currently already taking place.
- Exposure to dusts and air emissions from the existing dump site including from the indiscriminate burning of wastes that produces harmful emissions. All of these items pose a high risk of extreme air quality deterioration, particularly the burning of wastes as the highest quantity of waste arriving at the site is single use plastic (polyethene bags), which when burned produce toxic pollutants such as microplastics, bisphenols, and phthalates, all toxins

that can disrupt neurodevelopment, endocrine, and reproductive functions in humans, particularly vulnerable populations such as children and the elderly.
- Exposure to hazardous materials and wastes including industrial waste and medical waste that currently finds its way to the site through third party contractors.
- Continued contamination of soil, groundwater aquifers, and air from the open dumpsite, through the unmitigated and un-engineered dumping of wastes.
- Leachate management and potential for contamination of surface water resources and groundwater resources.
- Transmission of diseases through vectors at the community in Haji Ibrahim Goth and the nearby areas in the AOI.

Mitigation Measures

The slope of the old site has been studied in line with the topographical study provided by SSWMB, where the slope obtained is roughly 1V:32H, highlighting that the slope stability is considerable and as such does not pose immediate threats or risks to the villagers of Haji Ibrahim Goth (where for engineered landfills it is 1V:3H or 1V:2H). The topography of the site, along with the slope graph is depicted below:

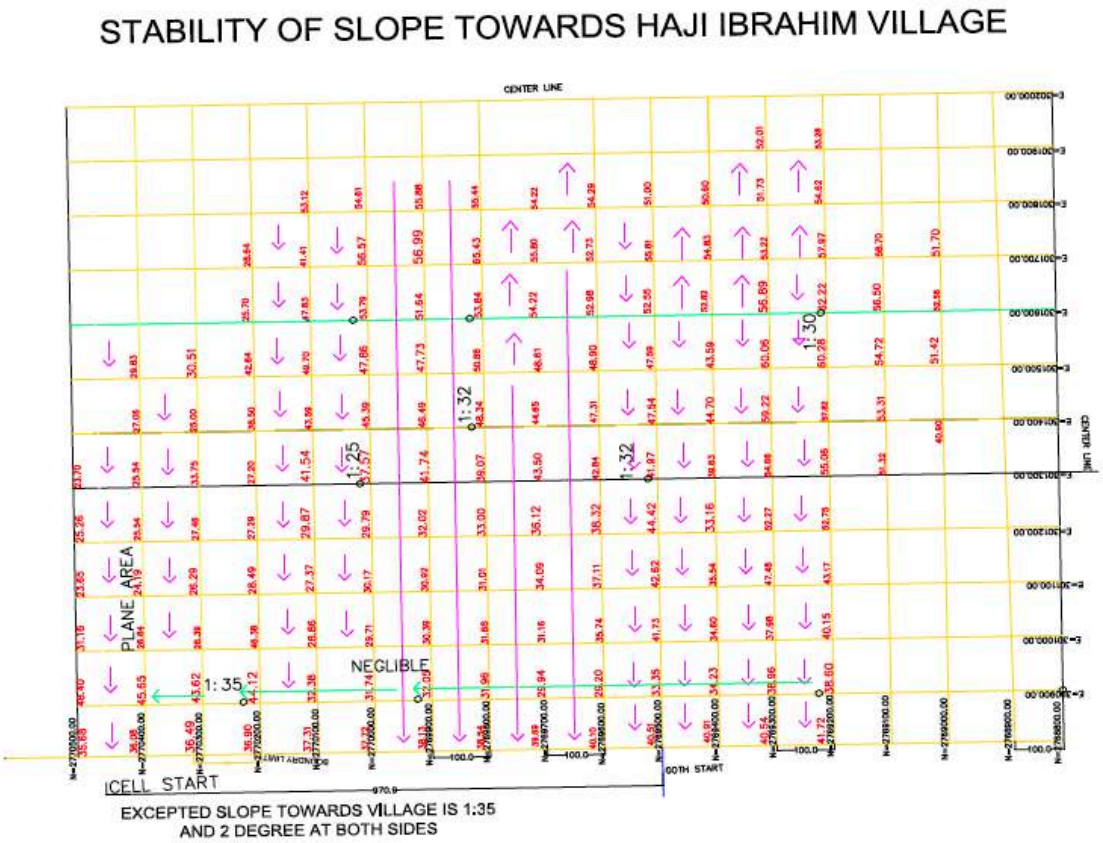


Figure 6.1 - Stability of Slope Towards Haji Ibrahim Goth

There are certain mitigation measures that the operations team at the existing dump site can apply to improve community health and safety conditions whilst operations continue at the dumpsite:

- Disallow people from burning waste at the site, where if burning waste is found, then it is immediately extinguished using the appropriate firefighting equipment.

- Avoid dumping wastes near the community at Haji Ibrahim Goth and the pathways they use for travel.
- Cover and contain waste that using a layer of soil or other appropriate materials to minimize the dispersion of pollutants into the air.
- Carry out fumigations at the site to reduce the risk of vectors and disease transmission to the extent feasible during the development of the new cells, along with the potential odor generation and propagation.

A Standard Operating Procedure (SOP) has been developed and added to this report as **Annex-XXII** for existing waste operations.

Nevertheless, to truly reduce the risk from the existing dump site, the appropriate long-term measure would be to carry out a detailed study for the capping/ closure of the dumpsite along with any potential rehabilitation of the site deemed necessary.

The closure/ capping of the site should look into the following items to effectively reduce risks:

- Usage of appropriate cover materials that includes impermeable layers of materials with appropriate thickness in line with the conditions identified at the site.
- Designing proper gas venting and collection systems to prevent gases from migrating into surrounding areas.
- Designing of appropriate leachate control and treatment mechanisms to prevent the migration of contaminated leachate into surrounding surface and ground water.
- Designing of appropriate drainage systems to control surface water runoff and to prevent erosion.
- Designing of appropriate monitoring wells around the closed site to regularly assess the groundwater quality.
- Establishment of security measures to prevent unauthorized access to the closed site.
- Development of a post closure monitoring plan to assess the long term effectiveness of the closure and capping measures.
- Development and communication of emergency response plans to address any unforeseen events or issues that may arise after closure.

If these items are considered during the design of the closure/ capping of the site, and implemented, then following closure, the risk of these items should be low.

For this the SWEEP has already brough onboard a consultant to prepare detailed design studies for the closure of the existing dumpsite where a tentative cost of 07 million US Dollars has also been proposed.

6.4 Assessment of Potential Impacts and Mitigation Measures (Construction Phase)

6.4.1 Resource Efficiency & Pollution Prevention

Impacts

Resources involved in the construction of proposed project include construction materials, water, and fuel. For the construction of administrative building, and the embankments, and the access road, materials required will be coarse aggregates, fine aggregates, asphalt, cementitious materials, reinforced and structural steel. Almost all the materials to be used in the construction of proposed project are non-renewable and therefore their sustainable use is necessary for the future use.

Further to this, for the construction of landfill and specially liner system, material required will be bentonite clay, High-density polyethylene (HDPE) liner, geo textile membrane and gravel.
Excessive water consumption for drinking and washing purposes by the construction staff may put additional pressure on the water resources in the project area.

Fuel (diesel and petrol) will be used to operate construction machinery, asphalt, and batching plants. Sustainable use of energy resources is very important not only to continue future use but also to reduce air pollutants.

Mitigation Measures

- Reduction of wastage of water through training of workers involved in water use will be planned.
- Careful selection of water source to minimize disturbances to existing community water supplies.
- Batching plants with insulation lining to reduce heat loss; will be designed or purchased from vendor (for sites where applicable).
- Plan for reuse of construction waste materials will be formulated.
- A good camp design and an efficient worksite management plan will be prepared by the contractor to reduce the water demand, and wastewater and solid waste volumes to the lowest levels.
- Apart from the resource conservation, following measures will be considered as pollution prevention:
  - Emissions will be reduced/controlled as far as possible and direct discharges to air will be avoided by strictly adhering to the mitigation measures outlined air quality sections of this ESIA report.
  - Wastewater will not be discharged directly into the water resources and must be managed as per the recommendations presented in wastewater section of this ESIA; and
  - Construction and demolition waste and municipal solid waste will not be dumped/ burnt openly and will be handled according to the preventative measure given in solid waste section of ESIA study.

Residual Impacts

With the implementation of the above mitigation measures, the residual impact is likely to be minor adverse.

6.4.2 Particulate, Gaseous, & Dust Emissions

Impacts

The construction of a landfill site involves the movement of heavy vehicles and machinery, such as dump trucks, excavators, and bulldozers. These vehicles release exhaust emissions containing pollutants such as nitrogen oxides (NOx), particulate matter (PM), and volatile organic compounds (VOCs). These pollutants can contribute to air pollution and have detrimental effects on air quality in the surrounding areas specially on the housing societies that are near landfill site. The potential dust sources associated with construction activities are loading and unloading of materials depending upon the extent of activity, length of the construction period, specific construction operations, types of equipment, topsoil removal, travel on unpaved areas, precipitation conditions and wind erosion etc.

In addition to this, construction activities, especially excavation and earthmoving, can generate significant amounts of dust which consists of fine particles, including PM_{10} (particles with a diameter of 10 micrometres or less) and $PM_{2.5}$ (particles with a diameter of 2.5 micrometres or

less). These particles can remain suspended in the air for long periods and be transported over long distances, potentially impacting the air quality of nearby communities. Dust can also contain harmful substances, such as heavy metals which can pose additional health risks if inhaled.
Construction equipment and machinery to be used during landfill site construction, such as generators, concrete mixers, and compressors, may emit pollutants into the air. These emissions can include NOx, Sulphur oxides (SOx), carbon monoxide (CO), and PM, depending on the type of fuel used and the efficiency of the equipment. Poorly maintained or outdated equipment can result in higher emissions, exacerbating the air quality impacts.

During baseline, sensitive receptors such as Educational Institute, Religious site and medical facility are also established, adverse impacts are envisaged during construction activities.

Mitigation Measures

The impacts construction phase of the proposed Project could be effectively mitigated by the implementation of simple procedures by the Contractor including but not limited to the following:

- Before the commencement of activities, Contractor will prepare an Air Quality Management Plan as part of its Site-Specific Environmental Management Plan (SSEMP) that incorporates use of following measures:
  - Contractor to maintain a minimum setback distance of 500 m from sensitive receptors (schools, hospitals, mosques, residential areas etc.) for batching plants.
  - The important dust suppression measures proposed will be regular water sprinkling or misting on main haul roads in the project area, this activity will be carried out at least twice a day, if need arises frequency will be increased on windy days, in this way around 50% reduction on the dust contribution from the exposed surface will be achieved.
  - The duration of stockpiling will be as short as possible as most of the material will be used as backfill material for the open cut trenches for road development.
  - Cover loose soil and stockpiles to prevent wind erosion and dust dispersal.
  - Implement proper waste management practices, including covering waste materials with soil or other suitable materials to reduce odours and gas emissions.
  - Conduct regular monitoring of air quality parameters, including pollutant concentrations, dust levels, and odours.
  - Implement a robust compliance program to ensure adherence to air quality regulations and standards.
  - Evaluate the effectiveness of mitigation measures and make necessary adjustments based on monitoring results.
  - Maintain open communication with local communities and stakeholders to address any concerns related to air quality.

Vehicular and Equipment Emissions

- Regular maintenance of construction machinery and vehicles to ensure that all machines and vehicles abide by the stringent standards for emissions.
- Implement machines and vehicles maintenance programs to ensure machines and vehicles are properly tuned and emissions are minimized.
- Limit unnecessary vehicle idling and establish no-idling policies to reduce emissions.
- Establish designated routes for construction vehicles to minimize impacts on surrounding communities.
- SEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during construction works.
- Service roads (used for earthmoving equipment and general transport) should be regularly sprayed with water during dry weather.

Dust Emission Control

- Maintaining dust collection equipment to prevent any leaks.

- Developing a buffer zone that surrounds operations that generate dust.
- Instituting a whole management approach for plant operations, as well as the delivery system
- Checking regularly for leaks in filter fabric, cartridge filters, and suctions and shrouds
- Installing audible alarms on storage silos to avoid overfilling.
- Keeping sand and aggregates under cover so that materials are not dispersed by wind.
- Using an enclosed batch mixer and spray to limit dust emissions.

Construction Monitoring

The Contractor will be required to monitor particulate matter in the vicinity of construction sites, temporary sites including construction yards and storage areas, and access routes. Baseline conditions around Landfill sites often exceed SEQS standards, which should be considered when evaluating air quality conditions during construction. If community complaints arise, the contractor will intensify use of mitigation measures to minimize air quality impacts. In addition, the Contractor is required to certify emission controls on construction equipment and vehicles. Special attention must be paid to sensitive receptors such as patients in hospitals and students in educational institutions.

Residual Impacts

Considering the mitigation measures stipulated above, the residual impact is likely to be moderate adverse.

6.4.3 Clearance of Legacy Waste

Impacts

Whilst the new landfill cell is proposed on virgin land, there is a small 10-acre portion on the Eastern valley where legacy waste from the operations of the existing dumpsite is present and shall have to be removed before site development. Furthermore, the access road also proposed to the cells will also be formed through the existing dumpsite where waste will be removed to a level where strength bearing ratios for the development of the road are obtained. Currently, it is not yet entirely known the amount of waste that will have to be removed.

Nevertheless, the removal of this waste would generate air quality and noise impacts from the increased movement of machinery, excavation to remove waste and relocation to another part of the landfill. This impact is expected to be substantial adverse, and temporary in nature.

Mitigation Measures

The following mitigation measures may be implemented to reduce this impact:

- Use of legally permitted fuel with lower levels of contaminants for machinery.
- All vehicles, machinery, equipment, and generators to be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions and subsequent impacts on surrounding receptors.
- Stringent environmental quality standards applicable to gaseous emissions generated by construction vehicles, equipment, and machinery will be enforced during works; and
- Personal Protective Equipment's (PPEs) like masks, goggles which are suitable for specific jobs will be provided to workers and visitors and used during work times.

Similarly, issues arising from dust during the construction phase can be effectively mitigated through the implementation of simple procedures by the contractor(s) including but not limited to the following:

- Regular water sprinkling on the site and other unpaved areas to be carried out to suppress excessive dust emissions. The frequency of water sprinkling is to be increased during summers, as required. Furthermore, it is to be ensured that the water used for sprinkling is not drinking water and will be purchased privately through companies registered through KWSB, and not taken from the community's water supply.
- Earth moving will be done under damp conditions as much as possible to prevent emission of dust into the air.
- Preventive measures against dust will be adopted for on-site mixing and unloading operations.
- Vehicle speed in the project area will be prescribed not more than 20 km per hour and controlled accordingly especially near the sensitive receptors.
- Tires of all the vehicles leaving the site will be washed at designated washing area in vehicle parking lots. No earth, mud and dust will be deposited on the public road.
- Air emission monitoring program for NO2, SO2, CO, PM2.5 and PM10 will be undertaken by the construction contractor, according to the programme specified in the ESMP. The location of the monitoring points will be finalized considering the sensitive receptors so that the impact of air quality deterioration will be assessed accordingly.

6.4.4 Noise Impacts

Impacts

The noise impacts may vary depending on the location, scale, and construction techniques employed at the landfill site. Noise will be generated from the operation of heavy machinery such as excavators, bulldozers, and dump trucks these machines are used for excavating, compacting, and transporting waste materials. The noise produced by their engines, hydraulic systems, and moving parts can be loud and disruptive.

The other source of noise generating activity would be construction activities such as like drilling and concrete pouring for auxiliary facilities. Drilling for wells or geotechnical investigations and surface water monitoring wells installed around the corners of landfill site and pouring concrete for structures can all generate noise that may be audible in the surrounding areas.
Increase amount of vehicular movement associated with the construction process, including deliveries of construction materials and waste transportation, can add to the noise levels. This includes noise from trucks, vans, and other vehicles used for transportation purposes.
The typical noise level generating from different construction equipment's and activities are present below. The cumulative effects from several machines can be significant and may cause significant nuisances. However, these increased noise levels will prevail only for a short duration during the preconstruction and construction stage.

Table 6.6: Typical noise levels of construction equipment (noise level in dB (A) at 15 m)

Clearing		**Structure Construction**	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
Excavation and Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94

Table 6.6: Typical noise levels of construction equipment (noise level in dB (A) at 15 m)			
Clearing		**Structure Construction**	
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
Grading and Compaction		**Landscaping and clean-up**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94
Source: U.S. Environmental Protection Agency, Noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. December 31, 1971			

Considering the location of sensitive receptors around project area and settlements specially Haji Ibrahim Goth is the south of proposed landfill site and Hassan Brohi goth on the north of proposed access road for landfill, the adverse impacts is envisaged from the use of construction equipment's and trucks involved for the movement of construction material from access routes.

Mitigation Measures

Before the commencement of activities, Contractor will prepare a Noise quality management Plan as part of its SSEMP that incorporates use of following measures:

- Impose speed limits on construction vehicles to minimize noise emission along areas where sensitive receptors are located (residential areas, etc.).
- Limit noisy construction-related activities during the night near sensitive receptors (e.g., hospitals and residential areas). Such activities should be restricted to daylight hours.
- Provide prior notification to the community on schedule of construction activities.
- Whenever feasible, schedule diverse noisy activities (e.g., earthmoving) to occur at the same time, since less-frequent noisy activities would be less irritating than frequent less-noisy activities.
- Use equipment with built in noise abatement, especially pavement breakers, crawler cranes, excavators, and concrete cutter.
- It shall be ensured that generators, vehicles, and other potentially noisy equipment used will be in good condition.
- The use of pressure horns shall not be allowed especially near sensitive receptors.
- Movement of all project and personnel vehicles shall be restricted within work areas.
- In areas with higher noise levels or longer shifts, use of ear plugs and earmuffs will be ensured among the workers.
- Use of ear plug, and earmuffs must be ensured during construction. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.
- Periodic medical hearing checks should be performed on workers exposed to high noise levels.
- All the equipment and machinery used during construction phase should be well maintained and in compliance with SEQS.
- Grievance redress mechanism to deal any public complaints related to noise is established.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.5 Vibration Impacts

Impacts

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods used. The operation of construction equipment causes vibrations that spread through the ground and diminish in strength with travelled distance.
During earthworks and excavations heavy machinery such as bulldozers, excavators, and loaders used for earthmoving can generate significant vibrations and it can have impact on nearby building structure. The predicted ground vibrations at various distances are shown in Table 5-3 for typical equipment that may be used during proposed construction. The typical vibration from heavy trucks is generally low, and usually imperceptible in nearby buildings.

Table 6.7:[28]Typical Vibration Levels at Distances (Peak mm/s)

Plant Item	Peak Vibration (mm/s), Distance from Source			
	10m	20m	50m	100m
15ft roller	7.0 to 8.0	3.8	1.5	0.8
7t compactor	5.0 to 7.0	3.0	1.2	0.6
Dozer	2.5 to 4.0	1.6	0.7	0.3
Backhoe	1.0	0.5	0.2	0.1

Based on the predicted peak vibration levels described in above table, it is expected that vibration would be barely perceptible at sensitive receiver locations within over 50m for most construction activities.

According to British Standards of Noise and Vibration, humans are particularly sensitive to vibration with the threshold of perception typically being in the range of 0.14 to 0.3 mm/sec Peak Particle Velocity (PPV) and levels above this may cause annoyance. However, significantly higher levels than this can be tolerated for single short-term events and do not cause annoyance or disturbance to humans. Further, there is no historical building or masonry structure within 150 m of the earmarked landfill site to sustain damage from construction vibrations.

Mitigation Measures

- Vibration measurement will be carried out during construction phase by the contractor near the settlements as well as all the sensitive receptors in the AOI.
- Timing of the construction works to be conducted during the recommended operational hours, to reduce vibration levels to sensitive receptors (especially all the educational institutes) and residential properties in the AoI.
- Residents and occupants in all the buildings including offices, hospitals, school, and religious places of to be pre-warned of high vibration events and any operations being undertaken outside recommended hours.
- The vibration from major construction activities such as excavation, compacting, drilling, etc. are considered intermittent and short-term, and likely to be tolerated if prior warning is given to potentially affected residents.
- The equipment operators to be made aware by the contractor of potential vibration issues problems and of techniques to minimize vibration effects during construction works near to the sensitive receptors especially educational institute and medical facility.

[28] Source: Environmental Noise Management Manual-Roads & Traffic Authority, NSW, Australia, 2001

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.6 Impact from Wastewater generation

The potential sources of water pollution associated with the construction of landfill site have been identified and include:

Construction Site Runoff
Runoff from the construction works area may contain increased loads of sediments, suspended solids and other contaminants which will increase the pollution load of the available water resources in the project area. Potential sources of pollution from the site include:

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

Wastewater produced by On-Site Work Force
Wastewater would be generated from construction camp during the construction phase. If the generated wastewater is not properly treated in septic tank before disposed, this may contaminate the surface water sources.

Groundwater
Construction waste, if left unattended will result in forming leachate that will percolate through the soil strata and will reach underground water table and hence, will end up contaminating groundwater. There is a probability that various materials like fuel, lubricant oil, and other oily products, which are used during the construction phase may contaminate groundwater and channels carrying water.

Impounding of Water
During the construction activities of the proposed sub-project, it is likely that there will be surface gradients created at different portions of site. These surface gradients result in the accumulation of water coming either from rainfall event or wastewater/sewage overflow. The water impounding during the implementation phase of the project will cause nuisance to the communities and various health risks such as spread of malaria, gastroenteritis, diarrhoea etc.

Mitigation Measures

- Stormwater drains will be constructed around the perimeter of the landfill in order to intercept surface run-off from the restored surface. For the majority of the site the drainage will be directed northwards, as is the present drainage pattern for the site.
- All stormwater run-off from buildings and from paved surfaces in the Administration Area will be intercepted and directed to a retention pond in the Administration Area (rainwater harvesting).
- Protection of water resources from any source of contamination generated due to the proposed project such as the construction and oily waste that will further deteriorate its baseline quality by installing screens and barriers at source of contamination.

- Water required for construction will be obtained in a sustainable way that the water availability and supply to nearby communities remain unaffected.
- Stockpiles of cement and other construction materials will be kept covered when not being used.
- Avoid fuel and other chemicals being stored at non-designated locations around the site.
- Maintenance of vehicles and machinery will be carried out only at designated area and on impermeable areas where any oil spillages can be contained.
- Oils, fuel, and chemicals must be stored at bunded fuel stores and mobile bunded stores.
- Careful planning of the works to avoid soil excavation works during intense rainfall events.
- All kinds of waste will be stored in covered containers and disposed of safely as soon as possible.
- Sand and silt removal facilities such as sand traps, silt traps and sediment basins must be provided to remove the sand and silt particles from run-off. These facilities will be properly and regularly maintained. These facilities will be carefully planned to ensure that they will be installed at appropriate locations to capture all surface water generated on site.
- Wastes will be collected, stored, and taken to approved disposal site.
- Wastewater effluent from the Contractors' workshops and equipment washing yards will be passed through gravel/sand beds to remove oil/grease contaminants before discharging into the natural streams. The biological and chemical oxygen demand concentrations in sewage must be brought down to less or equal to the applicable stringent limits before being discharged into existing KWSB's sewerage system.
- As a mandatory step, all the effluents will be discharged into existing sewerage system as per the requirements of stringent environmental quality standards.
- Construction camps will be established in areas with adequate natural drainage channels in order to facilitate the flow of the treated effluents after ensuring that stringent environmental quality standards are met.
- The solid waste will be disposed in designated landfill sites to sustain the water quality for domestic requirements.
- Regular water quality monitoring according to determined sampling schedule.
- Road drainage system will remain clear and well maintain by avoiding the stockpile of earth material on the way of their inlets so that the runoff will be easily diverted, and water impounding will be avoided on the road.
- Prohibit washing of machinery and vehicles in surface waters, provide sealed washing basins and collect wastewater in sedimentation/retention pond.
- Construction work close to the water bodies will be avoided, especially during monsoon period.
- To avoid water impounding, following mitigation will be adopted:
  - Careful planning of the construction works to avoid soil excavation during rainy seasons.
  - Toilet wastewater will not be discharged untreated into the sewerage system.
  - Washout from washing of equipment and gadgets will be drained into a septic tank.
  - Septic tanks of adequate capacities will be constructed for all kinds of wastewater storage and timely disposal will be ensured.
  - Unnecessary excavations will be avoided especially during monsoon; and
  - All spoils will be disposed of as desired, and the site will be restored back to its original conditions as soon as the activity gets completed.

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.7 Soil Erosion

The majority of the works proposed for development of the landfill may result in soil erosion and sedimentation. Spoils will be generated from the excavation activities, particularly during construction of landfill cells. Potential impacts from spoils and their disposal are (i) land for disposal

of spoil, (ii) potential erosion from the spoil areas and spoil material reaching the waterways, and (iii) aesthetic impacts.

The soil will be exposed to erosion due to excavations for development of Landfill sites, construction camps and workshops. Erosion may increase during intense rainfall events. Soil erosion is also envisaged during the construction of auxiliary facilities such as construction of admin building its associated infrastructure and construction of roads.

Mitigation Measures

- Stored excavated/fill material will be covered and will be reused.
- Geo-technical results indicates that site-worn materials have high frictional strength with an adequate Factor of Safety, thus it can be used in embankment, which will be constructed between each cell.
- Excavated soil will be stored at site and will be used as daily cover during landfill operations.
- Stockpile will have a side slope of 2:1 or flatter and will have a height lower than 2m.
- Excavated materials/stockpile should not be placed adjacent to any water streams especially near hub canal on north side of landfill cell.
- Storm water runoff originating from stockpiles should be directed to, and/or controlled by, a suitable sediment trap.
- Contractor will prepare a Traffic Management Plan for use and movement of construction vehicles within the area based on the nature of soil to reduce the soil erosion impact.
- Vehicles and equipment movement will be confined to dry areas with hardened soil; no vehicle and equipment will enter the damp areas, water areas, vegetative areas, and areas with soft soil.
- Sprinkling of water will also reduce the erosion of soil.
- Non-bituminous wastes from construction activities will be dumped in approved sites, in line with the guidelines for dump sites, and must be covered.
- Washing yards will be paved to avoid seepage of runoff from the yard.
- Controlling runoff volumes and intercept runoff before it leaves the site.
- Perennial grasses, sod, shrubs, and trees will be planted to control the runoff on the site.
- Confining excavations to the specified spots as per the approved engineering drawings and unnecessary excavations will be avoided.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.8 Soil Contamination

Soil contamination can occur due to spilling of chemicals during construction or during transportation from one container to another. During the construction phase, contamination of soil is primarily due to spillage of oil and materials dissolved and transported through water at the construction site.

Leakages of oils, lubricants, chemicals, and other similar substances from their storage sites and from engines of the generators, machines, equipment, and vehicles can spoil the receiving soils and may undermine ability of the spoiled soils to support growth of vegetation and plants; further contaminate the soil.

Non-provision of septic tanks with the temporary worksite toilets, constructed for the labour and others, effluent can contaminate the receiving soils because of raw nature of the effluents.
Also washing of the gadgets, machinery, and equipment without proper drainage of the washout water can adversely affect the soil quality. This impact is, however, temporary, and minor negative in nature.

Mitigation Measures

- Material Safety Data Sheets (MSDS) for purchased chemical additives, reagents and compounds will be kept at the work site.
- All spills to be cleaned and removed from the site, where the site will be restored back to its original conditions.
- Oils, lubricants, chemicals, and other listed hazardous materials should be stored safely at designated spots, enclosures, or storerooms, which should be safe from rainfall and away from any potential source of fire.
- Septic tanks of adequate capacities should be constructed for receiving and treating wastewater from all temporary worksite toilets and at the temporary container offices, if any. The toilet wastewater should not be discharged untreated onto the adjacent lands.
- All machineries and materials should be stored at the designated areas and compounds.
- Washout from washing of equipment and gadgets should be drained into either a septic tank or a sand-gravel bed for removal of the grit and contaminants.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.9 Construction & Labor Camp

The establishment of construction & Labor camp sites may lead to health, environmental, and social impacts in the sub-project areas, arising from the camp sites, despite these impacts being temporary in nature. The potential environmental and social impacts related to this aspect are:

Impacts

- The sitting of campsite will have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.
- Worker camps will need to be developed and ancillary facilities will need to be provided, such as electricity, drinking water, sewerage, effluent facility, and accommodation facility.
- There will be generation of different waste streams such as domestic waste, hazardous waste and medical waste resulting from the first aid treatment.
- The migrant workers may travel to nearby communities for visiting shops etc., hence creating chances of interactions with the local communities.
- There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading Sexually Transmitted Infections (STIs) and Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). In adequate safety facilities to the construction camps may create security problems and fire hazards

Mitigation Measures

- Establish workers' camps separated from local communities with strict protocols for interaction with local communities in order to avoid project impacts from labour influx.
- Contractor will provide septic tank and soakage pit (100 meter away from surface water body or groundwater well) for the toilets to treat the sanitary wastewater before its discharge in the sewerage system.
- Avoid tree cutting for setting up camp facilities. However, if such type of land is not available, it will be ensured that minimum clearing of the vegetation occur.
- Provide a proper fencing and compound wall for camp sites.
- The camp site will be adequately drained to avoid the accumulation of stagnant water.
- Camp site will not be located near (100 meter) water bodies, and any ecologically, socially, and archeologically sensitive areas.

- Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit.
- Train employees in the storage and handling of materials which can potentially cause soil contamination.
- Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio-cultural values.
- Code of conduct (CoC) will be prepared and implemented/adopted. All project staff and workers will be required to sign the CoC.
- Training will be provided to all staff on camp management rules and overall discipline and cultural awareness. This will include, in appropriate languages:
  - A briefing on camp rules
  - A community relations orientation to increase awareness about the local area, cultural sensitivities, and the project Code of Conduct.
  - Awareness-raising on health considerations, including Sexually Transmitted Disease (STDs).
  - Awareness and orientation on GBV/SEA/SH.
  - Information about the worker GRM which will also address cases of GBV/SEA/SH.

- The construction contractor is required to develop a construction camp management sub-plan to address:
  - Discipline.
  - Community liaison.
  - Ethnic tensions; and
  - Communicable diseases.
- A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behaviour.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.10 Construction of Access Roads

Since there is currently no access road to the proposed sanitary landfill, a new access road shall be designed and constructed.
Major activities of road works will include preparation of sub-grade, sub-base, base and wearing course. Major equipment to be involved in road widening works are tractor, bulldozer, roller, compactor, shovel, grader, dumper, aggregate and spreader, asphalt mixer, bitumen boiler and sprayer, concrete mixer and paver, batching plant, and finisher.

Mitigation Measures

The following mitigation measures will be implemented during construction of the proposed access road:

- The majority of the landfill will be surrounded by a perimeter road for both waste delivery vehicles and to facilitate maintenance. Different types of roads are proposed depending upon the assessed traffic load and function.
- For waste delivery vehicles access roads shall be two lanes, a minimum of 6.5 m wide and provided with double surface dressing. Maintenance roads shall be one lane, minimum of 4 m wide and surfaced with gravel. The Administration Area will be paved to the same standard as that of the primary roads used by waste delivery traffic. Within the landfill temporary haul roads, 6 m wide and surfaced with free-draining granular material, shall provide access to the tipping area.

- The road widening will be to a standard that is suitable for movement of high-capacity waste carrying vehicles.
- Work areas outside the project site, especially where machinery is involved, will be barricaded, and will be constantly monitored to ensure that local residents, particularly children stay away.
- Women's residing in Haji Ibrahim Goth who will be working in salvaging items from existing dumpsite will be briefed on traffic safety prior to start of construction activities.
- Traffic diversions will be planned in such way that it does not create traffic congestion or hinders the movement for the vehicles that are still be working on dump site.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project.
- Vehicle speed will be regulated and monitored to avoid excessive dust emissions.
- Periodic sprinkling on access road at least twice per day during construction phase.
- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area.
- Proper drainage system to provide in order to prevent ponding of rainwater on roads.
- Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.
- Periodic water sprinkling will be carried out during widening works to suppress dust.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.11 Greenhouse Gases & Climate Change

The main sources of GHG (CO_2, CH_4, NO_x etc.) during the construction activities of the proposed project will include both mobile and stationary sources. The mobile source will be the construction and transportation vehicles. Emission of GHG causes global warming and other climatic changes on regional and global scale.

Mitigation Measures

- Use construction machinery designed with suitable pollution abatement technology such as scrubbers.
- In order to control NO_2 emission at site, diesel engine equipment and machinery will be installed with catalytic converter, as it allows diesel engine to take advantage of the trade-off between NO_2, PM_{10} and fuel consumption, and calibrate the engine in a lower area of fuel consumption.
- Plantation development as per the tree plantation/reforestation sub-plan is highly recommended for the sequestration of CO_2.
- Used and old electrical equipment will be banned that can also help to reduce urban emissions.
- Burning of waste will be strictly prohibited at site.
- Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and
- As appropriate use of solar panels at construction camp sites instead of diesel generators will also reduce the emissions.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.12 Occupational Health and Safety

The construction of landfill will pose Occupational health and Safety (OHS) risk for the workers which could lead to any minor to major incident. The risk will arise due to working at elevated platforms for the construction of admin building and during excavation of landfill site. The different HSE risk and their mitigation measures are prescribed in below sections.

Over-Exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries at construction site.

Mitigation Measures

Recommendations for their prevention and control include:

- Workers will be trained with lifting and materials handling techniques before the construction of the project, including the placement of weight limits above which mechanical assists or two-person lifts are necessary.
- Work site layout will be planned to minimize the need for manual transfer of heavy loads.
- Tools will be selected, and workstations would be designed to reduce force requirements and holding times, which promote improved postures, including, where applicable, user adjustable workstations.
- Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes.

Work at Height

Falls from elevation associated with working with ladders and scaffolding are among the most common cause of fatal or permanent disabling injury at construction site. If fall hazards exist, a fall protection plan will be in place which includes one or more of the following aspects, depending on the nature of the fall hazard. This hazard is particularly envisaged during the construction of multi-story administrative building.

Mitigation Measures

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface.
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards as well as fall rescue procedures to deal with workers whose fall has been successfully arrested.
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labelling covers for openings in floors, roofs, or walking surfaces.

Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.

Mitigation Measures

Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Good house-keeping practices, such as the sorting and placing loose construction materials in established areas, would be implemented.

- Excessive waste debris and liquid spills will be cleaned up regularly.
- Electrical cords and ropes will be in common areas and marked corridors.
- Slip retardant footwear will be used.

Struck By Objects

Construction activities of the project may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Mitigation Measures

Techniques for the prevention and control of these hazards include:
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap.
- Temporary fall protection measures in scaffolds and out edges of elevated work surfaces would be used, such as handrails and toe boards to prevent materials from being dislodged.
- Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore.

Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise.
Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving.

Mitigation Measures

Techniques for the prevention and control of these impacts include:
- The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.
- Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

Physical Hazards
- Exposure to heat stress, as a result of rapid movement between cold and hot areas.
- Exposure to UV radiation during welding operations.

Mitigation Measures
Techniques for the prevention and control of these impacts include:
- Educate workers on heat stroke and guide them to take preventive measures.
- Encourage frequent breaks in summer season to allow workers to recover from extreme temperatures.
- Ensure an adequate supply of potable water is available to workers to prevent dehydration in hot environments.
- Educate workers on recognizing and responding to the signs and symptoms of heat stress, as well as the importance of proper hydration.
- Provide welders with protective clothing, including welding helmets with UV-filtering lenses, welding gloves, and flame-resistant clothing.

- Install effective ventilation systems to remove fumes and gases generated during welding, reducing exposure to harmful substances.
- Create barriers or enclosures around welding operations to prevent bystanders from being exposed to UV radiation.
- Ensure workers are adequately trained in proper welding techniques and safety measures to minimize the risk of UV radiation exposure.
- Contractor and Construction Supervision Consultant (CSC) to regularly inspect welding equipment and PPE to ensure they are in good working condition, and promptly repair or replace any faulty equipment.

Chemical Hazards

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

Mitigation Measures

- Use chemical and adhesives in well-ventilated areas or ensure proper ventilation systems are in place.
- Wear appropriate personal protective equipment (PPE), such as gloves and goggles, when handling chemicals.
- Follow the manufacturer's instructions for safe use and storage of adhesives and chemicals.
- Ensure Material Safety Data Sheet (MSDs) at chemical storage area.
- Store chemicals in a designated area away from incompatible substances

Biological Hazards

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

Mitigation Measures

- The contractor should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.
- Project contractor must provide good working and sanitation conditions at camp and work sites. Disease surveillance should be carried out to identify any exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, ticks, and dengue.
- Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented, and maintained in close co-operation with the local health authorities and according to recognized international standards.

Below table enlist the appropriate PPEs according to the hazard type.

Table 6.8: Summary of Recommended Personal Protective Equipment According to Hazard

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapours, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or earmuffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids, and chemicals.

Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapours.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapours and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting. and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.
Source: WBG Environmental, Health, and Safety General Guidelines		

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be moderate adverse.

6.4.13 Community Health and Safety

Construction activities and vehicular movement may result in roadside accidents, particularly. affecting local communities especially the residents of Haji Ibrahim Goth will be vulnerable, as they are closely located to proposed landfill site. A detailed community health & safety plan including impacts and mitigation measures for all phases of the project is provided in the **Annex-XV**.

Mitigation Measures

Work areas outside the project site, especially where machinery is involved, will be barricaded, and will be constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for landfill related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition.

- Local communities especially the resident of Haji Ibrahim Goth will be briefed on traffic safety, especially women who are the main care providers to children.
- Speed limit of 20 km/hr will be maintained by all project related vehicles and night-time driving of project vehicles will be limited where possible.
- Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.
- Contractor must take proper safety measures (placing warning tapes around excavations) to avoid people, especially children, accidentally falling into excavations.
- All the working platforms must be cordon off with special care by well-trained skilled workers.
- Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.
- During construction, the stability of the old dump site must also be taken into account, where investigations should be carried out to ensure that no untoward impact comes from project activities.
- PIU SWEEP should ensure the contractor staff working in the project are well trained and educated in the Health, Safety and Environment (HSE) hazards associated with their duties, and that of the public, in the project area.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.14 Social and Cultural Conflicts

During the construction phase of the project, conflicts may arise between labor force and local community. Furthermore, differences in cultural values may also cause discomfort to local residents.

Mitigation Measures

- Local labor especially from nearby communities will be informed on time and will be given preference in a transparent manner for the construction works.
- Careful planning and training of work force to minimize disturbance to the local people.
- Public notification through print or electronic media during the entire construction phase to avoid any inconvenience in accessibility to the locals; and
- Adequate training of especially for the transitive workforce of the station (involved both in the construction process and in the commissioning) to regard the customs of the area so that the locals do not feel insecure.
- A Code of Conduct will be prepared and adopted for the project (as prepared in the LMP and GAP). All project personnel will be required to sign and follow the CoC.
- Liaison will be maintained with the local communities, and they will be educated about the GRM established for the proposed project.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.15 Child Labor

There are two basic conventions on child labor adopted by the ILO, and one adopted by the United Nations. The ILO Minimum Age Convention, 1973 (No. 138) and its accompanying Recommendation (No. 146) set the goal of elimination of child labor, and the basic minimum age for employment or work (in developing countries at 14 years of age or the end of compulsory schooling, whichever is higher; and 15 or the end of compulsory schooling for developed countries). The Convention sets a minimum age of 2 years younger for “light work,” i.e., 12 and 13 years, respectively; and a higher minimum age for dangerous or hazardous work (basically 18 years of age, but 16 in certain circumstances). The Convention also has various other flexibility clauses.

Inhabitants of the project area have mix economic background and different sources of income. Children of low-income groups mostly involve in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods. However, the Sindh Restrictions on Employment of Children Act, 2017 prohibits the employment of child and restrict the employment of adolescents in certain occupations and processes such as construction industry, and whoever employs or permits a child (person under the age of 15 years) to work in an establishment will be liable to punishment with imprisonment.

The child labor impact might arise during construction stage, as large number of skilled and unskilled labor will be required by the contractor for the construction activities of the proposed project. Furthermore, there are currently children involved in waste picking activities in Jam Chakro dumpsite. These impacts are adverse substantive in significance.

Mitigation Measures

- Awareness will be created among the local communities about the adverse impacts of child labor. For the public awareness, meetings will be held in the project area, and announcements will be made using the available local platforms with the involvement of all sectors of the society.
- Contractor through contractual agreement will be bound to follow the labor standards, rules, and regulations during hiring the labor force and all activities will be monitored by the social and environmental staff of the implementing agency.
- Client and SC will ensure that contractor will have its employment policy in accordance with relevant act and labor policies in Pakistan.
- Contractor will ensure the presence of all persons at site are adults and have their proper identity cards with them.
- Reduce or eliminate the worst forms of child labor and rescue and rehabilitate the children in the worst forms of child labor.
- Penalize contractors/employees using the worst forms of child labor and penalize adults who violate children's rights and who force children to enter child labor, especially in its worst forms.
- Reduce the health hazards and dangers to young persons in the workplace; and
- An LMP and LRP has been prepared to eliminate the issue of child labor at project sites and find ways to rehabilitate children who are involved in waste picking practices currently at these sites by providing them education and skills to be able to augment their family income.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.16 Gender Based Violence Impacts

Women from low-income groups (which make up a considerable demographic in the project areas) are one of the vulnerable groups of the project, where their exploitation is one of the major potential impacts of the project. During surveys, consultations with females were conducted at individual and group levels to understand the apprehensions of females regarding sub-project activities.
With the potential influx of workers and work happening in the area, the risk of GBV will be higher than normal due to discrimination made against women by unequal work distribution and unequal pay structure among others. Sexual Harassment against women may occur as a consequence of the mixing of men and women at the construction sites, and moving on the roads, and areas. Educational institutions near the sub-project sites are also sensitive regarding gender issues.
This impact is medium adverse in significance.

Mitigation Measures

- A standalone Gender Action Plan (GAP) has been developed for the SWEEP project, which will also be applicable to the proposed sub-project, which outlines in detail the measures to take to minimize the risk of GBV.
- Construction workers will undergo training, and strict measures and penalties will be implemented to prevent and address instances of sexual assault and gender-based violence (GBV).
- During school hours, workers will not be allowed to gather in the vicinity.

- To prevent the mixing of women with workers, alternative pedestrian routes will be provided.
- The enforcement of the Gender Protection Act will be strict during construction activities within the project area. Field staff and district-level in charges will monitor its implementation. Communities will be educated about the potential risks of GBV, and response services will be established to address instances of GBV, particularly related to labour influx issues. The contractor will ensure that no gender discrimination occurs during the hiring of workers. Comprehensive standard operating procedures (SOPs) will be developed and implemented to address the presence of women workers on-site. The implementation of these SOPs will be monitored by supervising consultants (SCs).
- Gender-segregated bathing, changing, and sanitation facilities will be provided.
- The contractor will take appropriate measures to address and resolve issues of harassment, intimidation, and exploitation, with a particular focus on women.
- The World Bank Guidelines on GBV will be adopted.
- Workers' camps will be established separate from local communities, with strict protocols for interactions to minimize the impact of labour influx on the project.
- Project staff will receive training on SEA/SH prevention. Skilled trainers will be engaged to raise awareness among project workers about risks, expected behaviours, and consequences of violations. Codes of conduct will be communicated through training and publicized.
- Local organizations and government initiatives on community STDs education, prevention, and treatment programs will be arranged and supported.
- Extensive training will be provided on the awareness-raising strategy, which outlines how workers and local communities will be sensitized to SEA and SH risks, and their responsibilities under the Code of Conduct.
- Whenever possible, routes and places frequented by women will be avoided. If unavoidable, alternative routes will be identified, especially along paths commonly used by women, such as routes to local wells or water sources.
- The construction crew will minimize entry into villages and settlements.
- Communities will be informed and consulted before commencing works inside or near their communities.
- Provisions related to SEA/SH will be included in the bidding document.
- Service providers will be identified and mapped to address SEA/SH issues.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.4.17 Impact on Flora and Fauna

Impacts

The Karachi city is already devoid of vegetation and tree cover, similarly no major impact on flora and fauna is envisaged as Jam Chakro site is situated in already a disturbed and heavily anthropogenic environment which is not a suitable habitat for a diverse range of flora and fauna species. During ecological survey, critically endangered species (listed in IUCN) Commiphora wightii recorded within the premises of existing dumpsite, which has been disturbed due to anthropogenic activity this involve, burning of waste and movement of vehicle within the proximity of dumpsite.

In terms of fauna, some opportunistic and adaptable species may be observed in and around the dumpsite due to the availability of food and shelter resources. These species typically have adaptations that allow them to survive in disturbed or urbanized environments. Albeit the ecological conditions within the landfill, including the presence of pollutants and limited resources, make it challenging for a diverse range of fauna species to thrive. The recorded mammalian species are

common in nature and no significant impact on them are envisaged, irrespective of that, there are chances of species being killed by the Contractor's personal.

Mitigation Measure

- Effort will be done not to disturb or uproot critically endangered species (listed in IUCN) Commiphora wightii.
- If the trees are to be removed, then they should be uprooted and planted in the buffer area being planned for between Haji Ibrahim Goth & the landfill cell.
- The contractor's personnel will be instructed not to kill/poach the wild animals. If there is any burrow/den with juveniles found, it will not be disturbed until the maturity of the juveniles.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be medium adverse.

6.4.18 Physical and Cultural Resources

There are no archaeological importance structure exists with project area, however, it is possible that relics or artefacts of historical, cultural, or archaeological interest could be unearthed during excavation for landfill bed. The Contractor is required to stop construction on discovery of objects of archaeological origin; and notify the owner, who will contact the Department of Antiquities, Government of Sindh to investigate and, if desirable, undertake recovery. Work must remain halted at the specific location until investigation is complete. A chance finds procedures have been developed and added to this ESIA as an **Annex-VIII**.

6.5 Assessment of Potential Impacts and Mitigation Measures (Operation Stage)

6.5.1 Generation of leachate

Impacts

Leachate generation depends on a variety of factors, such as Incident precipitation, evaporation, the extent of the waste surface that is open and exposed, the rate at which the site is covered and capped; and the permeability and water holding capacity of the waste material. The Design Consultant in its feasibility report estimated leachate generation of 650 m^3 for a 1 in 2 years storm. It has been calculated assuming an exposed waste surface of 2.5 acres (1 ha.) the maximum leachate generation, excluding potential reductions through absorption by waste and evaporation. This can readily be stored within the base of any of the Cells on a temporary basis.

The general risks from leachate generated from wastes are due to its normally high organic contaminant concentrations and high ammoniacal nitrogen. Pathogenic microorganisms and hazardous substances that might be present in it are often cited as most dangerous, but pathogenic organism counts have been found to reduce rapidly with time in the landfill, so this only applies to fresh leachate. If generated leachate not properly treated, it could alter the physiochemical parameters and heavy metal concentration in soil and groundwater.

Mitigation Measure

- The primary method of leachate treatment shall be by leachate recirculation to the waste mass, given the prevailing climatic conditions. Re-infiltration shall be achieved by a combination of mobile tanker and spray bar in the active waste deposition area and by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level.
- If leachate re-circulation does not prove to be completely effective as a leachate management process, then it will be necessary to consider other forms of treatment that might be more appropriate, particularly if treated leachate is required to be discharged off-site.

- For collection and temporary storage of leachate the Design Consultant has proposed Leachate tanks will be provided at the northern end of the site.
- Leachate storage tanks shall have a sufficient volume to collect and store leachate for a period of 15 days under maximum precipitation conditions.
- One option of leachate treatment is anaerobic digestion leachate treatment plant which is completely enclosed and produces electricity to offset the operations costs and the water quality.
- Operate the landfill in accordance with applicable internationally recognized standards to minimize leachate generation.
- The operators of the landfill must ensure that an effective and efficient leachate control and monitoring system is maintained. This may be complimented by establishment of groundwater monitoring wells and regularly collecting samples for laboratory analysis. Results of the analysis could aid the operators to determine the final fate of the collected leachate and/detect any potential leakages. Final decision rests with the landfill operator on the final number of wells as well as the frequency of sampling for groundwater quality.

Residual Impacts

- Considering the mitigation measures stipulated above, the residual impact is likely to be moderate to minor adverse.

6.5.2 Possible Contamination of Soil and Groundwater

Impacts

The most anticipated impact of landfill in consider as possible contamination of soil and groundwater, this could happen, if liner system installed is inadequate or in case of leakage into liner. In both the cases, leachate can percolate underground having adverse impact on ground water resources.

During Geotechnical study groundwater was found to be deeper below more than 200 feet. In setting up baseline for proposed site groundwater samples were collected from 6 locations, each near the residential setups in the AOI.

Six (6) storage cell is proposed in sanitary landfill site, there are chances of leachate infiltration from proposed storage cells thus contaminating the ground water and soil.

Mitigation Measure

- A very comprehensive basal lining system has been proposed for sanitary landfill sites, which consist of composite lining system, this will be overlay by Geo composite clay liner and HDPE membrane. A geotextile, with a proposed weight of 1,200 grams/m2, will be placed immediately above the geomembrane for liner protection prior to the placement of the overlying leachate collection gravel and pipework. Considering the proposed multi-layer liner system, it will be able to prevent leachate infiltration into surface.
- An efficient leachate collection and treatment system has been provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum.

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.5.3 Generation of Landfill Gas

Impacts

When waste in landfill goes decomposition, it produces landfill gas which constitutes of Methane and Carbon dioxide CO_2 with small number of other gases like nitrogen, oxygen, and Volatile Organic Compounds (VOCs). The generated landfill gas if uncontrolled release will result in

greenhouse gas emissions, particularly Methane, which is approximately 25 times more effective at trapping heat in the atmosphere than CO_2 over a 100-year period.
Similarly, the release of VOCs will result in air pollution adversely affecting the near-by communities, VOCs when released into the atmosphere, can lead to the formation of ground-level ozone and smog, which can have detrimental effects on human health and the environment.
The other potential adverse from release of landfill gas is fire and explosion, as landfill gas in flammable and if not adequately managed it can create a safety risk.

Mitigation Measures

- A gas treatment plant will be setup with all its necessary piping network and infrastructure to treat and safely discharge the gases that emits from the landfill, thus no significant impacts on occupational or community health and safety are envisaged from landfill gas exposure.
- Periodic GHG monitoring will be carried out during operation phase of the project and accordingly, necessary design changes will be incorporated, if required. The monitoring will include methane and hydrogen Sulfide gases where monitoring will be conducted at the wells and at the residential/ sensitive receptors within the AOI.
- Gas collection wells will be installed in landfill, and it will design in such a way that when two meters of waste layer is deposited in the first cell a 30m x 30m grid of perforated gas recovery pipes will be installed and will be brought up as waste filling progresses. Gas collection system is designed from bottom up to avoid emission during landfill operation and to avoid drilling through the garbage when the cell is filled with waste.
- The gas well will be extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome is installed at the top of the well. Each gas collection wells/domes will be connected to collection strings and each string will lead to a main collection pipe at the manifold that can be regulated with a separate valve based on the quality of gas.
- The design of landfill gas treatment plant will cater the issue of Odor and air pollution, mitigating adverse effect on surrounding communities.
- PIU SWEEP shall ensure that during operation phase of the project, if there are changes in the baseline ambient air quality based on monitoring results, then quantitative assessment will be carried out for flaring and necessary design changes will be incorporated to avoid air quality impacts from flaring.
- A waste to energy plant is also proposed (as a separate project), to convert waste in generation of electricity, the detail of proposed plant is not finalized yet, further a separate ESIA will be conducted to anticipate its impact and mitigation measures.

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.5.4 Attraction of Vermin and Disease Vector Generation

Impacts

The operation of the landfill may attract presence of pests such as rats, cockroaches, flies, ants, and other pests in the immediate area along with various other vectors such as feral cats, dogs, birds, and other animals. These pests can freely move around the area and may find their way to buildings and areas adjacent to the landfill. Since these pests are known to be carriers of diseases, they may trigger the sudden occurrence of illnesses and unacceptable conditions among people of weak resistance and children. Each type of vector can live and multiply at a landfill and is potentially of concern to site operators, regulators, public health professionals and the general public. Fortunately, vectors are controllable and should rarely, and even then, only intermittently, be present on a well-controlled landfill.

Mitigation Measures

- The most effective way to control vermin and disease vector generation is the application of daily soil cover which will be placed before the end of the day. Waste will be covered all the time except tipping face where it will be worked. Due to large quantities needed for daily cover, and the additional requirement required for intermediate and final cover, long-term planning should be done ensure availability of the materials.
- There should be no ponding water on the landfill property except as designed for runoff storage or sedimentation. Sedimentation ponds can, however, aid vector reproduction if not designed and controlled properly so as to minimise stagnant water, nutrient build-up, and plant growth.
- On-site landfill site personnel must be trained and must monitor the levels of key vectors on a daily basis as part of daily management. A simple monthly site walk-over can provide a baseline of vector activity so changes can be noted and translated into action. Observations of various droppings, sightings, tracks, insect counts, etc are useful indicators of activity. Written reports from regular walk-over assessments should be kept on file so changes that occur over time and in response to control measures can be assessed.

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.5.5 Occupational Health and Safety

Keeping in view, the use of heavy machinery that too on daily basis, there are considerable risk associated during the operation of landfill site. Some of the anticipated risks and their mitigation measures are stipulated in below table:

Table 6.9: Risk and its mitigation measures during operation phase of Sanitary Landfill:

Impacts /Risks	Mitigation Measure
There are chances of accidents due to use of heavy machinery such as compactors, bulldozers, and garbage truck this pose a risk of collision, and accident on landfill site.	Workers should receive proper training in the safe operation of machinery and vehicles. Implementation of traffic management plans, speed limits, and designated routes can help minimize the risk of accidents. High-visibility clothing and barriers can enhance worker safety
Workers may come into contact with hazardous substances (especially at MRF) present in the waste, such as toxic chemicals, medical waste, or unknown materials	Personal protective equipment (PPE) should be provided and worn at all times. This includes gloves, respirators, coveralls, and safety boots. Proper waste sorting and handling procedures should be followed to reduce exposure
Landfill can have uneven terrain and slippery surfaces due to waste materials and weather conditions	Workers should wear appropriate footwear with good grip and receive training on safe walking and working on uneven surfaces. Proper site maintenance, including regular waste compaction and surface levelling, can reduce the risk of slips and falls
Workers may be exposed to pathogens from decomposing waste, leading to potential infections or diseases	Regular health monitoring of workers and providing necessary vaccinations can be important preventive measures. Proper hygiene practices, such as frequent handwashing and avoiding touching the face, are essential.

Landfill operations can expose workers to high temperatures, leading to heat-related illnesses, particularly during the month of May to July when temperature is moderately high in Karachi	Providing shaded rest areas, regular breaks, and access to drinking water can help mitigate the risk of heat stress. Educating workers about the symptoms of heat-related illnesses and their prevention is crucial.
Workers involved in waste sorting and handling may face musculoskeletal injuries due to repetitive motions and heavy lifting.	Proper training in safe lifting techniques and the use of mechanical aids (e.g., conveyor belts, lifting equipment) can reduce the strain on workers. Job rotation can also help minimize the risk of repetitive stress injuries

Residual Impacts
With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.5.6 Waste Collection and Hauling Impacts

Impacts
The operation of the proposed landfill will result in the movement of a higher volume of trucks and heavy vehicles. In general, transporting solid waste from GTS at Imtiaz, Sharafi Goth, and Dinga Morr and also by direct delivery from the Central, East, Korangi, Malir and West Districts and, very rarely, from the South District. The movement of these heavy vehicles could result in a higher risk of accidents along with the risk of increased congestion events taking place along the route of these vehicles, particularly during the times of peak traffic, such as during the morning and evening times of the day.
Increased traffic volume of waste carrying vehicles will result in increased noise levels and dust issues if such impacts are not managed properly. Waste hauling through mechanically unfit vehicles will result in increased noise levels in the project area. Waste transport without purpose-built vehicles or waste transport on dirt roads will result in increased dust levels.

Mitigation Measures
For above anticipated impacts, following mitigation measures are proposed:
- SSWMB to Implement a well-designed traffic management plan that includes designated routes and restricted timings for waste-carrying vehicles to avoid peak traffic hours. In addition to that schedule waste collection and transportation to avoid overlapping with peak traffic hours in busy areas.
- During operation of landfill, SSWMB will also ensure that waste-carrying vehicles are well-maintained and regularly inspected to minimize the risk of accidents due to mechanical failures. The driver hired will also be provided trainings on safe driving practices and the potential hazards associated with waste transportation.
- Encourage the use of covered waste trucks to prevent dust emission during transportation or at minimum cover the garbage transportation trucks with tarpaulin in order to reduce its impact on surrounding environment while waste transportation to Landfill.
- Encourage residents to support waste reduction, recycling, and composting efforts to reduce the overall volume of waste needing transportation.

Residual Impacts
- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.5.7 Fire & Explosion Hazards

Impacts

Fire and explosion hazards can be a risk for engineered landfill sites, which may result from the decomposition of organic waste, the build-up of flammable gases, and other factors. This impact is substantial to moderate adverse. The potential impacts and mitigation measures include:

Generation and accumulation of methane gas

Landfills produce methane gas as organic waste decomposes. Methane is highly flammable and can explode is it accumulates in sufficient quantities.

Mitigation Measures

- A gas collection system is already proposed to capture and control methane emissions, along with a gas processing plant to deal with the accumulated methane in the form of collection and flaring or generation of electricity.
- Regular monitoring of gas levels in an around the landfill can help detect and respond to potential issues.

Spontaneous Combustion

Organic materials in landfills can undergo spontaneous combustion due to the heat generated during decomposition.

Mitigation Measures

- Use daily, intermediate, and final cover systems to help limit oxygen ingress and temperature fluctuations, reducing the risk of spontaneous combustion.
- Regularly monitoring and for signs of elevated temperatures or smoke can help identify potential combustion events early.

Ignition Sources

Ignition sources such as cigarettes, sparks, or lightning strikes can start fires at landfill sites.

Mitigation Measures

- Implement no smoking policies and prohibit smoking in and around landfill areas.

Waste Cover & Compaction

Inadequate waste cover or improper compaction may leave waste exposed to oxygen, increasing risk of combustion.

Mitigation Measures

- Ensure daily and final covers are correctly applied to limit oxygen ingress.
- Adequate compaction of waste can reduce void spaces and limit the availability of oxygen for combustion.

Residual Impact

With the implementation of these mitigation measures, the risk of fires and explosions is likely moderate adverse.

6.5.8 Impacts on Waste Pickers

Impacts

E&S Consultant in its socio-economic survey identified 1067 waste pickers of whom livelihood are associated with waste picking. The proposed landfill site will have a boundary restricting the access of waste pickers, who are now engaged in waste picking at dump site, meaning their livelihood will be affected.

Mitigation Measure

A Livelihood Restoration Plan has been prepared for identified waste pickers with an objective to provide a detailed plan to livelihood restoration options for the people affected due to the Landfill site development at Jam Chakro. LRP covers the alternative livelihood options for the affected waste pickers whose livelihoods will be altered due to the development of the cells. Nevertheless, in line with the Bank's mitigation hierarchy, measures have been developed to minimize and offset these impacts where trainings, skill development, and linkages with industries have been explored in detail for the waste pickers at Haji Ibrahim Goth.

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.5.9 Emergency Preparedness & Response

The operations at the landfill site may at times be hampered, leading to operational failures. In addition, disasters such as explosions, fires, gas leakages, earthquakes may occur. This impact is negative, permanent, and moderate to substantial adverse in nature.

Mitigation Measures

- SSWMB and the operator to develop an Emergency Response Plan (ERP) using the guide plan attached as an **Annex-XVI** for disasters related to the landfill site in collaboration with the Fire Fighting Department, Local Police, Nearby healthcare providers, and Provincial Disaster Management Authority (PDMA).
- Regular training sessions will be conducted to educate staff, employees, and the population at Haji Ibrahim Goth about the emergency procedures and plans.
- A designated responsible person will be assigned to oversee the implementation of the ERP.
- Emergency contact numbers will be prominently displayed to ensure swift action during emergencies.
- Firefighting systems will be regularly calibrated and maintained.
- Routine fire emergency drills will be conducted to ensure preparedness and response effectiveness.

Residual Impacts

After the implementation of these mitigation measures, the residual impact is low to moderate adverse in significance.

6.5.10 Closure and Post Closure Impacts

Impacts

Closure and post-closure adverse impacts of a sanitary landfill site refer to the negative effects that can arise after the landfill reaches its capacity and is closed for waste disposal. Despite the best efforts to mitigate these impacts during the closure process, certain adverse effects may persist or emerge during the post-closure period.
Some of the closure and post-closure adverse impacts of a sanitary landfill site include:
Even with proper capping and covering, leachate can continue to be generated and may seep into the surrounding soil and groundwater, potentially contaminating local water source, landfill gas continues to be produced long after the landfill is closed. If not properly managed and collected, these gases can migrate into the atmosphere and contribute to air pollution and climate change.
Over time, the waste in a landfill undergoes decomposition and compaction, leading to subsidence and settlement of the landfill area. This can result in uneven ground surfaces, improperly closed or poorly managed landfills can experience soil erosion, landslides, or slope failures, which can impact the stability of the surrounding land and pose risks to nearby communities.
Closed landfills may not blend seamlessly into the surrounding landscape, leading to visual blight and negatively impacting the aesthetic appeal of the area.

Mitigation Measures

To address the closure and post-closure adverse impacts of a sanitary landfill site, various mitigation measures can be implemented.

- The Design Consultant to establish a comprehensive groundwater monitoring network around the landfill to regularly monitor water quality. Early detection of contamination allows for timely intervention and corrective actions.
- Appropriate selection of soil type for final cover will be ensured to prevent direct or indirect contact of living organisms with the waste materials and their constituents.
- Application of final cover components that are consistent with post closure use and local climatic conditions.
- SSWMB to implement a monitoring program to assess ground settlement and subsidence over time.
- SSWMB to conduct slope stability analysis to identify potential unstable areas and take corrective actions, such as slope reinforcement or stabilization measures.
- Develop plans for alternative land uses that are compatible with the site's constraints.
- SWMB to educate nearby communities about the landfill's closure and post-closure management measures, potential risks, and the importance of adherence to safety guidelines.
- Conduct regular environmental monitoring to assess air quality, water quality, and soil conditions as present in Environmental Management Plan (EMP).
- Future Land use of the site will be defined in consultation with local communities and government agencies.
- SSWMB will ensure that financial instruments are in place to cover the costs of closure and post-closure care and monitoring.
- Long term integrity and security of the site will be maintained.

Residual Impacts

- With the implementation of mitigation measures stipulated above, the residual impact is likely to be minor adverse.

6.6 Positive Socio-economic and Environmental Impacts of project

This will be first Engineered design landfill site of Karachi it will provide an essential and controlled method for managing and disposing of solid waste, by organizing waste in designated areas and covering it with layers of soil, potential risks of open dumping, uncontrolled burning, or illegal waste disposal will be minimized which is current practice in Jam Chakro Dump site.

- It will stop further contamination of groundwater and soil through leachate percolation.
- After a landfill reaches its capacity and closure measures are implemented, the site can be reclaimed and restored for other beneficial purposes. Land reclamation can involve converting the landfill into recreational areas, wildlife habitats, or green spaces.
- Sanitary landfills help protect public health by reducing the potential for disease transmission, as waste is confined and properly covered. Properly managed landfills also minimize the release of hazardous substances that could otherwise pose health risks to nearby communities.
- It will create jobs and economic opportunities for the local community, including positions in waste management, landfill operation, and recycling program.
- The material recovery facility which will be setup besides landfill will reduces the need for extracting and processing virgin resources. By recycling materials such as paper, plastic, metal, and glass, the demand for raw materials is reduced, contributing to resource conservation and sustainability.
- Capture of fugitive emissions from waste, along with foul odours, improving the overall liveability of the area.
- Formalization of the site, reducing the negative impacts overall to the receptors.
- It will reduce vermin and vectors in the area.
- Generation of short term and long-term direct employment for locals. It is envisaged that about three-quarter of the workforce required during construction phase will be for unskilled jobs/work. Locals will be preferred for the workforce, expected to be about two-third of the unskilled workforce. For the operational phase, requirement of local unskilled labor is not expected to be more than half of the workforce. Possession of valid National Identity Card will be required to ensure hiring of locals among the workforces.

7. Grievance Redress Mechanism

7.1 Review of the Existing SSWMB Complaint System

SSWMB operates a complaints system, which comprises several complaint registration channels including:

1. A dedicated telephone helpline (1128)
2. The SSWMB's website and social media pages (that provide direct telephone numbers for central and regional offices as well as email addresses for relevant officials). The social media pages are updated regularly and allow social media users to send messages directly or use an email address displayed on the website and social media pages to file complaints or give suggestions.
3. A smartphone application (SSWMB's Citizen' Application for android and iPhone users) where citizens can log in to provide suggestions and complaints on all SWM related issues. Using the application, complainants can also upload pictures, videos, audio files, or even handwritten text files in support of their complaints.

The SSWMB employs staff at its command-and-control center who are tasked with the registration and management of complaints.

While the SSWMB's complaints system is primarily focused on service-related complaints regarding the Board's operations, a dedicated GRM for SWEEP, described below, will be built on top of the existing complaints systems of the SSWMB, such that complaints concerning project-supported investments and activities may be received through existing channels and relayed by existing staff, however, these will be registered separately, managed under the SWEEP GRM, and tracked by the Grievance Redress Committee (GRC) until resolution.

7.2 SWEEP GRM - Overview

The Project has developed a dedicated GRM, to receive and resolve all complaints and grievances related to project-supported activities. A GRC has already been notified, comprising relevant staff from the SWEEP PIU, with the Project Director at its head and the Stakeholder Engagement and Gender Specialist as the secretary. Other than the GRC members, the Committee may also utilize existing resources at the SWEEP-PIU and SSWMB to address and resolve grievances. Available SSWMB staff at the command-and-control center will be tasked to operate and manage key interfaces such as dedicated telephone lines and email accounts set up to receive complaints, who will then relay to the pertinent SWEEP personnel to settle grievances and provide feedback related to project activities. The existing SSWMB team will be provided training to manage project-specific communications and grievances, which will require response and redressal procedures that are distinct from normal complaints on services. The existing SSWMB team may be supplemented with additional resources using project financing if needed.

The GRM employs the available complaint registration channels that are part of the existing system used by SSWMB, as well as dedicated project-specific interfaces, and also builds on top of them, as described below:

- **Helpline: 1128** SSWMB's Complaint helpline where all project-specific communications and grievances are to be recorded, tracked, and managed in the GRM database. The helpline will also be used for SWEEP complaints.
- **SSWMB's Citizen Application.** Complainants may register on the application to lodge complaints or provide feedback on project-supported activities, which will be filed in the dedicated sub-portal of SWEEP.

- **Dedicated email:** complaints@sweep.gos.pk Any complaints or grievances received at other email addresses used by the SSWMB for complaints will be routed to the dedicated email address.
- **Online Complaint Application via the website (sweep.gos.pk)**
- **Social Media pages** of SWEEP (registering complaint process and links), with project-related communications and grievances, routed to the SWEEP GRM and GRC
- **Telephone numbers**: 021-99217787-88**.** Call and complaint numbers already in use by SSWMB will also be used to receive project-related communications or complaints, which will then be recorded in the SWEEP GRM.
- **In-Person registration of complaints at project offices (PIU and site offices).** All communications will be shared with the GRC and entered into the GRM database by the dedicated staff of SWEEP-PIU.
- **On-site complaints register and complaints boxes** will be placed at all sub-project sites prior to the construction of the project. The supervision consultants engaged for specific subprojects will ensure that qualified staff of contractor/s is tasked with and available on-site to receive verbal complaints and shared them with the PIU.

7.3 Grievance Redress Procedure/ Mechanism

A set of procedures for receiving, recording, and handling complaints has been defined in the following subsections. This includes procedures for recording, registering, and sorting grievances, conducting an initial assessment of grievances, referring grievances to appropriate levels or persons, determining the resolution process, making decisions, including parameters and standards for accurate and consistent decision-making, notifying complainants and other affected parties of eligibility, the resolution process, and outcomes, along with tracking, documentation, monitoring, and evaluation.

7.4 Grievance Redress Committee (GRC) under SWEEP

Role	Designation
Head of the GRC	Project Director SWEEP
Director GRC	Deputy Project Director SWEEP
Secretary to GRC	Stakeholder Engagement and Gender Specialist
Member	Deputy Director Communication
Member	Community Engagement and Resettlement Specialist

Note: Deputy Project Director or Deputy Director Communication SSWMB will chair the Committee in the absence of Project Director. Three persons are necessary in the quorum for conducting the meeting and the committee meeting cannot be conducted without chair. The Secretary to the committee will be responsible to keep all records confidential. Record may be share after the approval of Project Director SWEEP with the World Bank or any stakeholder.

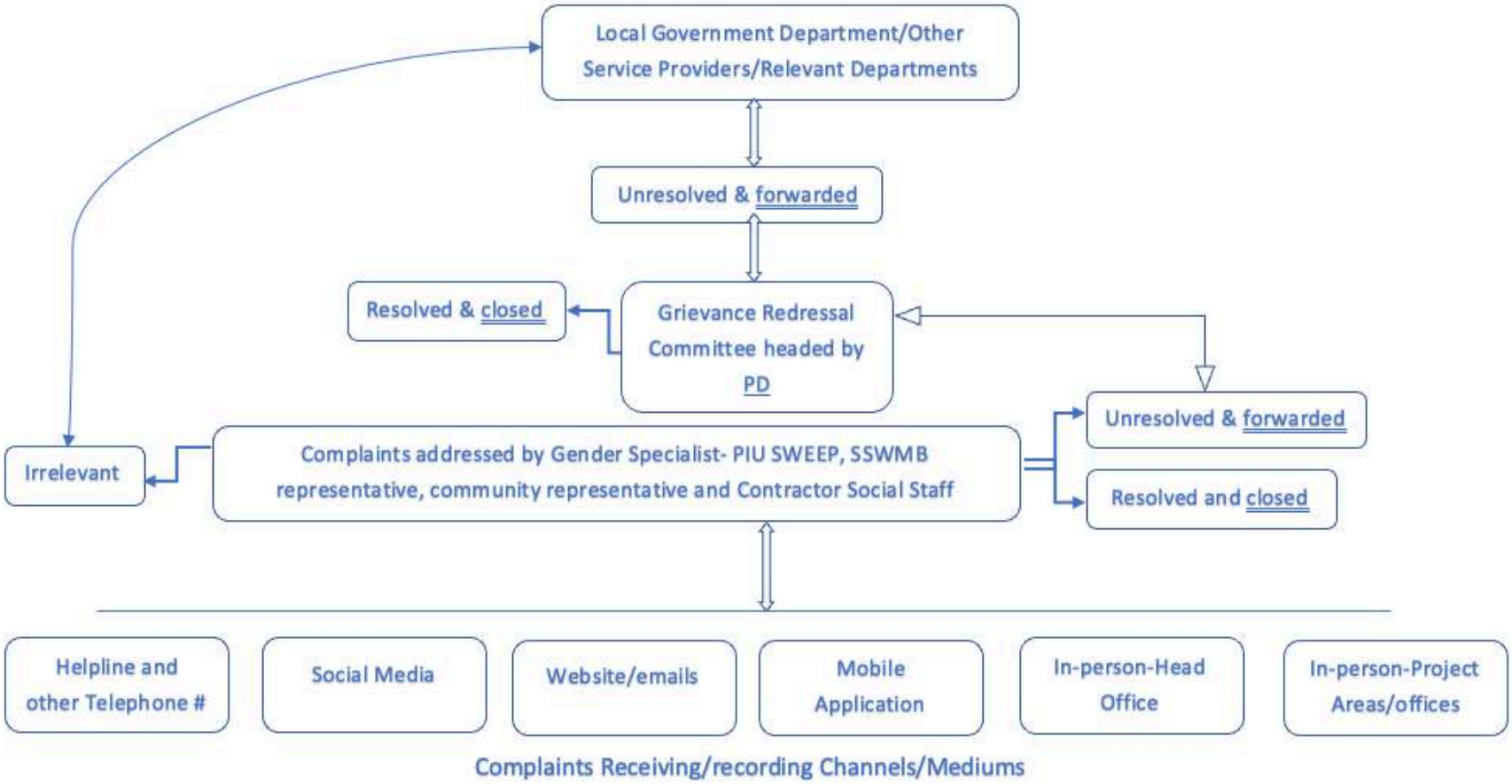


Figure 7.1 - Nomenclature of GRM

7.5 Audit, inspection, and physical verification/Enquire Grievance Record

All grievance record is auditable, and each grievance may be audited by stakeholders or any nominated staff at the SWEEP PIU with the permission of Project Director SWEEP. The record will be maintained at the SWEEP-PIU level, if a team member/others required a record will produce a record with the approval of the Project Director SWEEP.

Timeline for Resolution of Complaint

- The committee will finalize the decision within a 14-day period and assess progress on its decision.
- Categorization of grievance by Assistant (for GRM) to Secretary GRC (Within 2 days of receipt)
- Assignment of complaint to relevant department/ Personnel for redressal of complaints (Within 3 days of receipt)
- Submission of complaint status to GRC (fortnightly)
- Updated status of the complaint by the relevant department /personnel and submission to PD SWEEP (Monthly)

7.6 Complaints of Gender Based Violence, Sexual Exploitation & Abuse/ Sexual Harassment & Violence Against Children (GBV, SEA, SH, and VAC)

Gender-based violence (GBV) is a violation of human rights. Nearly six in ten women around the world suffer some kind of violence in their lifetime, whether physical or sexual (UN Women, 2019b). Although countries have been encouraged by international and regional legal entities to take steps to fight the problem, GBV continues to occur worldwide in many forms, ranging from domestic violence to sexual abuse, to more severe forms such as honour killings, acid attacks, and other forms of femicide. The global prevalence of GBV indicates that the issue is yet to fully be tackled, which has far-reaching consequences. Studies reveal that GBV leads to physical injuries, disability, and death, and victims also suffer mental and psychological disorders. According to a World Bank study (Nata Duvvury, 2013), some women fear GBV more than war or cancer.

The PIU SWEEP is focused on addressing any GBV, SEA, and SH related grievances across all project-supported activities and subproject sites. A survivor-centred approach will be adopted under which the survivor's safety, confidentiality, choices, needs, and well-being will remain central. The SEA/SH and VAC complaints will be addressed in the following manner:

7.7 Procedures of Addressing Grievances on GBV, SEA, SH & VAC

The GRM for GBV, SEA, SH, and VAC will require a dedicated and specific system to receive, manage, and resolve such complaints. The (i) Stakeholder Engagement and Gender Specialist and (ii) Community Engagement and Resettlement Specialist, at the SWEEP PIU will be central to this system as *the focal points for all complaints and grievances related to GBV, SEA and SH*. The PIU staff will be responsible for tracking and managing such complaints, and will be provided training from a certified and reputable organization focusing on issues of GBV and VAC. The system will rely on designated *GRM operator(s) for GBV, SEA, SH, and VAC,* who will actively coordinate with staff managing the various complaint channels (among the SWEEP PIU, SSWMB, and supervision consultants) for receiving and lodging such complaints. The designated staff will be provided adequate training on handling and documentation of complaints related to gender-based violence, sexual exploitation and abuse, and sexual harassment, and covering referral

mechanisms to related service providers. All grievances related to GBV, SEA, and SH will be managed by a *dedicated GBV, SEA, SH and VAC committee* specifically set up for this purpose. The members of the committee will also need to be well-trained to manage such complaints.
The detailed Grievance Redress Mechanism, highlighting the various steps and procedures is attached as **Annex-XVII**.

8. Stakeholder Consultations

8.1 Overview

Public consultation and information disclosure is an essential component of the Environmental & Social assessment process, recognized by development agencies and national governments alike. Similarly, to incorporate the views, concerns, and suggestions of project stakeholders and to provide them with sufficient opportunity to become part and parcel of the development process, the importance of stakeholder engagement throughout the project life cycle cannot be dismissed.

Stakeholder consultation presents an opportunity for mutual information-sharing and dialogue between the project proponent and stakeholders. An effective public consultation provides concrete suggestions that can help improve project design, resolve conflicts at an early stage, identify management solutions to mitigate potentially adverse consequences and enhance perceived positive impacts.

8.2 Consultation Objectives

Effective stakeholder engagement enhances project beneficiaries' role from "participants" to "enabling agents" that proactively provide insights to project planning and implementation. The stakeholder consultation process for this project has been designed to enhance the role of stakeholders and thereby contribute towards project success and sustainability. Specific tasks and purposes of consultations with stakeholders have been given in the table below.

Table 8.1 - Tasks and Purposes of Consultations

Task	Purpose of Consultation with Stakeholders
Need for consultation with the stakeholders?	• To build trust to ensure sustained support for the proposed project and build resilience during the times of crisis. • To learn about public concerns that need to be addressed and considered in designing of the project concept and preparing mitigation measures and programs. • To learn about the strengths, skills, and organizational support that the stakeholders can bring to support project planning and implementation. • To introduce the project and obtained their views and feedback on it, along with measures to incorporate to improve the project.
Modes and benefits of consultation	• Listening and creating dialogue with stakeholders to keep the project tuned to public concerns early, to pre-empt breakdowns, and avoid mistrust in public confidence. • Engaging the public as advocates for the project construction and to support the implementation of social, resettlement, and environment and health programs.

The specific objectives of the stakeholder engagement exercise carried out for the SWEEP project include:

- Inform all stakeholders about the SWEEP project, its context and objectives, salient design features and potential social and environmental consequences.
- Facilitate and encourage interaction with project's beneficiaries, including project-affected parties and other-interested parties to encourage project acceptance, sustainability, and ownership.

- Adopt an inclusive, participatory, and transparent approach towards stakeholder engagement that provides opportunities for engagement with relevant stakeholders of all backgrounds, regardless of gender, race, ethnicity, income-class, and ability.
- Benefit from the local knowledge for enhancing strategic interventions for public space design and infrastructure improvement; and
- Identify specific community concerns and suggestions about proposed designs and develop solutions to ensure satisfactory results.

8.3 Stakeholders Identification and Analysis

The three categories of stakeholders as per the ESS10 are outlined below:

- **Affected Parties** – persons, groups, and other entities within the project area of Influence (AOI) that are directly influenced (actually or potentially) by the project and/or have been identified as most susceptible to change associated with the project, and who need to be closely engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measures.
- **Other Interested Parties** – individuals/groups/entities that may not experience direct impacts from the project but who consider or perceive their interests as being affected by the project and/or who could affect the project and the process of its implementation in some way; and
- **Vulnerable Groups** – persons who may be disproportionately impacted or further disadvantaged by the project(s) as compared with any other groups due to their vulnerable status[29], and that may require special engagement efforts to ensure their equal representation in the consultation and decision-making process associated with the project.

Stakeholder identification, consultations, and analysis was done as per the SEP of SWEEP.

8.3.1 Project Affected Parties

ESS10 refers to identifying individuals, groups, institutions, and other parties that may be directly or indirectly affected by the project, positively or negatively. Affected Parties include local communities, community members and other parties that may be subject to direct impacts from the project. This ESIA focuses particularly on those directly affected, positively or adversely by the project activities. At this time, the PIU of SWEEP has identified directly affected parties under this category as:

- Beneficiaries of the project; and
- Project Affected People (PAP) as well as entities affected by environmental and social impacts such as livelihood loss, social and cultural issues, noise, dust and increased vehicular traffic.

Primary Stakeholders for this project include:

- **All those situated within the AOI of the project sites** - This includes the residential and commercial makeup in the surroundings of these sites which comprises of:

29Vulnerable status may stem from an individual's or group's race, national, ethnic, or social origin, colour, gender, language, religion, political or other opinion, property, age, culture, literacy, sickness, physical or mental disability, poverty or economic disadvantage, and dependence on unique natural resources.

  - People of mixed ethnic (Urdu speaking, Pathan, Sindhi, Punjabi, Balochi) and religious backgrounds,
  - Pockets of selected minor and major commercial entities (including roadside vendors, eateries, and industries), and
  - Social service providers such as schools and health facilities.
- **The waste pickers in Jam Chakro especially the community of Haji Ibrahim Goth** This includes:
  - Informal workers i.e., the waste pickers who pick recyclable materials out of the incoming waste at the Jam Chakro dumpsite.
- **Government Departments directly involved in the project** – This includes departments like the SSWMB, the Local Government Department.
- **Non-Governmental Organizations working in the area** – list given ahead.

The roles and responsibilities of each of these stakeholders is given below:

Table 8.2 - Roles and Responsibilities of Primary Stakeholders

Project Stakeholders	Roles and Responsibilities
Sindh Solid Waste Management Board (SSWMB)	• The Board shall regulate control or inspect the source points of generation, accumulation, transfer, recycling, trading of the solid waste. • The Board shall have the right over the solid waste related issues, assets, funds, and liabilities of the Councils and shall possess sole rights on all kinds of solid waste within the limits of all Councils. • The Board may support, promote, administer, execute, and implement schemes for undertaking any commercial or business enterprise which may benefit the management of waste.
Communities and Project Affected Persons	• Participation in social impact assessment surveys, Consultation, and Focus Group Discussions • Identification of project impacts, specific community concerns/suggestions from community leaders, male and female community members • Identification of mitigation measures and solutions for enabling win-win solutions
Vulnerable / Disadvantaged Groups	• Identification of project-specific impacts on vulnerable / disadvantaged groups • Identification of mitigation measures and solutions to ensure vulnerable / disadvantaged groups are not adversely affected
Beneficiaries of the project	• Identification of issues, suggestions, and coordination for improvement of the project design • Support for implementation and aftercare of the project • Identification of project-related environmental and social issues and concerns • Identification of positive solutions for environmental and social sustainability of the project that are technically sound and cost-effective. • Aftercare of the project

8.3.2 Other Interested Parties

There may be broader stakeholders who are interested in the project because it indirectly affects their work or has some bearing on it. As elucidated in ESS10, while these groups may not be directly affected by the project, they may have a role in the project preparation/ implementation or have a broader concern including for, but not limited to, information dissemination, awareness raising, community mobilization, and feedback. Interested parties identified under this category include:

- Revenue Department.
- Local Councillors.
- Environment Protection Agency of Sindh.
- Civil Society Organizations (CSO) and Community Based Organizations (CBO).
- Academia and Subject Specialists.
- Labor and Human Resource.
- Social Welfare Department.
- Women Development Department.
- Donor Agencies; and
- Press and Media.

Details regarding roles and responsibilities of the concerned departments, institutions and primary stakeholders are given in Table 8.3 below:

Table 8.3: Role and Responsibilities of Secondary Stakeholders

Project Stakeholders	Roles and Responsibilities
Sindh Environmental Protection Agency	• SEPA is the regulatory authority and mainly responsible for the development and implementation of the environmental policies and strategies in order to integrate the environmental issues and sustainable development approaches into the legal and regulatory frameworks as per Sindh Environmental Protection Act, 2014. • EPA Sindh is responsible for the approval of the proposed project prior to implementation. • EPA Sindh is responsible for the compliance of ESMP, and provisions laid down in the approval during the construction and operation stages of the project.
Revenue Department	• Provide and verify land ownership data which include but not limited to the ownership record, land categorization and price details of land around the project sites.
Political Parties	• The politics of Karachi takes place at the municipal, provincial, and federal levels, there are many prominent parties such as various fractions of MQM, PPP, Jamat-e-Islami, PTI and other parties
Local Councillor's	• Elected union committee constituents. Key link between constituents and city legislature and executive. • Help in project implementation through raising awareness and increasing project acceptability through dialogue.
Civil Society Groups (CSG) and Community Based Organizations (CBOs)	• Largely policy advocacy with limited interaction with government except in areas where strong CBO culture exists. • CSOs involved in development activism and service delivery may provide insights and different recommendations for working on social issues. • Identification of project-related environmental and social issues and concerns • Identification of mitigation measures and solutions to ensure community issues, including those of vulnerable / disadvantaged groups are adequately addressed. • Identification of positive win-win solutions for environmental and social sustainability of the project
Academia and Subject Specialists	• Identification of project-related environmental and social issues and concerns • Identification of positive solutions for environmental and social sustainability of the project that are technically sound and cost-effective
Labor and Human Resource	• Enforcement of labor laws • Promotion of healthy labor management and conditions

Project Stakeholders	Roles and Responsibilities
	• Monitoring of labor working conditions • Implementation of labor standards • Address grievances of labor force • Maintain the minimum wages rates and impose restriction of child labor
Social Welfare Department	• Social protection including institutional care, skill development and rehabilitation amongst workers. • Provide welfare services
Women Development Department	• Cover all the needful grounds regarding women without the discrimination of class, creed, religion, economic position. • Address concerns of women related to the project. • Create employment opportunities. • Training and capacity building of women
Donor Agencies	• Compliance with Environmental and Social Safeguards of Unilateral and Multi-Lateral Development Agencies • Lessons from previous/on-going development projects in the project-affected districts

8.3.3 Disadvantaged / Vulnerable Individuals or Groups

It is particularly important to understand whether project impacts may disproportionately fall on disadvantaged or vulnerable individuals or groups, who often do not have a voice to express their concerns or understand the impact of a project. This vulnerability may stem from a person's origin, gender, age, health condition, literacy levels, economic deficiency and financial insecurity, disadvantaged status in the community (e.g., religious, and ethnic minorities or fringe groups), dependence on other individuals or natural resources, especially those living in remote, and insecure or inaccessible areas.

Through detailed surveys and consultations, 03 vulnerable groups have been identified for this sub-project, which include:

- **Women from marginalized groups** – Women working in the informal sector and in low paid occupations are particularly vulnerable to exploitation (financial, and social/ sexual).
- **Households and communities living below the poverty line** – Communities living below the poverty line are also prone to social and financial exploitation as they may make meagre wages and have little to no access to good quality social infrastructure.
- **Minorities** – A significant portion of Pakistan's sanitation workers are Christian or Hindu and suffer multiple forms of discrimination on account of their poor socio-economic status as a religious minority.

8.4 Consultation and Participation Process

The project utilizes various methods of engagement that were employed as part of its continuous interaction with project stakeholders. For the engagement process to be effective and meaningful, a range of various techniques were applied that were specifically tailored to the identified stakeholder groups. For ascertaining the perceptions of different stakeholders about the project consultations/ meetings were carried out at following two levels:

- Consultations with PAPs and Vulnerable / Disadvantaged Group
- Consultations Other Interested Parties

8.4.1 Consultations with Project Affected Parties

In order to align with international standards and good practices, local level engagement was provided to all stakeholders. Apart from those potentially affected communities and their representatives, the vulnerable and disadvantaged people within these communities (people who would not normally be involved in decision-making) were also engaged.

The main purpose of the consultation exercise was to disseminate project information to relevant stakeholders and solicit their feedback received at an early stage regarding potential issues and concerns based on the current project concept and design features. Identification of stakeholders is one of the major steps for designing an effective consultation process. For this purpose, several site visits were carried out by E&S team to identify the relevant stakeholders for consultation.

Consultation meetings were conducted with the identified stakeholders. The stakeholders were briefed about the background and scope of the SWEEP project at the beginning of the meeting sessions. Concerns and suggestions of the respondents were noted down by the team and pictures and video recordings of the session were taken with the consent of the stakeholders. If the interviewees had any queries regarding the project, the team responded to their queries during the session.

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

The following methods were used for public consultation with project stakeholders in order to ascertain their views regarding project implementation, which were formally recorded:

- Formal and informal Group Meetings with institutions
- Individual meetings with PAPs
- Focused Group Discussions (FGDs)
- Key informant interviews (KII)
- Gender Consultations

Consultations with primary stakeholders were conducted twice in the sub-project preparation phase:

1) Once at the start of the project to ascertain their views and feedback on the issues encountered from the existing operations of the Jam Chakro dump site in their current form.
2) Second, when the design of the Jam Chakro dump site had been conceptualized, to obtain their views on the design and identify room for further improvements where possible, along with a potential assessment on the types of preferred trainings for livelihood restoration against any potential livelihood impacts arising from the sub-project.

8.4.2 Consultations with Other Interested Parties

Other Interested Parties identified, in the form of departmental stakeholders such as non-governmental organizations, government departments, and utility departments, were not only approached separately for the project's consultations, but also invited for a stakeholder consultation session, arranged to allow for all these departments to gather, and facilitate a meaningful dialogue on the project, and obtain their feedback on the project.

All relevant Government Departments/Organizations were invited in the consultation session where they were informed of the project in detail and requested to share their concerns and suggestions. Local representatives of all other stakeholder groups were also invited to the

consultation session to encourage a collaborative and inclusive approach that includes the stakeholders from the civil society sector, academia, and media representatives. Invites sent out to these stakeholders are attached as **Annex-XVIII**, and the attendance sheet from the session as **Annex-XIX**.

8.4.3 Other Consultation / Participation Methods

- **Letters** - The letters were the instrument used in order to facilitate the project planning process through good collaboration between the implementing entities and other stakeholders. Invitation letters were written to stakeholders for the consultation meetings.
- **Reports** - The reports used to monitor the project implementation and to keep informed the main stakeholders of the project.
- **E-mails** - To facilitate communication between implementing entities.

8.5 Consultation Feedback and Analysis

8.5.1 Project Affected Parties - Primary Stakeholders

The comments, concerns, and suggestions received from stakeholders during the survey have been collated in this section. The comments solicited from stakeholders were helpful in the screening of the potential environmental and social aspects of the project. Consultations were conducted during the site surveys at different locations within the area of influence to record views of the PAPs related to the project.

Community at Haji Ibrahim Goth

A list of the consultations conducted with the community at Haji Ibrahim Goth for the development of the engineered landfill cells is given below :

Table 8.4 - Consultations with Community at Haji Ibrahim Goth

S#	Types of Consultation/ Meeting	Dates	Number of Participants (males)	Number of Participants (females)
1	Initial Visit of Jam Chakro to meet SSWMB staff and village influential, teachers, volunteers	15 April 2022	15	6
2	Pre-census consultations	20 June 2022 to 30 July 2022	22	4
3	Consultations with village elders, political workers, and volunteers	13 July 2022	12	-
4	Haji Ibrahim Goth Household Census Survey	1 August 2022 to 10 August 2022	710	615
5	Haji Ibrahim Goth Commercial Census Survey	11 August 2022 to 15 August 2022	29	-
6	Consultation with Educational Institutions	30 September 2022	2	8
7	Consultation with Healthcare Facilities	30 September 2022	2	-
8	Follow up of census	13 Oct 2022	12	2
9	Cut-off date information declaration	26 Nov 2022	67	5
10	Focused group discussion with male and females on gender-based violence issues	28 Nov 2022	16	32
11	Pre-skill trade need assessment consultations	3 March 2023	16	2
12	Skill trade need assessment consultations	13 March 2023	841	226

Engagement with the community was extensive, where the consultations conducted helped to not only establish a baseline of the existing conditions, but also in the overall development of the project in a manner that would be acceptable to the community. At different stages of the sub-project design and development, the same was disclosed to the community, their queries answered, and their opinions and feedback incorporated into the project wherever possible.

A summary of the Frequently Asked Questions by the community throughout the consultation process, along with the answers provided by the ESIA team is given below:

Table 8.5 - Stakeholder Feedback from Primary Stakeholders

Concerns Raised	Responses by ESIA Consultant
Consultation with Haji Ibrahim Village Community	
Given that there are plenty of people residing at Haji Ibrahim Goth and are nearby the area where the cells are being developed, preference should be provided to the locals for jobs during construction and operation of the sub-project.	Provisions will be added to the contracts of the contractor and the operator, where they will be obligated to hire local labor to the extent possible (unskilled and skilled). The contract document will have a clause to engage local community including women for skilled and unskilled jobs during construction and operations phases also wherever possible.
Will the people at Haji Ibrahim Goth be subject to any sort of physical relocation or displacement as part of the works proposed under the sub-project?	The sub-project has taken every effort onboard to ensure that it is developed in a manner that involves no physical displacement or involuntary resettlement of any persons. Furthermore, there also plans being developed by the Government of Sindh to ameliorate the living standards of the community at Haji Ibrahim Goth through focused infrastructural interventions.
There is a considerable population of persons at Haji Ibrahim Goth whose livelihoods are tied to waste picking at the Jam Chakro landfill site. If these people are unable to access the new cells moving forward, how will the project compromise the livelihood losses that will take place?	These impacts have been considered in the overall impact assessment being done for the sub-project, where accordingly, a dedicated Livelihood Restoration Plan has been prepared (as there is no physical resettlement involved). The plan will feed off of the feedback and suggestions provided in a dedicated training needs assessment conducted for the waste pickers at Haji Ibrahim Goth, where preferred professions and skills were highlighted by the community for training.
Apart from the development of the sub-project, there is also development happening around the area in the form of housing schemes, and buildings, where preference may be provided to the local community as laborers.	As part of the development of the Livelihood Restoration Plan, the nearby construction activities and developments were mapped and consulted. The consultations focused on the potential of understanding the type of workers and skills required, where the same would be provided to the community to make them eligible for these jobs. Part of the LRP implementation will also include creating linkages between the community at Haji Ibrahim Goth and these developers to facilitate the recruiting and hiring process.
Given the nature of work the waste pickers at Haji Ibrahim Goth are involved in, daily payments are provided against waste sold. A part of the population echoed that similar sort of remuneration mechanism would be preferred where daily wages are provided rather than specialised works.	The feedback of the community has been taken into account whilst preparing the Livelihood Restoration Plan, where during implementation, the preferred skills/ type of work shall be focused upon for further development.
Some women in the community are already involved in small scale businesses such as making Rali (handmade quilts). However, they do not possess the skills and linkages to be able to sell their items in the open market. Would the project be able to aid these women in creating linkages with the market?	The implementation of the LRP will create linkages between these women and the market, along with working on increasing their marketing skills in stitching and other selected programs. Linkages with other Mina Bazars/District Municipal Corporation run weekly bazars will be developed to promote their products

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Table 8.6 - Pictures of Consultations with Primary Stakeholders




Consultation with Villagers, Haji Ibrahim Goth




Consultation with Villagers, Umar Goth

Furthermore, a brief description of the major consultations conducted is provided below:

1. Initial Visit of Jam Chakro to meet SSWMB staff and Key Individuals in Village

An initial Social Reconnaissance survey was carried out of the site for the scoping purpose by the team. During this visit, the team met with different people including the village elders, shop keepers, waste pickers, social workers, teachers, and traders, providing clear ideas about the ground situation, the environment the living conditions and the livelihoods of the people.

Key individuals in the community at Haji Ibrahim Goth along with the SSWMB personnel were identified at site who would later continue to serve as representatives of the community and the operations at the site.

It was at this point in time that the community was given an indication of a development proposed in the area that would cater to the current problems they are facing from the operations at the open dumpsite. To this, most of the community and individuals consulted gave a positive response, and requested for further details, which were agreed to be provided following development of the sub-project and the availability of more information.

2. Pre-Census Consultations & Census Survey

Following the initial scoping and consultations, the assessment team had a preliminary survey of the village before the census and had discussions with the local volunteers and village elders to strategize the work at hand. Locals from the area were also recruited to aid in the census efforts and to ensure that the data of the entire community is obtained.

The scope, purpose, and objectives of the census survey was explained to these locals, and through them to the general population at Haji Ibrahim Goth during the survey. Whilst the people in the area were generally apprehensive at first to provide detailed information, seeing their colleagues and fellow villagers working with the assessment team along with a detailed explanation of the purpose of the census survey, people became more comfortable with the census team.

Through this, and the consultations conducted, the team was able to obtain extensive first-hand data on the existing conditions of the people at the site and how the community operates living next to the open dumpsite.

3. Consultation with Educational Institutions & Health Care Facilities

Following consultations with the community, consultations were also conducted with the educational institution in the area along with the healthcare facilities frequented by the locals. The sub-project information available at the time was disclosed to the personnel, where their feedback was also taken onboard into the sub-project.

The consultations helped in gaining a better insight into the characteristics of the people at Haji Ibrahim Goth, where education was not cited as a priority by the schoolteachers, with community members instead opting for their children to work.

Similarly, the personnel at the health facility highlighted the constant outbreak of skin diseases amongst people at the community, where the facility is at times ill equipped to handle the cases as they come in, leading people to have to go further out to obtain proper treatment.

4. Cut-off date meeting

The initial census count in August 2022 was documented 713 residential households and 63 commercial structures. A subsequent confirmation survey conducted in October 2022 refined this count. A cut-off date for any consideration of entitlement from the sub-project was set in November 2022, resulting in a final count of 3,448 residents, residing in 723 makeshift/thatched houses in the vicinity, along with 63 commercial structures.

Following this confirmation, meetings were held with the Key Informants and the elders of the village, where they were apprised of the establishment of the cut-off date, and what that would entail for the community. Their feedback was taken onboard on how to disclose the pertinent information to the other members of the community.

Subsequent to these discussions, two main meetings were organized at 2 public places in the Haji Ibrahim Goth to announce the cut off date for any potential entitlements under the project. In these meetings people were explained how in the case of any resettlement or livelihood restoration that was deemed necessary under the sub-project, any entitlements that would be calculated would be against the assets documented for the people who formed part of the census survey. It was also announced that should anyone settle in the area after the cut-off date, then they may not necessarily be entitled to any of the compensations or measures planned under the sub-project.
The overall feedback from the community was positive, where they once again insisted on knowing more about the project and its overall impact on the community. The assessment team ensured

that all efforts were being made to minimize impacts on the community, and once substantial information was at hand, it would be disclosed to the community.

5. Pre-Skill Trade Need Assessment Consultation

Following advancements in the sub-project design, and through the inclusion of specific measures, any impacts of involuntary resettlement on the community were negated, however, livelihood loss of the waste pickers at Haji Ibrahim Goth could not be ruled out. The same was then conveyed to the community through similar meetings conducted as that of the cut-off date.

Following this declaration, most of the population exhibited a positive response, citing their gratefulness in ensuring that they would not have to be moved from the area. Some mixed responses were also obtained from waste pickers who did not know on what they would do for their livelihoods if they would be not able to pick waste. As a response to this, the assessment team informed them that a detailed Livelihood Restoration Plan would be prepared that would highlight trainings and skill development programmes that would be implemented under the sub-project, to ensure waste pickers are able to develop other means of earning livelihoods, and ultimately minimizing the livelihood loss impact from the sub-project.

6. Skill Trade Need Assessment Consultation

Following the previous declaration and introduction to the development of the Livelihood Restoration Plan, a needs assessment Survey was planned by the assessment team. During the survey, the team consulted 1,067 waste pickers residing in the area including males and females and noted down the community concern and feedback for the preferred trainings and skill developments.

There were queries raised on the potential linkage between obtaining training/ skill development and the potential of these people getting jobs as a result of these trainings. This point was taken up, and as a response to this, further measures were planned and implemented in the development of the LRP including consultations with nearby developments, industries, and NGOs in the area on establishing the potential linkages and hiring of these personnel following training and skill development.

Once these consultations were conducted, the feedback was shared with the community at Haji Ibrahim goth to showcase their concerns had been taken onboard and measures against which planned for implementation under the LRP.

<u>Non-Governmental Organizations & Training Institutes</u>

As part of consultations conducted for the sub-project assessment, NGOs and Vocational Training Institutes were also consulted for their feedback on minimizing impacts from the project, and to also ascertain any role they could play in this process also. Brief details and key takeaways from the consultations are provided below, where the detailed feedback can be found in the Livelihood Restoration Plan prepared.

Table 8.7 - Feedback from NGOs

S. No	Organization/Institute Name	Remarks/Feedback
1	HOME - ZVMG Rangoonwala Trust	The Trust has agreed to work for Jam Chakro by providing customized trainings. It will offer a number of trade-specific trainings to empower individuals in acquiring the necessary skills and knowledge. Through these trainings, the Trust aims to enhance the employability and livelihood opportunities for the people of Jam Chakro
2	Initiator Human Development Foundation	IHDF has offered socio-psychological counselling to waste pickers, recognizing the potential emotional and mental health challenges they may face. Additionally, health and hygiene sessions will be conducted to educate waste pickers on maintaining their well-being and preventing diseases.
3	DevCon – An Association for Rural Development (devconpk.org)	DevCon has agreed to work with Jam Chakro, a specific area, by providing customized trainings tailored to the needs of the local population. These trainings will cover a variety of trades, equipping individuals with the skills necessary to enhance their employment prospects and improve their livelihoods.
4	HUNAR Foundation	THF has expressed its willingness to work at Jam Chakro, indicating its commitment to extend its services and educational programs to the community in that area. The organization aims to provide customized training to cater to the specific needs and aspirations of the individuals in Jam Chakro. By tailoring the training programs, THF can effectively address the requirements of the local population.
5	Memon Industrial & Technical Institute – MITI (wmomiti.com)	THF has expressed its willingness to work at Jam Chakro, indicating its commitment to extend its services and educational programs to the community in that area. The organization aims to provide customized training to cater to the specific needs and aspirations of the individuals in Jam Chakro. By tailoring the training programs, THF can effectively address the requirements of the local population.
6	Sindh Education Foundation (sef.org.pk)	It can only support through NGOs working for education and for adults and children in nearby areas of Jam Chakro and help in creating linkages with educational institutes for children at GTS sites and Jam Chakro.
7	SHARP PAKISTAN – Society for Human Rights and Prisoners' Aid (sharp-pakistan.org)	Agreed to provide Legal Protection and support liaison for Afghan refugees at project sites with other government agencies and NGOs working for wellbeing of refugees.
8	Vocational Training Centre - KVTC	They agreed to conduct awareness workshops, livelihood engagement and customized vocational training to differently abled persons after basic screening.

9	VOCATIONAL TRAINING INSTITUTE (WOMEN) – SINDH TECHNICAL EDUCATION AND VOCATIONAL TRAINING AUTHORITY (vtiwbzone.edu.pk)	The institute can customize the vocational training for women and can provide holistic modules for them.
10	SPARC - Pakistan's Leading Child Rights Organization (sparcpk.org)	SPARC can provide assistance in education, health and safety and customized vocational trainings to waste pickers specifically children.
11	HANDS: Non-profit organization in Pakistan | Top NGO of Pakistan	HANDS has experience of executing project for waste pickers at Gond Pass (landfill site) a community development project. A consultative meeting was arranged by SWEEP with HANDS regarding their poverty alleviation program for Jam Chakro. HANDS can provide customized vocational training program for waste pickers Jam Chakro.
12	Consultation with Idara Al-Khair-Schools	They will provide the facility for vocational trainings for women after school timings and agreed to provide some permanent space women subject to space requested by the LPRIF. PIU SWEEP will ensure a positive and long-term collaboration with the school and LRPIF along with support of Jam Chakro community.
13	Rana Liaqat Craftsmen's Colony https://rlccpk.org/about-rlcc/	RLCC management has agreed to customize vocational trainings for women of their selected trades as proposed by APs of Jam Chakro, they will chalk out detailed plan subject to approval of proposal.

Industries and Residential Settings near Jam Chakro

The agenda of approaching and consulting the nearby industrial and residential settings is to sensitize them about the livelihood restoration of Jam Chakro waste pickers via training and capacity building and to take into consideration for hiring or utilizing them as wage earners. The purpose of this consultation is to know and measure the potential of employment opportunities for the waste pickers of Jam Chakro's Haji Ibrahim Goth, who will be trained by the SWEEP project in different trades, such as masonry, driving, electrician, plumbing, carpenter, etc.
The area around Jam Chakro is sprouting with several construction projects such as North Town Residency, North Town Villas, Marva Hill View, Falak Naz Wonder City, Burj al Mehmad, Pearl Villas, NTR Industrial Zone etc. In these projects several thousand housing and industrial units will be constructed. In these projects exists a huge potential of construction related skill and non-skilled laborers such as masons, shuttering work, plaster, electricians, plumbers, carpenters, flooring work, painters etc.
Following projects were visited and informed them about the purpose of consultation:

Table 8.8 - Feedback from Industries

Stakeholder	Feedback
Alghafoor Industrial Estate	Meeting Date: May 23, 2023 • Meeting with the Contract (infrastructure works) of Alghafoor Industrial Estate was undertaken. • The project is currently developing major infrastructure and base structures for open plots for industries. • Hence all the work is undertaken by heavy machinery. • We need drivers of heavy vehicles as contract basis; however, the work is usually done by sub-contractors. • It will take time to develop the individual industries and also the hiring in those particular industries. • It may be possible that future development of industries will create jobs for the locals.
Sky Clan Global (Stone Cutting Factory)	Meeting Date: May 23, 2023 • M/s Sky Clan Global is a stone / marble cutting factory and having a huge yard in which cutting machines are installed. • The team had a meeting with the Mr. Bilal, Manager of the factory. • While providing a brief about the project and agenda of the meeting, the team asked about the hiring for labor work or any other skilled job. • Mr. Bilal said that mostly the work is performed by machines, while occasionally, we require daily wage labor for which we contacted nearby villages. • The team emphasized that any laborious work in future which requires daily wage workers comes up, the trained persons of Jam Chakro will be prioritized.
Ali Town Residency	Meeting Date: May 23, 2023 • Meeting with Furqan Ali – CEO of Ali Town, a residential housing scheme, was undertaken regarding the livelihood restoration of waste pickers. • Mr. Furqan is of the view that major infrastructure works of the scheme has been completed and now the plots are for sale. If any plot owner will require local labor for the construction of its house, he can contact the us or hire directly. • We can support, if possible, when the construction labor and skilled labor is required, but right now, we do not commit for their hiring under the project as most of the work is done by contractors.
GFS Builders and Developers	Meeting Date: May 23, 2023

	• The GFS Builders and Developers are developing North Town Residency – Phase II which is a housing project. • Meeting with the GFS representatives regarding the livelihood opportunities for Jam Chakro Waste pickers concluded with the follow points: • The residential scheme is under construction and all the construction work is usually assigned to construction contractor. • The contractor then only hires their labor for two types of works; a) major construction work in which roads and large infrastructure is built which is usually done by subcontractors via heavy vehicles, so the manual works is not required and b) small daily wage works usually requires when the houses are going to be constructed. • They have the opinion that if any drivers having heavy vehicle skill can be contracted out with the subcontracted. • The daily wage workers as well as skilled labor will also be required when houses are to be constructed by owners of the plots. However, it is basically on the need basis. • If any trained labor work force available in the area, share the details with GFS's Engineering and construction department.
Hamdard Laboratories Factory	Meeting Date: May 23, 2023
	• Meeting with the in-charge Hamdard Laboratories was undertaken. • The facility in-charge was reluctant to provide any information or commitment and said that all the matters were dealt by Human Resource Department.
NTR Industrial Zone	Meeting Date: June 08, 2023
	• The NTR Industrial Zone is in its initial development and marketing stage. • Met with Mr. Mohammad Asif, a clerk, who said that the zone is in its initial stage and definitely after its maturity stage when industries will be developed in the zone, there will be many employment opportunities in construction and technical areas such as electricians, masons, pipe fitters, plumbers etc.
The Pearl Villas	Meeting Date: June 08, 2023
	• Mohammad Hunaid, marketing executive informed that the Pearl Villas is a gated community project which will have about 300 housing units and 750 apartments. • He said, at this stage they are in the marketing and selling stage and development work is going on. • After that definitely construction phase will be started by main and petty contractors, who will engage skilled and non-skilled laborers, including masons, shuttering contractors, electricians, painters, flooring laborers, carpenters, kitchen makers etc.
North Town Villas, a project of GFS Builders	Meeting Date: June 08, 2023

	• Mr. Faisal Javed informed that; North Town villas is a project of 650 villas of 120 yards. • He said that boom of construction industry brings employment to hundreds of thousands of people associated with different trades and skills. • He said GFS are builders are not involved in construction, which is done by numerous contractors, engaged by the plot owners, so there will be a good opportunity for Jam Chakro's waste pickers, if they learn new skills seriously and apply them for their livelihood.
Marva Hill View Project	Meeting Date: June 08, 2023
	• They are a project of 300 Bungalows and 650 apartments and are in development stage. • Mr. Mubin, Site in-charge said that he doesn't have any idea that how many trained workers could be absorbed in the project, but definitely this is good intention on behalf of Sindh government to provide technical training to poor waste pickers so that they can improve their life through training and facilitation. • He said the will welcome this initiative.
Falaknaz Wonder City	Meeting Date: June 08, 2023
	• Mr. Taha Khan, office assistant said that the project is spread over 450 acres, where 3500 villas and apartment are planned. • He expressed similar views about employment opportunities for trained waste pickers.

The concerns and proposed mitigation actions raised have been taken into account in the preparation of this environmental assessment.

8.5.2 Other Interested Parties

A stakeholder consultation workshop was organized by the SWEEP PIU, and EMC Pakistan which was conducted at Avari towers Karachi on 12 May 2022. All key stakeholders were contacted through letters. The agenda of the workshop was also shared with participants. About 80 people attended this workshop.

The comments, concerns, and suggestions received from stakeholders during the stakeholder consultation sessions has been collated and described below. The comments received from stakeholders were helpful in the screening of potential E&S aspects of the project.

The main issues and concerns that were raised by these stakeholders during the workshops specifically related to the sub-project in focus are given below:

Table 8.9 - Stakeholder Feedback from Secondary Stakeholders

Participant from Urban Resource Center	• Fresh garbage is still burnt at Deh Jam Chakro. Condition of the local populace there is worrisome. They are being paid meagre amounts for their services at the landfill. • Planning for lifting and disposal of animal offal on Eid-ul Adha should be carried out in advance. Worker protection is key as they work in unhygienic environment. Collective slaughterhouses should also be conceived.
Participant from Bahria University	• Collection and disposal of hospital waste is of importance. Besides major hospitals, numerous small hospitals and clinics operate in the city and they usually through their waste indiscriminately. Their waste collection and disposal should also be ensured. • Trust deficit will be reduced if the garbage collection is regular. • How are bills for the solid waste for households expected to be collected?
Participant, Flora Expert	• Incentive-based solid waste picking and collection should be promoted.
Participant from WWF	• Prohibition on plastic bags should be enforced. PET bottles are not a problem as they can be recycled. Problem is plastic bag which cannot be easily recycled and is not usually picked by waste pickers. • Awareness raising sessions should be conducted.
Participant from Geoprofessionals	• How to lift the heaps of old garbage at Jam Chakro landfill? Or how will the landfill site be reclaimed? • If the electricity can be produced from the waste, will there be lower electricity prices for the consumers if such electricity available in grid?
Participant, Consultant	• Informal waste pickers should be incorporated into the project
Participant from Karachi University	• Project should also aim for sustainability in according with the sustainable development goals SDGs.
Participant from National Forum for Environment and Health (NFEH)	• There has been some improvement in garbage collection in the city after establishment of SSWMB. • Segregation at source should be promoted. • Debris should be regulated as they cannot be thrown indiscriminately. • Informal waste pickers should be utilized and included in this project.
Participant from Samaa TV	• Garbage tax can be implemented to made citizens responsible and cautious of garbage issue. • Landfill sites are approx. 20-25 kms away from existing/proposed GTS sites. Trucks that carried garbage out of city to these landfills, are usually not covered and substantial amount of garbage eventually lands again in the city. This should be rectified.

Participant from National Institute of Oceanography (NIO)	• Future planning for increase waste generation, collection and disposal requirements should also be considered. • Efforts should be made to formalize the informal garbage collection and disposal sector.
Participant from Geological Survey of Pakistan (GSP)	• Considerations for subsurface structure are important before and during construction of GTS and landfill sites.
Participant from Institute of Business Management (IoBM)	• Sustainability of the project is important. For project continuity in operations, a robust framework has to be in place.
Participant from Bahria University	• Consideration should be given to proximity of Jam Chakro to the Hub River. There have been issues of water contamination in the area. Land fill site should be planned as per international standards.
Participant, Former Secretary, GoS	• As it is a foreign aided project, it should be ensured that timelines are met and there should not be cost overruns. This is to save precious foreign exchange of the country which is depleting.

Table 8.10 - Secondary Stakeholders Consultation Workshop Pictures



Further feedback provided by these stakeholders at the session is attached as **Annex-XX**. Furthermore, the report containing all details on consultations conducted for the sub-project assessment is attached as **Annex-XXI**.

8.6 Proposed Consultations Program

Stakeholder engagement and consultation is a continuous process, adopted to get real time feedback on the project, its impacts, and means/ methods to improve implementation. The ongoing consultation process may be scheduled on a need basis with all stakeholders including but not limited to the concerned government departments, local administration, community representatives, and affected persons from the proposed project areas.

Further consultations required under the project include the project's public hearing under the Sindh EPA's (SEPA) review process. SEPA will require a public hearing to formally garner public opinion on the project, where the hearing will be advertised in newspapers a set 10 days before the date of the hearing. Concerns raised during this hearing will be addressed in the ESIA report before approval from the Sindh EPA.

Consultations will then continue through the construction and operation stages of the project, where consultations with communities will take place quarterly, or more, depending on the number of concerns raised under each consultation. The type of stakeholder's engagement activities to continue through the project include (but are not necessarily limited to):

- Community liaison during the implementation of the ESIA and LRP of the proposed project
- Reporting on progress of the implementation of the measures mentioned in the ESIA and LRP and their effectiveness.
- Updating communities and other stakeholders about project activities and recording of comments
- Implementation, and effectiveness of the grievance redress mechanism

Efforts will be made to maximize consultations during project implementation, where these will be carried out with the objectives to develop and maintain communication linkages between the PIU and the stakeholders, provide key project information to the stakeholders, and to solicit their views on the project and its potential perceived impacts, whilst ensuring that views and concerns of the stakeholders are incorporated during the implementation with the objectives of reducing or offsetting negative impacts and enhancing the benefits. A preliminary framework for future consultations is also given below in line with the guidelines established in the SEP of the project.

Table 8.11 - Proposed Consultations Framework

Description	Target Stakeholders	Timing	Responsibility
• Public awareness campaigns/ information sharing sessions to share the ESIA with the communities and other stakeholders. • Location: various places in project area	• Communities within project area, general public; and line departments/ agencies.	At the start of the site activities	PIU / Supervision Consultant (SC)
• Establishment of GRM and Grievance Redress Committees (GRCs) • Location: various places in project area	• Communities at/around project area	Before commencement of project activities.	PIU / SC
• Consultations with the communities during ESIA implementation • Location: various places in project area	• Communities at/around project area	During project implementation	PIU and SC
• Grievance redressal • Location: various places in project area	• PIU staff; consultants; relevant line departments; and communities.	Project implementation Stage	PIU and SC

Description	Target Stakeholders	Timing	Responsibility
• Informal consultations and discussions. • Location: various places in project area	• Communities at/around project area	Project implementation Stage	PIU and SC. contractor
• Consultations with the communities during internal monitoring • Location: various places in project area	• Communities at/around project area	Construction Stage	PIU and SC
• Consultations with the Communities during the Independent Monitoring • Location: various places in project area	• Communities at/around project area	Construction Stage	PIU and SC
• Consultation workshops to review ESIA implementation, any outstanding issues and grievances, views, and concerns of communities; and actions needed to address them. • Location: site offices in project area.	• Communities at/around project area; relevant line department; relevant NGOs	Quarterly during implementation phase	PIU and SC
• Consultations with the communities during the site visits by the World Bank Review Missions. • Location: various places in project area.	• PIU; Communities at/around project area	Construction/ Operation Stage	PIU; WB and AIIB Mission

8.7 Information Disclosure Plan

This ESIA and the translation of its Executive Summary in the local language will be disclosed on the SWEEP website[30] under the SWEEP portal, along with the World Bank website. Physical copies will also be available at the SWEEP PIU, any site offices established, and any other relevant location as needed.

[30] https://sweep.gos.pk/downloads/

9. Environmental & Social Management Plan (ESMP)

9.1 Introduction

9.1.1 General

This section discusses the implementation and management of mitigation measures that are required for proposed project that includes progressive report and techniques to assure that all necessary environmental protection measures are carried out in the future as planned and to reduce residual impact to acceptable levels and achieve the expected outcomes of the project. The Environmental and Social Management Plan (ESMP) are based on the type, extent, and duration of the identified environmental impacts. The ESMP has been prepared following the regulatory requirements and guidelines.

Environmental management and monitoring are a mandatory activity to be undertaken by the administration over the entire project cycle showing its commitment towards meeting environmental regulations/standards as well as maintaining health and safety standards.

9.2 Components

The ESMP is divided into the following core components:

- ESMP Objectives.
- Scope of the ESMP.
- Institutional Requirements.
- Environmental and Social Mitigation and Management Matrix.
- Environmental Monitoring Plan.
- Planning for ESMP Implementation.
- Training & Capacity Building.
- Communication and Documentation.
- Management Plans.
- Chance Find Procedure.
- Public Disclosure; and
- ESMP Cost.

9.3 Objectives of ESMP

The main objectives of the ESMP are:

- Present an assessment of project impacts alongside corresponding mitigation measures, outlining their implementation timelines.
- Ensure timely execution of necessary corrective actions to address any adverse environmental and social impacts.
- Establish a systematic monitoring approach to regularly assess factors that may pose risks to the environment's safety.
- Define the roles and responsibilities of the Project Proponent and Contractor(s) to facilitate effective communication regarding environmental and social issues.
- Establish a procedure for prompt action in the event of unforeseen environmental situations.
- Identify training needs for the project proponent, contractor(s), and SC at various levels.
- Develop an environmental and social monitoring program with specified parameters and monitoring frequency to ensure comprehensive and effective implementation of mitigation measures.
- Include an estimation of the environmental and social costs associated with the implementation of the Environmental and Social Management Plan (ESMP).
- Outline requirements for documenting compliance with the ESMP and communicating it to relevant regulatory agencies.
- Develop additional plans tailored to meet project specific requirements.

9.4 Coverage of the ESMP

All activities ordained under the three stages of the project (pre-construction, construction, and operation) will be controlled and monitored as per the guidelines of the ESMP. Aspects not explicitly covered in the ESMP will be managed through separate plans, including SEP, LMP, and LRP.

9.5 Institutional Requirements

The institutional requirements for the construction and operation phases of the proposed sub-project are elaborated upon in the following sections:

9.5.1 ESMP Preparation During Assessment Stage

This independent assessment and the ESMP that stems from it have been prepared by EMC Pakistan (Private) Limited, who were selected following a bidding process conducted by the SWEEP PIU in line with the Bank's procurement policies. This is in line with Paragraph 25 of ESS1 of the World Bank's ESF, which dictates:

25. The environmental and social assessment will be an adequate, accurate, and objective evaluation and presentation of the risks and impacts, prepared by qualified and experienced persons. For High and Substantial Risk projects, as well as situations in which the Borrower has limited capacity, the Borrower will retain independent specialists to carry out the environmental and social assessment.

EMC Pakistan (Pvt.) Limited, established in January 1997, is one of the pioneering consulting companies of Pakistan offering services in the field of Environment, Health & Safety and provides economic and technical solutions to Pakistan's rapidly expanding industrial & commercial sector.

EMC comprises a team of highly talented professionals, who work in sync with clients ensuring that the defined assessment, survey, or reporting is executed with high level of efficiency.
The company was established with a vision to provide sound environmental services and practices to the industrial, municipal as well as government sector. The company is headquartered in Karachi, with more offices throughout the country, and has been providing consultancy services in various fields of environment. EMC is registered with Pakistan Engineering Council and is also ISO certified (ISO-9001-2015, ISO 14001-2015, and ISO 45001-2018). The company is also registered with the Asian Development Bank (ADB) & World Bank (WB), while also running its own, SEPA Certified, Environmental Laboratory Setup under the name of Quality Testing Services (QTS).

EMC has a proven successful track record of working with industry & institutions and in executing multi-faceted projects funded by organizations like UN-Habitat, Japan International Cooperation Agency (JICA), Asian Development Bank (ADB), International Finance Corporation (IFC) Bank, Overseas Private Investment Corporation (OPIC), Ministry of Environment, CDGK, KMC, amongst others. EMC Pakistan Pvt. Ltd has laid down new benchmarks in all its areas of strategic operations by our dedicated team of outstanding professionals and client-centric approach, clearly evident by the company's accomplishments and clients list.

9.5.2 ESMP Implementation during Pre-Construction

The SWEEP project, and the proposed sub-project will be executed by the PIU-SWEEP during the pre-construction phase. In the organizational hierarchy of the PIU, the Project Director (PD), will be overall responsible for the design and pre-construction aspects of the proposed project. The Project Manager (PM) of the proposed sub-project along with the E&S specialists of the PIU will be solely responsible for monitoring and complying with the preconstruction guidelines of the ESMP. The responsibilities of the PIU staff will include the following:

- Engaging in collaborative efforts to monitor environmental and social compliance in the pre-construction phase.
- Providing regular reports on the status of environmental and social compliance to the Project Director, and the World Bank.
- Conducting assessments and implementing measures to address the long-term environmental and social impacts of the proposed sub-project.
- Maintaining a productive partnership among relevant line agencies and departments identified in Chapter 8 to ensure ongoing collaboration.

9.5.3 ESMP Implementation during Construction

The key stakeholders during the construction phase of the proposed sub-project are the PIU, SEPA, the Supervision Consultant (SC), the Third-Party Monitoring Consultant, and the Contractor(s). The roles and responsibilities of all these parties are mentioned below:

- PIU (PD).
- PIU E&S Specialists.
- SC.
- Third Party Monitoring and Evaluation consultant; and
- Contractor's staff

The SWEEP PIU will bound contractors through clauses in their contracts to implement the ESIA including ESMP, and other terms and conditions of the Environmental approval issued by SEPA. The whole ESMP will be included as a clause in the contractor's documents. Construction camps will be established after necessary approvals and submission of site-specific ESMPs to be developed in the light of relevant agencies' requirements, prior to commencement of new works.

The organizational setup for the implementation of the ESMP during construction is provided below:

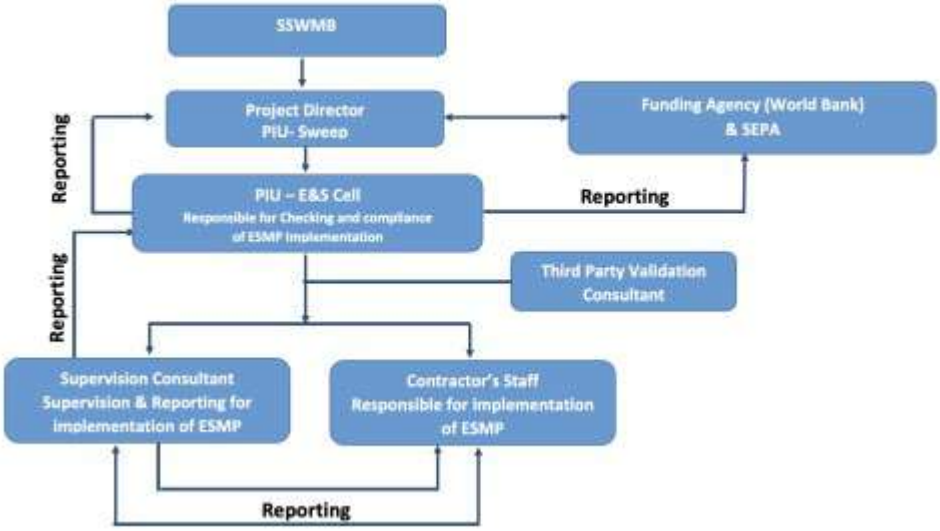


Figure 9.1: Organizational Setup for Implementation of ESMP during Construction

9.5.4 Roles & Responsibilities

a) SEPA

In accordance with the Sindh Environmental Protection Act of 2014, the responsibility for environmental protection and pollution control lies with SEPA (Sindh Environmental Protection Agency). SEPA is tasked with approving the Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) for all development projects falling under their jurisdiction. Additionally, SEPA will conduct audits of the proposed sub-project activities as necessary, ensuring adherence to the protocols outlined in the Environmental and Social Management Plan (ESMP) and obtaining environmental approval.

b) PIU (Project Director)

The Project Director (PD) of the Project Implementation Unit (PIU) serves as the principal authority overseeing the SWEEP project. As the executive head, the PD assumes responsibility for making crucial policy, administrative, and financial decisions to ensure the efficient and timely execution of the project in accordance with the approved framework and implementation schedules. In addition, the PD bears the overall responsibility for project implementation, including environmental and social management aspects, as well as the selection and engagement of contractors and consultants.

c) Environmental & Social Cell (PIU)

An ESC has already been established at the PIU, which currently consists of 5 specialists – two social development specialists, one environmental specialist, one occupational health & safety specialist, and one integrated solid waste management specialist. This Cell will be responsible for the overall implementation of the ESMP, the LRP and other related tasks. They will be responsible for ensuring the ESMPs are included in the contractors' bidding documents, along with the implementation supervision. The ESC under PIU will manage environmental and social aspects of the project activities, including arranging for environmental and social monitoring and preparing compliance reports for submission to the PD, the World Bank, and SEPA. The ESC will be responsible to ensure compliance of the ESMP during the construction phase. The PIU will also hire the services of an independent environmental and social consultancy firm as Third Party for Third Part Validation (TPV).

Furthermore, they shall be responsible for:

- Ensuring the provision of necessary environmental and social training to relevant personnel.
- Ensuring compliance with all contractual obligations pertaining to environmental and social standards.
- Conducting regular site visits to construction sites to assess the environmental and social performance of the Contractor(s).
- Regularly checking the proper implementation of the Environmental and Social Management Plan (ESMP) during the construction phase.
- Reviewing monitoring reports on the progress of environmental and social activities.
- Ensuring that the Contractor implements additional measures recommended by the Supervising Consultant (SC) in environmental and social monitoring reports.
- Documenting and disclosing monitoring results, identifying corrective and preventive actions in periodic reports, and monitoring the progress of these actions towards desired outcomes.
- Assisting the Contractor in ensuring timely payments of negotiated prices.
- Providing assistance to the Contractor in obtaining necessary approvals from relevant departments.
- Overseeing compliance with all monitoring programs outlined in the ESMP.
- Promptly reporting environmental and social incidents to the World Bank.
- Maintaining effective communication with other relevant departments and stakeholders.
- Reporting the status of ESMP implementation to the Sindh Environmental Protection Agency (SEPA).

d) Third Party Validation

The Third-Party Verification (TPV) process will involve the engagement of independent Environmental and Social (E&S) Specialists. These specialists will be responsible for monitoring environmental and social factors and conducting field surveys at the construction sites to assess the level of compliance. Their role will entail conducting external and independent monitoring of the ESMP implementation. The external monitoring agency will perform biannual, annual, and final evaluations of the ESMP implementation and provide recommendations for necessary changes to the Environmental and Social Committee (ESC).

Roles and responsibilities of the third-party consultant will include:

- Conduct autonomous monitoring at crucial sites throughout the construction phase and oversee the implementation of the Environmental and Social Management Plan (ESMP) within the project area.
- Track the Grievance Redress Mechanism (GRM) and ensure the resolution of complaints.
- Promptly notify the Environmental and Social Committee (ESC), World Bank (WB) of any significant impacts that arise during the construction process.
- Observe and revise or prepare corrective action plans as necessary.
- Monitor the implementation of the plans in collaboration with the Project Implementation Consultant.

e) Supervision Consultants

The Project Implementation Unit (PIU) will engage a Supervision Consultant (SC) to oversee the proposed sub-project across all four sites. The consulting firm will be responsible for preparing monthly monitoring and evaluation reports for each site, which will then be submitted to the Environmental and Social Committee (ESC). The ESC will carefully review the reports, hold discussions with the consulting firm, and finalize the findings. Should the contractors fail to comply with the requirements, the ESC has the authority to halt construction activities or impose penalties according to the contractual terms. The SC will provide the final versions of the monitoring and evaluation reports to the PIU as part of the periodic reporting mechanism outlined in the upcoming section. The PIU will subsequently submit these reports to the World Bank (WB) for their review and necessary actions. Additionally, the reports will be submitted to the Sindh Environmental

Protection Agency (SEPA) in accordance with the specified frequency outlined in the "Environmental Approval" requirements for the construction phase. The roles and responsibilities of the SC will be as follows:

- Conduct a thorough review and provide approval for the contractor's management plans.
- Oversee and supervise the contractor's performance to ensure compliance with the Environmental and Social Management Plan (ESMP).
- Ensure that the day-to-day construction activities adhere to environmentally and socially responsible practices.
- Maintain close coordination with the contractor and the Environmental and Social Cell of the PIU (ESC).
- Develop training materials and implement training programs.
- Verify the implementation of mitigation measures recommended in the ESMP.
- Supervise and monitor environmental and social activities at the construction site.
- Organize periodic training programs and workshops on environmental and social aspects for the consultant's and contractor's staff.
- Prepare regular reports as specified in the ESMP.
- Propose any additional mitigation measures that may be necessary.

f) Construction Contractor

Contractors will be obligated to hire on-site Environmental and Social Experts who possess appropriate education and experience for each construction site. It will be the responsibility of the contractors to execute measures that prevent or minimize any negative environmental and social effects during the construction phase. Prior to commencing work, contractors must develop a site-specific Environmental and Social Management Plan (SSESMP) that outlines their approach to meeting the ESMP requirements for each site. This plan must be submitted for approval to both the Environmental and Social Committee (ESC) and the Supervision Consultant (SC). The Environmental and Social Experts employed by the contractors will be responsible for undertaking the following activities:

- Develop the Site-Specific Environmental and Social Management Plan (SSESMP) and secure approval from the Supervision Consultant (SC).
- Implement the mitigation measures outlined in the ESMP and SSESMP at each construction site.
- Contractors are contractually obligated to comply with all the specific and general provisions stated in the contract document.
- Provide appropriate Personal Protective Equipment (PPE) to workers and train them on its proper usage.
- Prepare and submit monthly, quarterly, biannual, annual, and final progress reports to the Supervision Consultant (SC).
- Immediately report any accidents, incidents, including environmental and social incidents, to the Supervision Consultant (SC) and Environmental and Social Committee (ESC).
- Conduct environmental and health and safety training for workers and laborers.
- Coordinate with the Supervision Consultant (SC) and Environmental and Social Committee (ESC).

Regardless of the number of contractors, each contractor will be mandated to have adequately qualified and experienced persons to function as environmental, social, and OHS specialists to work in close liaison with the ESC and SC.

9.5.5 ESMP Implementation during Operations

The proposed sub-project under SWEEP will be managed by SSWMB in the operational phase. In the organizational hierarchy of SSWMB, the Director Landfill will be overall responsible for the O&M of the landfill site. Project operations may be outsourced to third parties also. The monitoring and compliance of operational phase ESMP will be under the responsibilities of the engineers and plant managers for landfill site. The staff will be responsible for the following:

- Coordinating to monitor environmental and social compliance during operations.
- Advising on, and monitoring tree plantations at the landfill site.
- Reporting on the O&M progress of environmental and social compliance to the SEPA.
- Assessing as well as mitigating the long-term environmental and social impacts of the proposed project operation; and
- Sustaining a working partnership among the SEPA, Forest and Wildlife departments of Sindh, NGOs, and other related public private sector organizations.

9.6 Environmental and Social Mitigation & Management Matrix

The Environmental and Social Mitigation and Management Matrix is one of the central elements of the ESMP, where it will be used as the management tool for implementation of the above-mentioned mitigation measures. The plan includes the following:

- Envisaged impacts as identified in the ESIA and their recommended mitigation measures.
- The person/ organization directly responsible for adhering to or executing the required mitigation measures.

Regardless of different organizations being delegated responsibilities for execution and monitoring of the project, the PIU SWEEP will be the primary party responsible for ensuring the complete implementation of the ESMP. The following table provides information about all impacts to be raised due to project activities due to the project activities during different phases of the project. (refer Table 9.1). The Contractor(s) will be responsible for the preparation of the Site Specific Environmental and Social Management Plan (SSEMP) on the same format of this ESMP along with the site-specific plans based on the guidelines provided in the annexures.

Table 9.1 - Environmental & Social Mitigation Matrix

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
Preconstruction / Design Phase						
1.	**Design of Landfill Cell** From Landfill carbon dioxide and methane are the main gas components that are generated once waste undergoes decomposition, if gas collection system is not designed properly these gases can release into atmosphere contributing to air pollution and climate change. A poorly designed landfill can also emit foul odors and release particulate matter and volatile organic compounds (VOCs) into the air. These emissions can contribute to air pollution, leading to respiratory issues and other health problems for nearby communities especially people living at. The unpleasant odors can also reduce the quality of life for residents in the vicinity of the landfill. Leachate generation which is the liquid residuals of a landfill resulting from a combination of the physical, chemical, and biological processes that transfer pollutants from the waste materials is also one of the main environmental concerns during landfill operations, if appropriate design measures are not taken, then it may infiltrate and contaminate soil and ground water. Provision of adequate buffer zone from landfill is also one of the important design constituents, and as per World Bank	The nearest recognized and legal human settlement is 170 from the perimeter of the proposed landfill area. Other residential areas are located just outside of the 250 m limit, with the exception of Haji Ibrahim Goth which lies within the stipulated 250 m limit. However, the settlement is not legally covered land and has developed in parallel with dumpsite. Nevertheless, additional control measures are proposed in the design of landfill site to reduce odor and nuisance impacts and those are: • Construction of buffer zone all around the site perimeter, the buffer zone will include perimeter boundary wall for access and litter control, • Vegetative planting for screening, litter, and odour control (further details provided in the tree plantation plan attached as **Annex-XII**) • Internal roads to the waste disposal area, plant areas and for site maintenance; and • Stormwater drainage to prevent run-on into the site and to capture run-off from any restored surface of the waste disposal area. To control leachate infiltration the Design Consultant has proposed following components in lining system:	Confirmation of design incorporation. Audits and Checks.	Design Consultant and PIU SWEEP	PIU SWEEP	Costs included in the cost of the landfill development.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	guideline for Sanitary landfill design criteria, no residential development within 250 meters from the perimeter of the proposed landfill cell development shall be undertaken. However, in case of proposed sanitary landfill site Haji Ibrahim goth located around corner of Jam Chakro dumpsite is within the 250 m radius. Apart from above mentioned design technicalities, the nature of the bedrock strata and the proximity to the fault line at the northern end of the site do not meet the IFC guidelines of landfill site sitting criteria, therefore, appropriate site engineering that focuses on the prevention of leachate migration from the base of the sanitary landfill to be consider.	• The proposed lining system is consistent with the requirements for engineered barriers in municipal solid waste landfills adopted internationally (for example, Subtitle D of the Resource Conservation and Recovery Act, US Environmental Protection Agency). It will be composed of Geocomposite clay liner (GCL) which is a 4 – 6 mm thick consisting of a layer of sodium activated bentonite sandwiched between two non-woven, needle punched geotextiles, the intrinsic permeability of which is <1×10-9 ms-1 and will be produced in conformity with National Standard Material Specification 595 (US EPA). • The bentonite clay layer of the GCL will swell and become self-sealing in the unlikely event that it becomes damp from any seepage of leachate through the primary HDPE membrane installed above the GCL. • A 2 mm High Density Polyethylene (HDPE) Membrane will be placed above GCL with an intrinsic permeability of approximately 1×10-13 ms-1. The HDPE geomembrane will be textured on the underside in order to increase interface stability between the GCL and the HDPE geomembrane and/or the side slopes of the landfill where laid over bedrock surfaces.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• A second liner geo textile with a proposed weight of 1,200 grams/m2, will be placed immediately above the geomembrane for liner protection prior to the placement of the overlying leachate collection gravel and pipework. This geotextile is heavy duty but deemed necessary given the proposed thickness of waste to be placed in the landfill. • For leachate collection, a gravel layer, 30 cm thick will be placed above the basal lining system in order to facilitate the drainage of leachate towards the leachate collection pipes. Perforated pipes shall be 2/3rd slotted and placed on the prepared, profiled, and sealed basal lining system, these pipes shall be laid in a herringbone pattern and will lead into a main collection pipe which will be connected to sumps and further to the leachate collection tanks. • It has been proposed to re-circulate leachate to the waste mass which will be achieved by a combination of mobile tanker and spray bar in the active waste deposition area and by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level. If leachate re-circulation does not prove to be completely effective, anaerobic digestion for leachate treatment has				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		been proposed, the sludge produce from this process are an excellent quality compost with commercial value. • When two meters of waste layer will be deposit in the first cell a 30m × 30m grid of perforated gas recovery pipes will be installed and will be bought up as waste filing progresses. The gas well will be extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome will be installed at the top of the well, the gas collection wells //domes will then be connected to gas treatment plant, the details of which are discussed in chapter 03 of this report.				
2.	**Seismicity** The project is located in Seismic Zone 2B, where 2B (upper limit of moderate damage) represents the peak horizontal ground acceleration from 0.16g to 0.24g. In this zone, the designing of various types of structures shall be done on the basis of Peak Ground Acceleration. A low to moderate intensity earthquake can adversely impact the developments. Additionally, on the northern end the project lies on fault line, although there is no known seismic activity recorded on this fault line, even then all project infrastructure to design considering appropriate design measures.	• A thorough geotechnical analysis is necessary to understand the soil conditions and potential ground movement during seismic events. This analysis should include assessing soil liquefaction potential, soil stability, and slope stability. These findings help in determining appropriate design parameters. • The design of landfill slopes should consider seismic loading conditions. Stability analysis should be performed to ensure that the slopes can withstand potential ground shaking. Additionally, erosion control measures, such as	Confirmation of design incorporation. Audits and Checks.	Design Consultant and PIU SWEEP	PIU SWEEP	Costs included in the cost of the landfill development

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		reinforced vegetation or erosion blankets, should be implemented to prevent slope failures and soil displacement during seismic events. • Seismic condition to be considered while designing landfill leachate collection and treatment system, gas collection system and liner or barrier system.				
3.	**Locations of Labor Camps and Ancillary Facilities** The duration of the construction activity for the landfill development will involve a considerable amount of work force will be engaged. As a result, worker camps will need to be developed and ancillary facilities will need to be provided such as electricity, washrooms for labor with suitable effluent and sewage disposal facilities as well as water for their everyday use for drinking and bathing etc.	In order to prevent a nuisance, specific locations shall be designated for development of the labour camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc. The use of proper planning while identifying locations for the labour camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labour camps being set up roadside next to the construction sites.	Confirmation of design incorporation. Audits and Checks.	Design Consultant and PIU SWEEP	PIU SWEEP	Cost will be provided by contractor
4.	**Livelihood Restoration** Although, physical resettlement of any individual or structure is not involved in this subproject, however, livelihood of waste pickers living in Haji Ibrahim Goth (Community living next to jam Chakro dump site) will be affected. As highlighted in Census report drafted by E & S Consultant, a total of 1,067 waste pickers of Haji Ibrahim	To mitigate the livelihood impacts during construction & operations of the landfill site a training need assessment (TNA) survey was conducted at Jam Chakro by E&S Consultant, with main objective to assess the trainings/skills required for livelihood restoration and to mitigate the livelihood impacts during operations of the landfill site. The details are presented in Livelihood	Confirmation of design incorporation. Audits and Checks.	Design Consultant and PIU SWEEP	PIU SWEEP	Cost included in Livelihood Restoration Plan

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	Goth livelihood are associated with waste picking/scavenging activities in the area. The waste pickers are classified as Vulnerable, living below the poverty line with 95% of waste pickers reportedly having a monthly income up to Rs. 15,000 while only 5% reported having an income above Rs. 15,000. Through the upgradation of these sites, these waste pickers may lose their only source of income and be left with devastating livelihood loss impacts. The current dumpsite has reached its operational capacity hence it will be capped in future, meaning it will not be possible for waste pickers to earn their livelihood from salvage items. Similarly, the newly constructed landfill cell will have its boundary wall limiting access to waste pickers, thus it is important to restore livelihood of waste pickers to offset project generated impacts.	Restoration Plan developed for this sub-project. It is anticipated that training program would aid in the creation of jobs or self-employment, assisting participants in generating income. Increased economic independence and quality of life, especially for women would lead to an improvement in their standard of living, which would serve as a deterrent to the acceptance of antisocial behaviour like domestic abuse. The Project GRM would also be implemented to allow for grievances to be aired and resolved as they arise.				
5.	**Flood Risk** The contouring of the proposed landfill cell is such that the landfill site is surrounded by hills/ peaks that naturally keep the waste in, therefore there are chances of surface run off especially the risk of urban flooding, Hub Canal also passes through western boundary of landfill site and flooding can occur due to sudden ingress of water or if water in canal is discharge more than its intended capacity. Although chances of	• In order to intercept surface run-off water drains will be constructed around the perimeter of the landfill along the periphery of the ring road proposed. • An Emergency Response plan for flooding situations to be prepared and staff to be trained on it. • Ensure that stormwater drains are also connected to septic tanks so that they do not increase the risk of leachates being exposed into the environment.	Confirmation of design incorporation. Audits and Checks.	Design Consultant and PIU SWEEP	PIU SWEEP	Cost of stormwater drainage system not finalized yet

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	occurring such incident is low. In addition to that, internal flooding can also occur in Landfill in the event of heavy rainfall, if proper storm water drainage system is not in place, then flooding can increase the probability of erosion due to the movement of water over the site and because infiltration of high volumes of water can adversely affect the structural integrity of the waste increasing the likelihood of mechanical failure of the landfill. The risk of flooding is nevertheless low as identified by the flood risk assessment conducted.					
6.	**Site Stability of Old Dumpsite & Potential Remediation** During construction of the new cell, the dump site will continue to operate as is given that the waste generated from the city will still have to be disposed of. However, once the new cells are completed, the old dump site should be dealt with immediately as: • With Haji Ibrahim Goth lying at the foothills of the old dump site, and that too with most of the village exposed to the dump site (roughly along 650-690 metres), the stability of the slopes of the dump site with the depositions of waste will pose a risk to the village and its people should the site prove to be unstable.	• The slope of the old site has been studied in line with the topographical study provided by SSWMB, where the slope obtained is roughly 1V:32H, highlighting that the slope stability is considerable and as such does not pose immediate threats or risks to the villagers of Haji Ibrahim Goth (where for engineered landfills it is 1V:3H or 1V:2H). There are certain mitigation measures that the operations team at the existing dump site can apply to improve community health and safety conditions whilst operations continue at the dumpsite: • Disallow people from burning waste at the site, where if burning waste is found,	Confirmation of design incorporation. Audits and Checks.	Design Consultant and PIU SWEEP	PIU SWEEP	Tentatively 07 Million USD (where SWEEP has already brought onboard a design consultant)

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	• With the waste in the dumpsite still lying open, exposed to the atmosphere, the site would continue to be a nuisance in terms of environmental emissions, particularly any air emissions, and soil contamination that is currently already taking place. • Exposure to dusts and air emissions from the existing dump site including from the indiscriminate burning of wastes that produces harmful emissions. All of these items pose a high risk of extreme air quality deterioration, particularly the burning of wastes as the highest quantity of waste arriving at the site is single use plastic (polyethene bags), which when burned produce toxic pollutants such as microplastics, bisphenols, and phthalates, all toxins that can disrupt neurodevelopment, endocrine, and reproductive functions in humans, particularly vulnerable populations such as children and the elderly. • Exposure to hazardous materials and wastes including industrial waste and medical waste that currently finds its way to the site through third party contractors. • Continued contamination of soil, groundwater aquifers, and air from the open dumpsite, through the	then it is immediately extinguished using the appropriate firefighting equipment. • Avoid dumping wastes near the community at Haji Ibrahim Goth and the pathways they use for travel. • Cover and contain waste that using a layer of soil or other appropriate materials to minimize the dispersion of pollutants into the air. • Carry out fumigations at the site to reduce the risk of vectors and disease transmission to the extent feasible during the development of the new cells, along with the potential odor generation and propagation. Nevertheless, to truly reduce the risk from the existing dump site, the appropriate long-term measure would be to carry out a detailed study for the capping/ closure of the dumpsite along with any potential rehabilitation of the site deemed necessary. The closure/ capping of the site should look into the following items to effectively reduce risks: • Usage of appropriate cover materials that includes impermeable layers of materials with appropriate thickness in line with the conditions identified at the site.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	unmitigated and un-engineered dumping of wastes. • Leachate management and potential for contamination of surface water resources and groundwater resources. • Transmission of diseases through vectors at the community in Haji Ibrahim Goth and the nearby areas in the AOI.	• Designing proper gas venting and collection systems to prevent gases from migrating into surrounding areas. • Designing of appropriate leachate control and treatment mechanisms to prevent the migration of contaminated leachate into surrounding surface and ground water. • Designing of appropriate drainage systems to control surface water runoff and to prevent erosion. • Designing of appropriate monitoring wells around the closed site to regularly assess the groundwater quality. • Establishment of security measures to prevent unauthorized access to the closed site. • Development of a post closure monitoring plan to assess the long term effectiveness of the closure and capping measures. • Development and communication of emergency response plans to address any unforeseen events or issues that may arise after closure. If these items are considered during the design of the closure/ capping of the site,				

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				Implementation	Monitoring	
		and implemented, then following closure, the risk of these items should be low. Similarly, the old dump site, after the commissioning of the new cells, would be of little to no use for solid waste operations. Hence, it's rehabilitation and closure/capping would be the best-case scenario to avoid any further emissions/ pollution to the environment.				
Construction Phase						
7.	**Resource Efficiency & Pollution Prevention** Resources involved in the construction of proposed project include construction materials, water, and fuel. For the construction of administrative building, and the embankments, and the access road, materials required will be coarse aggregates, fine aggregates, asphalt, cementitious materials, reinforced and structural steel. Almost all the materials to be used in the construction of proposed project are non-renewable and therefore their sustainable use is necessary for the future use. Further to this, for the construction of landfill and specially liner system, material required will be bentonite clay, High-density polyethylene (HDPE) liner, geo textile membrane and gravel. Excessive water consumption for drinking and washing purposes by the construction	• Reduction of wastage of water through training of workers involved in water use will be planned. • Careful selection of water source to minimize disturbances to existing community water supplies. • Batching plants with insulation lining to reduce heat loss; will be designed or purchased from vendor (for sites where applicable). • Plan for reuse of construction waste materials will be formulated. • A good camp design and an efficient worksite management plan will be prepared by the contractor to reduce the water demand, and wastewater and solid waste volumes to the lowest levels. • Apart from the resource conservation, following measures will be considered as pollution prevention:	Visual observation. Regular environmental monitoring, sampling, and testing reports. vehicle maintenance records. Water sprinkling records.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor. Monitoring costs included in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	staff may put additional pressure on the water resources in the project area. Fuel (diesel and petrol) will be used to operate construction machinery, asphalt, and batching plants. Sustainable use of energy resources is very important not only to continue future use but also to reduce air pollutants.	➢ Emissions will be reduced/controlled as far as possible and direct discharges to air will be avoided by strictly adhering to the mitigation measures outlined air quality sections of this ESIA report. ➢ Wastewater will not be discharged directly into the water resources and must be managed as per the recommendations presented in wastewater section of this ESIA; and ➢ Construction and demolition waste and municipal solid waste will not be dumped/ burnt openly and will be handled according to the preventative measure given in solid waste section of ESIA study.				
8.	**Particulate, Gaseous, & Dust Emissions** The construction of a landfill site involves the movement of heavy vehicles and machinery, such as dump trucks, excavators, and bulldozers. These vehicles release exhaust emissions containing pollutants such as nitrogen oxides (NOx), particulate matter (PM), and volatile organic compounds (VOCs). These pollutants can contribute to air pollution and have detrimental effects on air quality in the surrounding areas specially on the housing societies that are near landfill site. The potential dust sources associated with	• Before the commencement of activities, Contractor will prepare an Air Quality Management Plan as part of its Site-Specific Environmental Management Plan (SSEMP) that incorporates use of following measures: ➢ Contractor to maintain a minimum setback distance of 500 m from sensitive receptors (schools, hospitals, mosques, residential areas etc.) for batching plants. ➢ The important dust suppression measures proposed will be regular water sprinkling or misting on main	Visual observation. Regular environmental monitoring, sampling, and testing reports. vehicle maintenance records. Water sprinkling records.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor. Monitoring costs included in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	construction activities are loading and unloading of materials depending upon the extent of activity, length of the construction period, specific construction operations, types of equipment, topsoil removal, travel on unpaved areas, precipitation conditions and wind erosion etc. In addition to this, construction activities, especially excavation and earthmoving, can generate significant amounts of dust which consists of fine particles, including PM_{10} (particles with a diameter of 10 micrometres or less) and $PM_{2.5}$ (particles with a diameter of 2.5 micrometres or less). These particles can remain suspended in the air for long periods and be transported over long distances, potentially impacting the air quality of nearby communities. Dust can also contain harmful substances, such as heavy metals which can pose additional health risks if inhaled. Construction equipment and machinery to be used during landfill site construction, such as generators, concrete mixers, and compressors, may emit pollutants into the air. These emissions can include NOx, Sulphur oxides (SOx), carbon monoxide (CO), and PM, depending on the type of fuel used and the efficiency of the equipment. Poorly maintained or outdated equipment can result in higher emissions, exacerbating the air quality impacts.	haul roads in the project area, this activity will be carried out at least twice a day, if need arises frequency will be increased on windy days, in this way around 50% reduction on the dust contribution from the exposed surface will be achieved. ➢ The duration of stockpiling will be as short as possible as most of the material will be used as backfill material for the open cut trenches for road development. ➢ Cover loose soil and stockpiles to prevent wind erosion and dust dispersal. ➢ Implement proper waste management practices, including covering waste materials with soil or other suitable materials to reduce odors and gas emissions. ➢ Conduct regular monitoring of air quality parameters, including pollutant concentrations, dust levels, and odors. ➢ Implement a robust compliance program to ensure adherence to air quality regulations and standards. ➢ Evaluate the effectiveness of mitigation measures and make necessary adjustments based on monitoring results.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	During baseline, sensitive receptors such as Educational Institute, Religious site and medical facility are also established, adverse impacts are envisaged during construction activities.	➢ Maintain open communication with local communities and stakeholders to address any concerns related to air quality. **Vehicular and Equipment Emissions** ➢ Regular maintenance of construction machinery and vehicles to ensure that all machines and vehicles abide by the stringent standards for emissions. ➢ Implement machines and vehicles maintenance programs to ensure machines and vehicles are properly tuned and emissions are minimized. ➢ Limit unnecessary vehicle idling and establish no-idling policies to reduce emissions. ➢ Establish designated routes for construction vehicles to minimize impacts on surrounding communities. ➢ SEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during construction works. ➢ Service roads (used for earthmoving equipment and general transport) should be regularly sprayed with water during dry weather. **Dust Emission Control**				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		➢ Maintaining dust collection equipment to prevent any leaks. ➢ Developing a buffer zone that surrounds operations that generate dust. ➢ Instituting a whole management approach for plant operations, as well as the delivery system ➢ Checking regularly for leaks in filter fabric, cartridge filters, and suctions and shrouds ➢ Installing audible alarms on storage silos to avoid overfilling. ➢ Keeping sand and aggregates under cover so that materials are not dispersed by wind. ➢ Using an enclosed batch mixer and spray to limit dust emissions. **Construction Monitoring** The Contractor will be required to monitor particulate matter in the vicinity of construction sites, temporary sites including construction yards and storage areas, and access routes. Baseline conditions around Landfill sites often exceed SEQS standards, which should be considered when evaluating air quality conditions during construction. If community complaints arise, the contractor will intensify use of mitigation measures to minimize air quality impacts. In addition, the Contractor is required to certify emission controls on construction equipment				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		and vehicles. Special attention must be paid to sensitive receptors such as patients in hospitals and students in educational institutions.				
9.	**Clearance of Legacy Waste** Whilst the new landfill cell is proposed on virgin land, there is a small 10-acre portion on the Eastern valley where legacy waste from the operations of the existing dumpsite is present and shall have to be removed before site development. Furthermore, the access road also proposed to the cells will also be formed through the existing dumpsite where waste will be removed to a level where strength bearing ratios for the development of the road are obtained. Currently, it is not yet entirely known the amount of waste that will have to be removed. Nevertheless, the removal of this waste would generate air quality and noise impacts from the increased movement of machinery, excavation to remove waste and relocation to another part of the landfill. This impact is expected to be substantial adverse, and temporary in nature.	The following mitigation measures may be implemented to reduce this impact: • Use of legally permitted fuel with lower levels of contaminants for machinery. • All vehicles, machinery, equipment, and generators to be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions and subsequent impacts on surrounding receptors. • Stringent environmental quality standards applicable to gaseous emissions generated by construction vehicles, equipment, and machinery will be enforced during works; and • Personal Protective Equipment's (PPEs) like masks, goggles which are suitable for specific jobs will be provided to workers and visitors and used during work times. Similarly, issues arising from dust during the construction phase can be effectively mitigated through the implementation of simple procedures by the contractor(s) including but not limited to the following:	Physical observation. Regular environmental monitoring, sampling, and testing reports. vehicle maintenance records.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor. Monitoring costs included in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Regular water sprinkling on the site and other unpaved areas to be carried out to suppress excessive dust emissions. The frequency of water sprinkling is to be increased during summers, as required. Furthermore, it is to be ensured that the water used for sprinkling is not drinking water and will be purchased privately through companies registered through KWSB, and not taken from the community's water supply. • Earth moving will be done under damp conditions as much as possible to prevent emission of dust into the air. • Preventive measures against dust will be adopted for on-site mixing and unloading operations. • Vehicle speed in the project area will be prescribed not more than 20 km per hour and controlled accordingly especially near the sensitive receptors. • Tires of all the vehicles leaving the site will be washed at designated washing area in vehicle parking lots. No earth, mud and dust will be deposited on the public road. • Air emission monitoring program for NO2, SO2, CO, PM2.5 and PM10 will be undertaken by the construction contractor, according to the programme specified in the ESMP. The location of the monitoring points will be finalized				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		considering the sensitive receptors so that the impact of air quality deterioration will be assessed accordingly.				
10.	**Noise** The noise impacts may vary depending on the location, scale, and construction techniques employed at the landfill site. Noise will be generated from the operation of heavy machinery such as excavators, bulldozers, and dump trucks these machines are used for excavating, compacting, and transporting waste materials. The noise produced by their engines, hydraulic systems, and moving parts can be loud and disruptive. The other source of noise generating activity would be construction activities such as like drilling and concrete pouring for auxiliary facilities. Drilling for wells or geotechnical investigations and surface water monitoring wells installed around the corners of landfill site and pouring concrete for structures can all generate noise that may be audible in the surrounding areas. Increase amount of vehicular movement associated with the construction process, including deliveries of construction materials and waste transportation, can add to the noise levels. This includes noise from trucks, vans, and other vehicles used for transportation purposes.	Before the commencement of activities, Contractor will prepare a Noise quality management Plan as part of its SSEMP that incorporates use of following measures: • Impose speed limits on construction vehicles to minimize noise emission along areas where sensitive receptors are located (residential areas, etc.). • Limit noisy construction-related activities during the night near sensitive receptors (e.g., hospitals and residential areas). Such activities should be restricted to daylight hours. • Provide prior notification to the community on schedule of construction activities. • Whenever feasible, schedule diverse noisy activities (e.g., earthmoving) to occur at the same time, since less-frequent noisy activities would be less irritating than frequent less-noisy activities. • Use equipment with built in noise abatement, especially pavement breakers, crawler cranes, excavators, and concrete cutter.	Physical observation. Regular environmental monitoring, sampling, and testing reports. vehicle maintenance records.	CC	SC & PIU SWEEP	Monitoring costs included in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	The typical noise level generating from different construction equipment's and activities are present in table 5-2. The cumulative effects from several machines can be significant and may cause significant nuisances. However, these increased noise levels will prevail only for a short duration during the preconstruction and construction stage. Considering the location of sensitive receptors around project area and settlements specially Haji Ibrahim Goth is the south of proposed landfill site and Hassan Brohi goth on the north of proposed access road for landfill, the adverse impacts is envisaged from the use of construction equipment's and trucks involved for the movement of construction material from access routes	• It shall be ensured that generators, vehicles, and other potentially noisy equipment used will be in good condition. • The use of pressure horns shall not be allowed especially near sensitive receptors. • Movement of all project and personnel vehicles shall be restricted within work areas. • In areas with higher noise levels or longer shifts, use of ear plugs and earmuffs will be ensured among the workers. • Use of ear plug, and earmuffs must be ensured during construction. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C). • Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Periodic medical hearing checks should be performed on workers exposed to high noise levels. • All the equipment and machinery used during construction phase should be well maintained and in compliance with SEQS. • Grievance redress mechanism to deal any public complaints related to noise is established.				
11.	**Vibration** It is expected that vibration would be barely perceptible at sensitive receiver locations within over 50m for most construction activities. According to British Standards of Noise and Vibration, humans are particularly sensitive to vibration with the threshold of perception typically being in the range of 0.14 to 0.3 mm/sec Peak Particle Velocity (PPV) and levels above this may cause annoyance. However, significantly higher levels than this can be tolerated for single short-term events and do not cause annoyance or disturbance to humans. Further, there is no historical building or masonry structure within 150 m of the earmarked landfill site to sustain damage from construction vibrations.	• Vibration measurement will be carried out during construction phase by the contractor near the settlements as well as all the sensitive receptors in the AOI. • Timing of the construction works to be conducted during the recommended operational hours, to reduce vibration levels to sensitive receptors (especially all the educational institutes) and residential properties in the AoI. • Residents and occupants in all the buildings including offices, hospitals, school, and religious places of to be pre-warned of high vibration events and any operations being undertaken outside recommended hours. • The vibration from major construction activities such as excavation, compacting, drilling, etc. are considered intermittent and short-term, and likely to	Physical observation. Regular environmental monitoring, sampling, and testing reports. vehicle maintenance records.	CC	SC & PIU SWEEP	Nil

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		be tolerated if prior warning is given to potentially affected residents. • The equipment operators to be made aware by the contractor of potential vibration issues problems and of techniques to minimize vibration effects during construction works near to the sensitive receptors especially educational institute and medical facility.				
12.	**Wastewater** The potential sources of water pollution associated with the construction of landfill site have been identified and include: ***Construction Site Runoff*** Runoff from the construction works area may contain increased loads of sediments, suspended solids and other contaminants which will increase the pollution load of the available water resources in the project area. Potential sources of pollution from the site include: • Runoff and erosion from exposed soil surfaces, earth work areas and stockpiles e.g., grouting and cement material with the rainwater during monsoon. • Wash water from dust suppression sprays. • Fuel and lubricants from maintenance of construction vehicles and mechanical equipment.	• Stormwater drains will be constructed around the perimeter of the landfill in order to intercept surface run-off from the restored surface. For the majority of the site the drainage will be directed northwards, as is the present drainage pattern for the site. • All stormwater run-off from buildings and from paved surfaces in the Administration Area will be intercepted and directed to a retention pond in the Administration Area (rainwater harvesting). • Protection of water resources from any source of contamination generated due to the proposed project such as the construction and oily waste that will further deteriorate its baseline quality by installing screens and barriers at source of contamination. • Water required for construction will be obtained in a sustainable way that the	Visual observation. Regular environmental monitoring, sampling, and testing reports. Waste management plan implementation.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor. Monitoring costs included in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	• Spillage of liquids stored on-site such as oil, diesel, and solvents etc. are likely to result in water pollution; and • Uncontrolled discharge of debris and rubbish such as packaging, construction material and refuse. ***Wastewater produced by On-Site Work Force*** Wastewater would be generated from construction camp during the construction phase. If the generated wastewater is not properly treated in septic tank before disposed, this may contaminate the surface water sources. ***Groundwater*** Construction waste, if left unattended will result in forming leachate that will percolate through the soil strata and will reach underground water table and hence, will end up contaminating groundwater. There is a probability that various materials like fuel, lubricant oil, and other oily products, which are used during the construction phase may contaminate groundwater and channels carrying water. ***Impounding of Water*** During the construction activities of the proposed sub-project, it is likely that there will be surface gradients created at different portions of site. These surface gradients result in the accumulation of water coming either from rainfall event or	water availability and supply to nearby communities remain unaffected. • Stockpiles of cement and other construction materials will be kept covered when not being used. • Avoid fuel and other chemicals being stored at non-designated locations around the site. • Maintenance of vehicles and machinery will be carried out only at designated area and on impermeable areas where any oil spillages can be contained. • Oils, fuel, and chemicals must be stored at bunded fuel stores and mobile bunded stores. • Careful planning of the works to avoid soil excavation works during intense rainfall events. • All kinds of waste will be stored in covered containers and disposed of safely as soon as possible. • Sand and silt removal facilities such as sand traps, silt traps and sediment basins must be provided to remove the sand and silt particles from run-off. These facilities will be properly and regularly maintained. These facilities will be carefully planned to ensure that they will be installed at appropriate locations to capture all surface water generated on site.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	wastewater/sewage overflow. The water impounding during the implementation phase of the project will cause nuisance to the communities and various health risks such as spread of malaria, gastroenteritis, diarrhoea etc.	• Wastes will be collected, stored, and taken to approved disposal site. • Wastewater effluent from the Contractors' workshops and equipment washing yards will be passed through gravel/sand beds to remove oil/grease contaminants before discharging into the natural streams. The biological and chemical oxygen demand concentrations in sewage must be brought down to less or equal to the applicable stringent limits before being discharged into existing KWSB's sewerage system. • As a mandatory step, all the effluents will be discharged into existing sewerage system as per the requirements of stringent environmental quality standards. • Construction camps will be established in areas with adequate natural drainage channels in order to facilitate the flow of the treated effluents after ensuring that stringent environmental quality standards are met. • The solid waste will be disposed in designated landfill sites to sustain the water quality for domestic requirements. • Regular water quality monitoring according to determined sampling schedule.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Road drainage system will remain clear and well maintain by avoiding the stockpile of earth material on the way of their inlets so that the runoff will be easily diverted, and water impounding will be avoided on the road. • Prohibit washing of machinery and vehicles in surface waters, provide sealed washing basins and collect wastewater in sedimentation/retention pond. • Construction work close to the water bodies will be avoided, especially during monsoon period. • To avoid water impounding, following mitigation will be adopted: ➢ Careful planning of the construction works to avoid soil excavation during rainy seasons. ➢ Toilet wastewater will not be discharged untreated into the sewerage system. ➢ Washout from washing of equipment and gadgets will be drained into a septic tank. ➢ Septic tanks of adequate capacities will be constructed for all kinds of wastewater storage and timely disposal will be ensured. ➢ Unnecessary excavations will be avoided especially during monsoon; and				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		➢ All spoils will be disposed of as desired, and the site will be restored back to its original conditions as soon as the activity gets completed.				
13.	**Soil Erosion** The majority of the works proposed for development of the landfill may result in soil erosion and sedimentation. Spoils will be generated from the excavation activities, particularly during construction of landfill cells. Potential impacts from spoils and their disposal are (i) land for disposal of spoil, (ii) potential erosion from the spoil areas and spoil material reaching the waterways, and (iii) aesthetic impacts. The soil will be exposed to erosion due to excavations for development of Landfill sites, construction camps and workshops. Erosion may increase during intense rainfall events. Soil erosion is also envisaged during the construction of auxiliary facilities such as construction of admin building its associated infrastructure and construction of roads.	• Stored excavated/fill material will be covered and will be reused. • Geo-technical results indicates that site-worn materials have high frictional strength with an adequate Factor of Safety, thus it can be used in embankment, which will be constructed between each cell. • Excavated soil will be stored at site and will be used as daily cover during landfill operations. • Stockpile will have a side slope of 2:1 or flatter and will have a height lower than 2m. • Excavated materials/stockpile should not be placed adjacent to any water streams especially near hub canal on north side of landfill cell. • Storm water runoff originating from stockpiles should be directed to, and/or controlled by, a suitable sediment trap. • Contractor will prepare a Traffic Management Plan for use and movement of construction vehicles within the area based on the nature of soil to reduce the soil erosion impact.	Visual observation, photographic records. Waste management plan implementation.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Vehicles and equipment movement will be confined to dry areas with hardened soil; no vehicle and equipment will enter the damp areas, water areas, vegetative areas, and areas with soft soil. • Sprinkling of water will also reduce the erosion of soil. • Non-bituminous wastes from construction activities will be dumped in approved sites, in line with the guidelines for dump sites, and must be covered. • Washing yards will be paved to avoid seepage of runoff from the yard. • Controlling runoff volumes and intercept runoff before it leaves the site. • Perennial grasses, sod, shrubs, and trees will be planted to control the runoff on the site. • Confining excavations to the specified spots as per the approved engineering drawings and unnecessary excavations will be avoided.				
14.	**Soil Contamination** Soil contamination can occur due to spilling of chemicals during construction or during transportation from one container to another. During the construction phase, contamination of soil is primarily due to spillage of oil and materials dissolved and	• Material Safety Data Sheets (MSDS) for purchased chemical additives, reagents and compounds will be kept at the work site. • All spills to be cleaned and removed from the site, where the site will be restored back to its original conditions.	Visual observation, photographic records. Waste management plan implementation.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	transported through water at the construction site. Leakages of oils, lubricants, chemicals, and other similar substances from their storage sites and from engines of the generators, machines, equipment, and vehicles can spoil the receiving soils and may undermine ability of the spoiled soils to support growth of vegetation and plants; further contaminate the soil. Non-provision of septic tanks with the temporary worksite toilets, constructed for the labour and others, effluent can contaminate the receiving soils because of raw nature of the effluents. Also washing of the gadgets, machinery, and equipment without proper drainage of the washout water can adversely affect the soil quality. This impact is, however, temporary, and minor negative in nature.	• Oils, lubricants, chemicals, and other listed hazardous materials should be stored safely at designated spots, enclosures, or storerooms, which should be safe from rainfall and away from any potential source of fire. • Septic tanks of adequate capacities should be constructed for receiving and treating wastewater from all temporary worksite toilets and at the temporary container offices, if any. The toilet wastewater should not be discharged untreated onto the adjacent lands. • All machineries and materials should be stored at the designated areas and compounds. • Washout from washing of equipment and gadgets should be drained into either a septic tank or a sand-gravel bed for removal of the grit and contaminants.				
15.	**Construction & Labor Camp** • The sitting of campsite will have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities. • Worker camps will need to be developed and ancillary facilities will need to be provided, such as electricity, drinking water, sewerage, effluent facility, and accommodation facility.	• Establish workers' camps separated from local communities with strict protocols for interaction with local communities in order to avoid project impacts from labour influx. • Contractor will provide septic tank and soakage pit (100 meter away from surface water body or groundwater well) for the toilets to treat the sanitary	Visual observation, photographic records. Waste management plan implementation.	CC	SC & PIU SWEEP	Costs will be included/ provided by contractor.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	• There will be generation of different waste streams such as domestic waste, hazardous waste and medical waste resulting from the first aid treatment. • The migrant workers may travel to nearby communities for visiting shops etc., hence creating chances of interactions with the local communities. • There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading Sexually Transmitted Infections (STIs) and Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). In adequate safety facilities to the construction camps may create security problems and fire hazards	wastewater before its discharge in the sewerage system. • Avoid tree cutting for setting up camp facilities. However, if such type of land is not available, it will be ensured that minimum clearing of the vegetation occur. • Provide a proper fencing and compound wall for camp sites. • The camp site will be adequately drained to avoid the accumulation of stagnant water. • Camp site will not be located near (100 meter) water bodies, and any ecologically, socially, and archeologically sensitive areas. • Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit. • Train employees in the storage and handling of materials which can potentially cause soil contamination. • Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio-cultural values. • Code of conduct (CoC) will be prepared and implemented/adopted. All project staff and workers will be required to sign the CoC.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Training will be provided to all staff on camp management rules and overall discipline and cultural awareness. This will include, in appropriate languages: ➢ A briefing on camp rules ➢ A community relations orientation to increase awareness about the local area, cultural sensitivities, and the project Code of Conduct. ➢ Awareness-raising on health considerations, including Sexually Transmitted Disease (STDs). ➢ Awareness and orientation on GBV/SEA/SH. ➢ Information about the worker GRM which will also address cases of GBV/SEA/SH. • The construction contractor is required to develop a construction camp management sub-plan to address: ➢ Discipline. ➢ Community liaison. ➢ Ethnic tensions; and ➢ Communicable diseases. • A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		framework with respect to worker behaviour.				
16.	**Construction of Access Roads.** Since there is currently no access road to the proposed sanitary landfill, a new access road shall be designed and constructed. The road will be constructed which comes off the link road close to the existing weighbridge and site office of the dump site. It runs north for a distance of approximately 850 m before swinging westwards for a further 650 m to enter the waste reception area at the south-east corner of the site. Major activities of road works will include preparation of sub-grade, sub-base, base and wearing course. Major equipment to be involved in road widening works are tractor, bulldozer, roller, compactor, shovel, grader, dumper, aggregate and spreader, asphalt mixer, bitumen boiler and sprayer, concrete mixer and paver, batching plant, and finisher. The nearby communities such as Hassan Brohi Goth can be disturbed due to excessive noise and dust issues.	• The majority of the landfill will be surrounded by a perimeter road for both waste delivery vehicles and to facilitate maintenance. Different types of roads are proposed depending upon the assessed traffic load and function. • For waste delivery vehicles access roads shall be two lanes, a minimum of 6.5 m wide and provided with double surface dressing. Maintenance roads shall be one lane, minimum of 4 m wide and surfaced with gravel. The Administration Area will be paved to the same standard as that of the primary roads used by waste delivery traffic. Within the landfill temporary haul roads, 6 m wide and surfaced with free-draining granular material, shall provide access to the tipping area. • The road widening will be to a standard that is suitable for movement of high-capacity waste carrying vehicles. • Work areas outside the project site, especially where machinery is involved, will be barricaded, and will be constantly monitored to ensure that local residents, particularly children stay away. • Women's residing in Haji Ibrahim Goth who will be working in salvaging items from existing dumpsite will be briefed on	Implementation of CHS plan. Use of PPEs, training records, work permits. Implementation of emergency response plan. Community concern records	CC	SC & PIU	Costs will be included/ provided by contractor. Monitoring costs included in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		traffic safety prior to start of construction activities. • Traffic diversions will be planned in such way that it does not create traffic congestion or hinders the movement for the vehicles that are still be working on dump site. • Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project. • Vehicle speed will be regulated and monitored to avoid excessive dust emissions. • Periodic sprinkling on access road at least twice per day during construction phase. • Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area. • Proper drainage system to provide in order to prevent ponding of rainwater on roads. • Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area. • Periodic water sprinkling will be carried out during widening works to suppress dust.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
17.	**Greenhouse Gases & Climate Change** The main sources of GHG (CO_2, CH_4, NO_x etc.) during the construction activities of the proposed project will include both mobile and stationary sources. The mobile source will be the construction and transportation vehicles. Emission of GHG causes global warming and other climatic changes on regional and global scale.	• Use construction machinery designed with suitable pollution abatement technology such as scrubbers. • In order to control NO_2 emission at site, diesel engine equipment and machinery will be installed with catalytic converter, as it allows diesel engine to take advantage of the trade-off between NO_2, PM_{10} and fuel consumption, and calibrate the engine in a lower area of fuel consumption. • Plantation development as per the tree plantation/reforestation sub-plan is highly recommended for the sequestration of CO_2. • Used and old electrical equipment will be banned that can also help to reduce urban emissions. • Burning of waste will be strictly prohibited at site. • Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and • As appropriate use of solar panels at construction camp sites instead of diesel generators will also reduce the emissions.	Regular Environmental Monitoring, sampling, and testing reports. Vehicle inspection records, plantation records.	CC	SC & PIU SWEEP	Monitoring costs and tree plantation costs included in the monitoring plan table ahead.
18.	**Occupational Health & Safety**	• Workers will be trained with lifting and materials handling techniques before the construction of the project, including the	Implementation of Health & Safety Manual.	CC	SC & PIU	Costs will be included/

	Over-exertion Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries at construction site. **Work at Height** Falls from elevation associated with working with ladders and scaffolding are among the most common cause of fatal or permanent disabling injury at construction site. If fall hazards exist, a fall protection plan will be in place which includes one or more of the following aspects, depending on the nature of the fall hazard. This hazard is particularly envisaged during the construction of multi-story administrative building. **Slips and Falls** Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site. **Struck By Objects** Construction activities of the project may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.	placement of weight limits above which mechanical assists or two-person lifts are necessary. • Work site layout will be planned to minimize the need for manual transfer of heavy loads. • Tools will be selected, and workstations would be designed to reduce force requirements and holding times, which promote improved postures, including, where applicable, user adjustable workstations. • Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes. • Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface. • Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. • Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labelling	Use of PPEs. Training records, work permits, implementation of emergency response plan. Community concern records, medical reports.			provided by contractor. Monitoring costs including PPE costs provided in the monitoring plan table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	Moving Machinery Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving. **Physical Hazards** • Exposure to heat stress, as a result of rapid movement between cold and hot areas. **Chemical Hazards** • Exposure to various chemicals, such as: adhesives, caulking compounds, fluxes (solder), hydrochloric acid, zinc chloride, tar and solvents, various greases, and inorganic lead. **Biological Hazards** Exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, and ticks.	covers for openings in floors, roofs, or walking surfaces. • Good house-keeping practices, such as the sorting and placing loose construction materials in established areas, would be implemented. • Excessive waste debris and liquid spills will be cleaned up regularly. • Electrical cords and ropes will be in common areas and marked corridors. • Slip retardant footwear will be used. • Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap. • Temporary fall protection measures in scaffolds and out edges of elevated work surfaces would be used, such as handrails and toe boards to prevent materials from being dislodged. • Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore. • The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations. • Educate workers on heat stroke and guide them to take preventive measures. • Encourage frequent breaks in summer season to allow workers to recover from extreme temperatures. • Ensure an adequate supply of potable water is available to workers to prevent dehydration in hot environments. • Educate workers on recognizing and responding to the signs and symptoms of heat stress, as well as the importance of proper hydration. • Provide welders with protective clothing, including welding helmets with UV-filtering lenses, welding gloves, and flame-resistant clothing. • Install effective ventilation systems to remove fumes and gases generated during welding, reducing exposure to harmful substances. • Create barriers or enclosures around welding operations to prevent bystanders from being exposed to UV radiation. • Ensure workers are adequately trained in proper welding techniques and safety				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		measures to minimize the risk of UV radiation exposure. • Contractor and Construction Supervision Consultant (CSC) to regularly inspect welding equipment and PPE to ensure they are in good working condition, and promptly repair or replace any faulty equipment. • Use chemical and adhesives in well-ventilated areas or ensure proper ventilation systems are in place. • Wear appropriate personal protective equipment (PPE), such as gloves and goggles, when handling chemicals. • Follow the manufacturer's instructions for safe use and storage of adhesives and chemicals. • Ensure Material Safety Data Sheet (MSDs) at chemical storage area. • Store chemicals in a designated area away from incompatible substances • The contractor should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs. • Project contractor must provide good working and sanitation conditions at camp and work sites. Disease surveillance should be carried out to				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		identify any exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, ticks, and dengue. • Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented, and maintained in close co-operation with the local health authorities and according to recognized international standards.				
19.	**Community Health & Safety** Construction activities and vehicular movement may result in roadside accidents, particularly. affecting local communities especially the residents of Haji Ibrahim Goth will be vulnerable, as they are closely located to proposed landfill site. A detailed community health & safety plan including impacts and mitigation measures for all phases of the project is provided in the **Annex-XV**.	Work areas outside the project site, especially where machinery is involved, will be barricaded, and will be constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for landfill related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition. • Local communities especially the resident of Haji Ibrahim Goth will be briefed on traffic safety, especially women who are the main care providers to children. • Speed limit of 20 km/hr will be maintained by all project related vehicles and night-time driving of project vehicles will be limited where possible. • Educate drivers on safe driving practices to minimize accidents and to prevent	Implementation of CHS plan. Use of PPEs, training records, work permits. Implementation of emergency response plan. Community concern records	CC	SC & PIU	Costs will be included/ provided by contractor. Monitoring costs included in the monitoring plan table ahead, along with the community health and safety plan.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		spill of hazardous substances and other construction materials during transport. • Contractor must take proper safety measures (placing warning tapes around excavations) to avoid people, especially children, accidentally falling into excavations. • All the working platforms must be cordon off with special care by well-trained skilled workers. • Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area. • During construction, the stability of the old dump site must also be taken into account, where investigations should be carried out to ensure that no untoward impact comes from project activities. • PIU SWEEP should ensure the contractor staff working in the project are well trained and educated in the Health, Safety and Environment (HSE) hazards associated with their duties, and that of the public, in the project area.				
20.	**Social & Cultural Conflicts** During the construction phase of the project, conflicts may arise between labor force and local community. Furthermore, differences in cultural values may also cause discomfort to local residents.	• Local labor especially from nearby communities will be given preference for the construction works.	Record register of all issues and rational expectations desired by the public. Camp	CC	SC & PIU SWEEP	Nil

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Careful planning and training of work force to minimize disturbance to the local people. • Public notification through print or electronic media during the entire construction phase to avoid any inconvenience in accessibility to the locals; and • Adequate training of especially for the transitive workforce of the station (involved both in the construction process and in the commissioning) to regard the customs of the area so that the locals do not feel insecure. • A Code of Conduct will be prepared and adopted for the project (as prepared in the LMP and GAP). All project personnel will be required to sign and follow the CoC. • Liaison will be maintained with the local communities, and they will be educated about the GRM established for the proposed project.	established 250 meters away from nearest community; locals hired for workforce. Any complaint from local community. Approved OHS plan, evidence of trainings conducted. Accident/ incident reported. Training records, health, and safety manual.			
21.	**Child labor** There are two basic conventions on child labor adopted by the ILO, and one adopted by the United Nations. The ILO Minimum Age Convention, 1973 (No. 138) and its accompanying Recommendation (No. 146) set the goal of elimination of child labor, and the basic minimum age for employment or work (in developing countries at 14 years of	• Awareness will be created among the local communities about the adverse impacts of child labor. For the public awareness, meetings will be held in the project area, and announcements will be made using the available local platforms with the involvement of all sectors of the society.	Audit and Checks. Physical observations. Employee records.	CC	SC & PIU SWEEP	Nil

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	age or the end of compulsory schooling, whichever is higher; and 15 or the end of compulsory schooling for developed countries). The Convention sets a minimum age of 2 years younger for "light work," i.e., 12 and 13 years, respectively; and a higher minimum age for dangerous or hazardous work (basically 18 years of age, but 16 in certain circumstances). The Convention also has various other flexibility clauses. Inhabitants of the project area have mix economic background and different sources of income. Children of low-income groups mostly involve in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods. However, the Sindh Restrictions on Employment of Children Act, 2017 prohibits the employment of child and restrict the employment of adolescents in certain occupations and processes such as construction industry, and whoever employs or permits a child (person under the age of 15 years) to work in an establishment will be liable to punishment with imprisonment. The child labor impact might arise during construction stage, as large number of skilled and unskilled labor will be required by the contractor for the construction activities of the proposed project. Furthermore, there are currently children	• Contractor through contractual agreement will be bound to follow the labor standards, rules, and regulations during hiring the labor force and all activities will be monitored by the social and environmental staff of the implementing agency. • Client and SC will ensure that contractor will have its employment policy in accordance with relevant act and labor policies in Pakistan. • Contractor will ensure the presence of all persons at site are adults and have their proper identity cards with them. • Reduce or eliminate the worst forms of child labor and rescue and rehabilitate the children in the worst forms of child labor. • Penalize contractors/employees using the worst forms of child labor and penalize adults who violate children's rights and who force children to enter child labor, especially in its worst forms. • Reduce the health hazards and dangers to young persons in the workplace; and • An LMP and LRP has been prepared to eliminate the issue of child labor at project sites and find ways to rehabilitate children who are involved in waste picking practices currently at these sites				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	involved in waste picking activities in Jam Chakro dumpsite. These impacts are adverse substantive in significance.	by providing them education and skills to be able to augment their family income.				
22.	**Gender Based Violence** Women from low-income groups (which make up a considerable demographic in the project areas) are one of the vulnerable groups of the project, where their exploitation is one of the major potential impacts of the project. During surveys, consultations with females were conducted at individual and group levels to understand the apprehensions of females regarding sub-project activities. With the potential influx of workers and work happening in the area, the risk of GBV will be higher than normal due to discrimination made against women by unequal work distribution and unequal pay structure among others. Sexual Harassment against women may occur as a consequence of the mixing of men and women at the construction sites, and moving on the roads, and areas. Educational institutions near the sub-project sites are also sensitive regarding gender issues.	• A standalone Gender Action Plan (GAP) has been developed for the SWEEP project, which will also be applicable to the proposed sub-project, which outlines in detail the measures to take to minimize the risk of GBV. • Construction workers will undergo training, and strict measures and penalties will be implemented to prevent and address instances of sexual assault and gender-based violence (GBV). • During school hours, workers will not be allowed to gather in the vicinity. • To prevent the mixing of women with workers, alternative pedestrian routes will be provided. • The enforcement of the Gender Protection Act will be strict during construction activities within the project area. Field staff and district-level in charges will monitor its implementation. Communities will be educated about the potential risks of GBV, and response services will be established to address instances of GBV, particularly related to labour influx issues. The contractor will ensure that no gender discrimination occurs during the hiring of workers. Comprehensive standard operating	Grievance redress record. Minutes of meetings of community/ gender consultation.	CC	SC & PIU SWEEP	Nil

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		procedures (SOPs) will be developed and implemented to address the presence of women workers on-site. The implementation of these SOPs will be monitored by supervising consultants (SCs). • Gender-segregated bathing, changing, and sanitation facilities will be provided. • The contractor will take appropriate measures to address and resolve issues of harassment, intimidation, and exploitation, with a particular focus on women. • The World Bank Guidelines on GBV will be adopted. • Workers' camps will be established separate from local communities, with strict protocols for interactions to minimize the impact of labour influx on the project. • Project staff will receive training on SEA/SH prevention. Skilled trainers will be engaged to raise awareness among project workers about risks, expected behaviours, and consequences of violations. Codes of conduct will be communicated through training and publicized. • Local organizations and government initiatives on community STDs education, prevention, and treatment				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		programs will be arranged and supported. • Extensive training will be provided on the awareness-raising strategy, which outlines how workers and local communities will be sensitized to SEA and SH risks, and their responsibilities under the Code of Conduct. • Whenever possible, routes and places frequented by women will be avoided. If unavoidable, alternative routes will be identified, especially along paths commonly used by women, such as routes to local wells or water sources. • The construction crew will minimize entry into villages and settlements. • Communities will be informed and consulted before commencing works inside or near their communities. • Provisions related to SEA/SH will be included in the bidding document. • Service providers will be identified and mapped to address SEA/SH issues.				
23.	**Flora & Fauna** The Karachi city is already devoid of vegetation and tree cover, similarly no major impact on flora and fauna is envisaged as Jam Chakro site is situated in already a disturbed and heavily anthropogenic environment which is not a suitable habitat for a diverse range of flora and fauna	• Effort will be done not to disturb or uproot critically endangered species (listed in IUCN) Commiphora wightii. • If the trees are to be removed, then they should be uprooted and planted in the buffer area being planned for between Haji Ibrahim Goth & the landfill cell.	Tree removal and relocation record. Visual observations, regular monitoring, audit, and checks.	CC	SC & PIU SWEEP	Cost of relocating plants provided in ESMP table ahead.

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	species. During ecological survey, critically endangered species (listed in IUCN) Commiphora wightii recorded within the premises of existing dumpsite, which has been disturbed due to anthropogenic activity this involve, burning of waste and movement of vehicle within the proximity of dumpsite. In terms of fauna, some opportunistic and adaptable species may be observed in and around the dumpsite due to the availability of food and shelter resources. These species typically have adaptations that allow them to survive in disturbed or urbanized environments. Albeit the ecological conditions within the landfill, including the presence of pollutants and limited resources, make it challenging for a diverse range of fauna species to thrive. The recorded mammalian species are common in nature and no significant impact on them are envisaged, irrespective of that, there are chances of species being killed by the Contractor's personal.	• The contractor's personnel will be instructed not to kill/poach the wild animals. If there is any burrow/den with juveniles found, it will not be disturbed until the maturity of the juveniles.				
Operation Phase						
24.	**Generation of Leachate** Leachate generation depends on a variety of factors, such as Incident precipitation, evaporation, the extent of the waste surface that is open and exposed, the rate at which the site is covered and capped; and the permeability and water holding capacity of	• The primary method of leachate treatment shall be by leachate recirculation to the waste mass, given the prevailing climatic conditions. Re-infiltration shall be achieved by a combination of mobile tanker and spray bar in the active waste deposition area	Visual observation. Regular environmental monitoring, sampling, and testing reports.	SSWMB	SSWMB	Not available at this time

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	the waste material. The Design Consultant in its feasibility report estimated leachate generation of 650 m^3 for a 1 in 2 years storm. It has been calculated assuming an exposed waste surface of 2.5 acres (1 ha.) the maximum leachate generation, excluding potential reductions through absorption by waste and evaporation. This can readily be stored within the base of any of the Cells on a temporary basis. The general risks from leachate generated from wastes are due to its normally high organic contaminant concentrations and high ammoniacal nitrogen. Pathogenic microorganisms and hazardous substances that might be present in it are often cited as most dangerous, but pathogenic organism counts have been found to reduce rapidly with time in the landfill, so this only applies to fresh leachate. If generated leachate not properly treated, it could alter the physiochemical parameters and heavy metal concentration in soil and groundwater.	and by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level. • If leachate re-circulation does not prove to be completely effective as a leachate management process, then it will be necessary to consider other forms of treatment that might be more appropriate, particularly if treated leachate is required to be discharged off-site. • For collection and temporary storage of leachate the Design Consultant has proposed Leachate tanks will be provided at the northern end of the site. • Leachate storage tanks shall have a sufficient volume to collect and store leachate for a period of 15 days under maximum precipitation conditions. • One option of leachate treatment is anaerobic digestion leachate treatment plant which is completely enclosed and produces electricity to offset the operations costs and the water quality. • Operate the landfill in accordance with applicable internationally recognized standards to minimize leachate generation. • The operators of the landfill must ensure that an effective and efficient leachate control and monitoring system is maintained. This may be complimented				

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		by establishment of groundwater monitoring wells and regularly collecting samples for laboratory analysis. Results of the analysis could aid the operators to determine the final fate of the collected leachate and/detect any potential leakages. Final decision rests with the landfill operator on the final number of wells as well as the frequency of sampling for groundwater quality.				
25.	**Contamination of Soil & Groundwater** The most anticipated impact of landfill in consider as possible contamination of soil and groundwater, this could happen, if liner system installed is inadequate or in case of leakage into liner. In both the cases, leachate can percolate underground having adverse impact on ground water resources. During Geotechnical study groundwater was found to be deeper below more than 200 feet. In setting up baseline for proposed site groundwater samples were collected from 6 locations, each near the residential setups in the AOI. Six (6) storage cell is proposed in sanitary landfill site, there are chances of leachate infiltration from proposed storage cells thus contaminating the ground water and soil.	• A very comprehensive basal lining system has been proposed for sanitary landfill sites, which consist of composite lining system, this will be overlay by Geo composite clay liner and HDPE membrane. A geotextile, with a proposed weight of 1,200 grams/m2, will be placed immediately above the geomembrane for liner protection prior to the placement of the overlying leachate collection gravel and pipework. Considering the proposed multi-layer liner system, it will be able to prevent leachate infiltration into surface. • An efficient leachate collection and treatment system has been provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum.	Visual observation. Regular environmental monitoring, sampling, and testing reports.	SSWMB	SSWMB	Not available at this time
26.	**Generation of Landfill Gas** When waste in landfill goes decomposition, it produces landfill gas which constitutes of	• A gas treatment plant will be setup with all its necessary piping network and infrastructure to treat and safely	Visual observation. Regular	SSWMB	SSWMB	Not available at this time

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	Methane and Carbon dioxide CO_2 with small number of other gases like nitrogen, oxygen, and Volatile Organic Compounds (VOCs). The generated landfill gas if uncontrolled release will result in greenhouse gas emissions, particularly Methane, which is approximately 25 times more effective at trapping heat in the atmosphere than CO_2 over a 100-year period. Similarly, the release of VOCs will result in air pollution adversely affecting the near-by communities, VOCs when released into the atmosphere, can lead to the formation of ground-level ozone and smog, which can have detrimental effects on human health and the environment. The other potential adverse from release of landfill gas is fire and explosion, as landfill gas in flammable and if not adequately managed it can create a safety risk.	discharge the gases that emits from the landfill, thus no significant impacts on occupational or community health and safety are envisaged from landfill gas exposure. • Periodic GHG monitoring will be carried out during operation phase of the project and accordingly, necessary design changes will be incorporated, if required. The monitoring will include methane and hydrogen Sulfide gases where monitoring will be conducted at the wells and at the residential/ sensitive receptors within the AOI. • Gas collection wells will be installed in landfill, and it will design in such a way that when two meters of waste layer is deposited in the first cell a 30m x 30m grid of perforated gas recovery pipes will be installed and will be brought up as waste filling progresses. Gas collection system is designed from bottom up to avoid emission during landfill operation and to avoid drilling through the garbage when the cell is filled with waste. • The gas well will be extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome is installed at the top of the well. Each gas collection wells/domes will be connected to collection strings and each string will lead to a main	environmental monitoring, sampling, and testing reports.			

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		collection pipe at the manifold that can be regulated with a separate valve based on the quality of gas. • The design of landfill gas treatment plant will cater the issue of odor and air pollution, mitigating adverse effect on surrounding communities. • PIU SWEEP shall ensure that during operation phase of the project, if there are changes in the baseline ambient air quality based on monitoring results, then quantitative assessment will be carried out for flaring and necessary design changes will be incorporated to avoid air quality impacts from flaring.				
27.	**Vermin & Vectors** The operation of the landfill may attract presence of pests such as rats, cockroaches, flies, ants, and other pests in the immediate area along with various other vectors such as feral cats, dogs, birds, and other animals. These pests can freely move around the area and may find their way to buildings and areas adjacent to the landfill. Since these pests are known to be carriers of diseases, they may trigger the sudden occurrence of illnesses and unacceptable conditions among people of weak resistance and children. Each type of vector can live and multiply at a landfill and is potentially of concern to site operators, regulators, public health professionals and	• The most effective way to control vermin and disease vector generation is the application of daily soil cover which will be placed before the end of the day. Waste will be covered all the time except tipping face where it will be worked. Due to large quantities needed for daily cover, and the additional requirement required for intermediate and final cover, long-term planning should be done ensure availability of the materials. • There should be no ponding water on the landfill property except as designed for runoff storage or sedimentation. Sedimentation ponds can, however, aid vector reproduction if not designed and controlled properly so as to minimise	Maintenance and cleaning records. Audits and regular checks.	SSWMB	SSWMB	Not available at this time

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	the general public. Fortunately, vectors are controllable and should rarely, and even then, only intermittently, be present on a well-controlled landfill.	stagnant water, nutrient build-up, and plant growth. • On-site landfill site personnel must be trained and must monitor the levels of key vectors on a daily basis as part of daily management. A simple monthly site walk-over can provide a baseline of vector activity so changes can be noted and translated into action. Observations of various droppings, sightings, tracks, insect counts, etc are useful indicators of activity. Written reports from regular walk-over assessments should be kept on file so changes that occur over time and in response to control measures can be assessed.				
28.	**Occupational Health & Safety** • There are chances of accidents due to use of heavy machinery such as compactors, bulldozers, and garbage truck this pose a risk of collision, and accident on landfill site. • Workers may come into contact with hazardous substances (especially at MRF) present in the waste, such as toxic chemicals, medical waste, or unknown materials. • Landfill can have uneven terrain and slippery surfaces due to waste materials and weather conditions.	• Workers should receive proper training in the safe operation of machinery and vehicles. Implementation of traffic management plans, speed limits, and designated routes can help minimize the risk of accidents. High-visibility clothing and barriers can enhance worker safety. • Personal protective equipment (PPE) should be provided and worn at all times. This includes gloves, respirators, coveralls, and safety boots. Proper waste sorting and handling procedures should be followed to reduce exposure. • Workers should wear appropriate footwear with good grip and receive training on safe walking and working on	Visual observations, implementation of emergency response plan	SSWMB	SSWMB	To be calculated by the operator

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	• Workers may be exposed to pathogens from decomposing waste, leading to potential infections or diseases. • Landfill operations can expose workers to high temperatures, leading to heat-related illnesses, particularly during the month of May to July when temperature is moderately high in Karachi. • Workers involved in waste sorting and handling may face musculoskeletal injuries due to repetitive motions and heavy lifting.	uneven surfaces. Proper site maintenance, including regular waste compaction and surface levelling, can reduce the risk of slips and falls. • Regular health monitoring of workers and providing necessary vaccinations can be important preventive measures. Proper hygiene practices, such as frequent handwashing and avoiding touching the face, are essential. • Providing shaded rest areas, regular breaks, and access to drinking water can help mitigate the risk of heat stress. Educating workers about the symptoms of heat-related illnesses and their prevention is crucial. • Proper training in safe lifting techniques and the use of mechanical aids (e.g., conveyor belts, lifting equipment) can reduce the strain on workers. Job rotation can also help minimize the risk of repetitive stress injuries				
29.	**Waste Pickers & Livelihood Loss** E&S Consultant in its socio-economic survey identified 1067 waste pickers of whom livelihood are associated with waste picking. The proposed landfill site will have a boundary restricting the access of waste pickers, who are now engaged in waste picking at dump site, meaning their livelihood will be affected.	A Livelihood Restoration Plan has been prepared for identified waste pickers with an objective to provide a detailed plan to livelihood restoration options for the people affected due to the Landfill site development at Jam Chakro. LRP covers the alternative livelihood options for the affected waste pickers whose livelihoods will be altered due to the development of the cells. Nevertheless, in line with the Bank's	Records, grievances registered and resolved, periodic consultations.	SSWMB	SSWMB	Cost included in livelihood restoration plan

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		mitigation hierarchy, measures have been developed to minimize and offset these impacts where trainings, skill development, and linkages with industries have been explored in detail for the waste pickers at Haji Ibrahim Goth.				
30.	**Fire & Explosion Hazards** Fire and explosion hazards can be a risk for engineered landfill sites, which may result from the decomposition of organic waste, the build-up of flammable gases, and other factors. This impact is substantial to moderate adverse. The potential impacts and mitigation measures include: <u>Generation and accumulation of methane gas</u> Landfills produce methane gas as organic waste decomposes. Methane is highly flammable and can explode is it accumulates in sufficient quantities. <u>Spontaneous Combustion</u> Organic materials in landfills can undergo spontaneous combustion due to the heat generated during decomposition. <u>Ignition Sources</u>	**Mitigation Measures** • A gas collection system is already proposed to capture and control methane emissions, along with a gas processing plant to deal with the accumulated methane in the form of collection and flaring or generation of electricity. • Regular monitoring of gas levels in an around the landfill can help detect and respond to potential issues. • Use daily, intermediate, and final cover systems to help limit oxygen ingress and temperature fluctuations, reducing the risk of spontaneous combustion. • Regularly monitoring and for signs of elevated temperatures or smoke can help identify potential combustion events early. • Implement no smoking policies and prohibit smoking in and around landfill areas. • Ensure daily and final covers are correctly applied to limit oxygen ingress.	Visual observation. Implementation of Firefighting Management Plan and Emergency Response Management Plan.	SSWMB	SSWMB	Not available at this time

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	Ignition sources such as cigarettes, sparks, or lightning strikes can start fires at landfill sites. <u>Waste Cover & Compaction</u> Inadequate waste cover or improper compaction may leave waste exposed to oxygen, increasing risk of combustion.	• Adequate compaction of waste can reduce void spaces and limit the availability of oxygen for combustion.				
31.	**Emergency Preparedness & Response** The operations at the landfill site may at times be hampered, leading to operational failures. In addition, disasters such as explosions, fires, gas leakages, earthquakes may occur. This impact is negative, permanent, and moderate to substantial adverse in nature.	• SSWMB and the operator to develop an Emergency Response Plan (ERP) using the guide plan attached as an **Annex-XVI** for disasters related to the landfill site in collaboration with the Fire Fighting Department, Local Police, Nearby healthcare providers, and Provincial Disaster Management Authority (PDMA). • Regular training sessions will be conducted to educate staff, employees, and the population at Haji Ibrahim Goth about the emergency procedures and plans. • A designated responsible person will be assigned to oversee the implementation of the ERP. • Emergency contact numbers will be prominently displayed to ensure swift action during emergencies. • Firefighting systems will be regularly calibrated and maintained.	Visual observation. Implementation of Emergency Response Management Plan.	SSWMB	SSWMB	Not available at this time

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
		• Routine fire emergency drills will be conducted to ensure preparedness and response effectiveness.				
32.	**Closure & Post Closure** Closure and post-closure adverse impacts of a sanitary landfill site refer to the negative effects that can arise after the landfill reaches its capacity and is closed for waste disposal. Despite the best efforts to mitigate these impacts during the closure process, certain adverse effects may persist or emerge during the post-closure period. Some of the closure and post-closure adverse impacts of a sanitary landfill site include: Even with proper capping and covering, leachate can continue to be generated and may seep into the surrounding soil and groundwater, potentially contaminating local water source, landfill gas continues to be produced long after the landfill is closed. If not properly managed and collected, these gases can migrate into the atmosphere and contribute to air pollution and climate change. Over time, the waste in a landfill undergoes decomposition and compaction, leading to subsidence and settlement of the landfill area. This can result in uneven ground surfaces, improperly closed or poorly managed landfills can experience soil erosion, landslides, or slope failures, which	• The Design Consultant to establish a comprehensive groundwater monitoring network around the landfill to regularly monitor water quality. Early detection of contamination allows for timely intervention and corrective actions. • Appropriate selection of soil type for final cover will be ensured to prevent direct or indirect contact of living organisms with the waste materials and their constituents. • Application of final cover components that are consistent with post closure use and local climatic conditions. • SSWMB to implement a monitoring program to assess ground settlement and subsidence over time. • SSWMB to conduct slope stability analysis to identify potential unstable areas and take corrective actions, such as slope reinforcement or stabilization measures. • Develop plans for alternative land uses that are compatible with the site's constraints. • SWMB to educate nearby communities about the landfill's closure and post-closure management measures,	Regular Monitoring, & Testing. Audits & Checks	SSWMB	SSWMB	Not available at this time

Sr. No.	Impacts	Mitigation Measure	Performance Monitoring Indicators	Responsibility		Tentative Cost (PKR)
				Implementation	Monitoring	
	can impact the stability of the surrounding land and pose risks to nearby communities. Closed landfills may not blend seamlessly into the surrounding landscape, leading to visual blight and negatively impacting the aesthetic appeal of the area.	potential risks, and the importance of adherence to safety guidelines. • Conduct regular environmental monitoring to assess air quality, water quality, and soil conditions as present in Environmental Management Plan (EMP). • Future Land use of the site will be defined in consultation with local communities and government agencies. • SSWMB will ensure that financial instruments are in place to cover the costs of closure and post-closure care and monitoring. • Long term integrity and security of the site will be maintained.				

9.7 Environmental & Social Monitoring Plan

Environmental and social monitoring plays a crucial role in providing timely and valuable information to project management and implementation agencies. In essence, monitoring involves regularly checking and balancing the progress of project activities and the achievement of developmental targets during construction and operation. It aids in promptly identifying, analysing, and addressing any obstacles that may arise. Specific environmental parameters, encompassing physical, ecological, and social aspects, are carefully selected, and subjected to quantitative analysis. The results of this analysis are then compared against established guidelines, standards, and pre-project conditions to assess the effectiveness of the Environmental and Social Management Plan (ESMP) and its implementation in mitigating impacts. The objectives of the environmental and social monitoring plan throughout the construction and operation phases are as follows:

- Monitor the actual impacts of the project on physical, ecological, and socio-economic receptors.
- Provide recommendations for mitigation measures in case of unforeseen impacts or when the impact level exceeds the anticipated level stated in the Environmental and Social Impact Assessment (ESIA).
- Ensure compliance with legal and community obligations, including safety measures during the construction and operation phases.
- Ensure the proper disposal of excess construction materials, solid waste, water, wastewater, and gaseous emissions.
- Evaluate the adequacy of the ESIA in relation to the project's predicted long-term impacts on the physical, ecological, and socio-economic environment of the area.
- Assess the effectiveness of the mitigation measures proposed in the Environmental and Social Management Plan (ESMP) and recommend improvements if necessary.
- Compile data on periodic incidents and accidents to support analyses aimed at minimizing future risks.

The SWEEP PIU will hold responsibility for all monitoring activities to be conducted (compliance and effects monitoring). All findings and results will form part of the monitoring report to be shared with SEPA and the World Bank.

9.7.1 Compliance Monitoring

Compliance monitoring of the proposed sub-project activities will serve as a tool to ensure that the environmental and social control measures identified are strictly adhered to during project execution. This will be conducted by the E&S staff of the SC. The goals of the compliance monitoring will be to:

- Observe the activities carried out by the contractor(s) or other individuals involved in the proposed project in a systematic manner.
- Ensure that the activities are in accordance with the Environmental and Social Management Plan (ESMP).
- Document and communicate the observations to the Environmental and Social Committee (ESC) of the Project Implementation Unit (PIU) for prompt corrective actions, if necessary.
- Maintain a record of all environmentally and socially significant incidents, along with the corresponding actions and corrective measures taken.
- Establish communication with the local communities, gather their opinions and concerns, and discuss them during monthly meetings.
- Prepare regular reports on the environmental and social performance of the proposed project.

9.7.2 Effects Monitoring

The Environmental and Social Impact Assessment (ESIA) takes into account the projected impacts of the proposed project using available information and the interconnectedness of various environmental and social factors. Mitigation measures are incorporated based on this assessment to ensure that the expected residual effects remain within acceptable thresholds. However, it is important to recognize that despite full implementation of mitigation measures, there is a possibility that the project's negative impacts may exceed predicted levels or acceptable limits. To address these concerns, an effects monitoring program will be implemented during the project activities, aiming to effectively manage environmental and social risks and uncertainties. The objectives of the effects monitoring program can be outlined as follows:

- To ensure that the impacts of the proposed project remain within acceptable thresholds, thereby establishing trust and confidence among the public.
- To promptly alert the PIU about any unforeseen adverse impacts or sudden changes in impact trends, enabling swift corrective actions such as modifications to project activities or the implementation of additional mitigation measures.
- To provide information that assists in planning and controlling the timing, location, and intensity of specific project activities, with the aim of minimizing their effects.
- To support research and development efforts by documenting the effects of the proposed project, which can be used to validate impact prediction methods and enhance the accuracy of future project assessments.

The contractor(s) holds the primary responsibility for conducting effect monitoring under the supervision of the SC and PIU-SWEEP at each site, covering the entire sub-project. The effect monitoring program has been meticulously developed, taking into account the identified impacts outlined in Chapter-5. Some adjustments may be made to this program, including potential changes in frequency, based on insights gained from the project's one-year operation, documented in the Change Record Register. Table 9.2 presents the schedule for environmental and social effect monitoring during the construction and operations phases of the proposed project.

Table 9.2 - Environmental Monitoring Plan

S. No	Parameter / Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility
Construction Stage						
1.	Water Resources/ Water Quality	Monitoring of all parameters of effluent from construction sites as per stringent environmental quality standards.	Proposed sub-project sites AOIs • Major receptor i.e., residential areas etc. within the AOI. However, estimated sampling points will be verified at construction stage. Other proposed effluent discharge points are: • Contractors camps • Fuel (Petrol. Oil and Grease) products storages. Vehicle and machines repairing and servicing yards.	Visual checks of laboratory activities Discrete grab sampling and laboratory testing of water samples by SEPA approved Laboratory for monitoring.	Once before the start of construction by activity monitors and reported; and • On monthly basis during the construction.	Contractor during Construction Phase • Compliance monitoring lies with CSC during Construction Phase
2.	Drinking water	Monitoring of all parameters of drinking water as per stringent environmental quality standards	Proposed sub-project sites AOIs • Major receptor i.e., construction site, camps area and nearby residential areas within the AOI. However, estimated sampling points will be verified at construction stage	Visual checks and monitoring of laboratory activities Discrete grab sampling and laboratory testing of drinking water samples by SEPA approved Laboratory for monitoring.	Once before the start of construction by activity monitors and reported; and • On monthly basis during the construction.	Contractor during Construction Phase • Compliance monitoring lies with SC during Construction Phase
3.	Soil Contamination	Soil contamination, uncontrolled solid waste disposal activities at sites	Proposed sub-project sites AOIs • Sites with severe contamination. Other proposed	Visual observations and checks of laboratory activities Sampling and	• Once before the start of construction by activity monitors	Contractor during Construction Phase • Compliance

			sampling sites are: • Construction Camp. • Equipment washing yards. • Spillage points of fuel, chemicals, and lubricants.	laboratory testing for soil samples.	and reported; and • On monthly basis during the construction	monitoring lies with CSC during Construction Phase
4.	Land Resources	Land use Change	Proposed sub-project sites AOIs • Sites with significant land use change	Random visits and visual observations of land use change.	Once before the start of construction by activity monitors and reported; and • On monthly basis during the construction.	Contractor during Construction Phase • Compliance monitoring lies with CSC during Construction Phase
5.	Dust Emission	Monitoring of PM10 PM2.5 as per stringent environmental quality standards	Proposed sub-project sites AOIs • Sensitive receptors within the AOI, construction site, camps area. Estimated sampling points will be verified during construction stage	Visual checks and monitoring of laboratory activities Onsite Ambient Air Monitoring equipment	• Once before the start of construction by activity monitors and reported; and On monthly basis during the construction	Contractor during Construction Phase • Compliance monitoring lies with SC during construction phase
6.	Noise Pollution	Day and night-time noise monitoring in dBA Leq. as per stringent environmental quality standards	Proposed sub-project sites AOIs • Sensitive receptors within the AOI. Estimated sampling points will be verified during construction stage. Other proposed sampling sites are: • Construction camps. • Equipment yards	Visual checks and monitoring of laboratory activities Monitoring of noise level at site.	Once before the start of construction by activity monitors and reported; and • On Monthly basis during the construction (spot measurement regular daily basis keeping in view the day-to-day application of	Contractor during Construction Phase • Compliance monitoring lies with SC during Construction Phase

					different heavy noise causing equipment by the contractor)	
7.	Fumes and gases	Monitoring of CO, CO2, SOx, NOx, HC and PM2.5 PM10 and compliance with stringent environmental quality standards Vehicular emissions as per stringent environmental quality standards.	Proposed sub-project sites AOIs • Major receptors within the AOIs. Estimated sampling points will be verified during construction stage. • Emissions from the silencers of heavy machinery, trucks, and other vehicles.	Visual checks and monitoring of laboratory activities Onsite monitoring of ambient air quality will be preferred	Once before the start of construction by activity monitors and reported; and On monthly basis during the construction	• Contractor during Construction Phase • Compliance monitoring lies with CSC during Construction Phase
8.	Ecological Resources	Disturbance to natural habitat and fauna, uncontrolled floral cutting which can be avoidable.	Proposed sub-project sites AOIs	Visual checks to ensure that only marked trees within landfill boundary are cut. Monitoring of Wildlife / birds hunting. Inventory of existing trees, cut trees, and planted trees.	Once before the start of construction by activity monitors and reported; and • On monthly basis during the construction	Contractor during Construction Phase • Compliance monitoring lies with CSC during Construction Phase
9.	Community around the project areas	Use of common resources. Hindrance to mobility. CHS	Community within the AOI	Community Consultation	Prior to the start of construction and during the construction stage. Reporting will be done on the basis of SEP recommendation.	Contractor during Construction Phase • Compliance monitoring lies with CSC during Construction Phase

10.	Waste Management	Inspection of waste and spoil disposal in accordance with Waste Management Plan	Main project area (AOIs) • Construction camps and Offices. • Equipment yards Other project allied facilities	Visual Observations, Monitoring and Audits	Review the waste management stream before start of the project. Monitoring and reporting on monthly basis during the construction stage;	Contractor during Construction Phase. Compliance monitoring lies with SC during Construction Phase
11.	Labor Management and Working Conditions	As per the LMP of SWEEP which include but not limited to OHS, hygiene facilities, appropriate camps area, etc	Main project area (AOIs) • Construction camps and Offices. • Equipment yards. • Other project allied facilities	Visual Observations, Incident/accident register Monitoring and Audits	Monitoring and reporting on monthly basis during the construction stage;	Contractor during Construction Phase • Compliance monitoring lies with SC during Construction Phase
12.	Traffic Safety and Management	As per the TMP which include but not limited to the observation of traffic congestion at bottleneck areas, provision of signs and signal, vehicular inspection, driving safety protocols, etc.	Main project area (AOIs) • Construction camps and Offices. • Equipment yards. • Other project allied facilities	Visual Observations, Vehicle Logbooks, Monitoring and Audits	Monitoring and reporting on monthly basis during the construction stage	Contractor during Construction Phase • Compliance monitoring lies with CSC during Construction Phase
13.	Social aspects including GBV and other Grievances	Social and cultural conflicts, SEA/SH complaints, grievances related to livelihood impacts, child abuse, etc	Main project area (AOI) • Construction camps and Offices. • Equipment yards. Other project allied facilities	Visual Observations and consultations, Grievance Redress/Social Complaint Register, Monitoring and Audits	Monitoring and reporting on monthly basis during the construction stage;	• Contractor during Construction Phase • Compliance monitoring lies with SC during Construction Phase

14.	OHS; CHS; accidents and incidents	As per O&CHS sub-plan which include but not limited to the inspection of working areas, work permits, provision and availability of mandatory PPEs, Community complaints on H&S	Main project area (AOI) • Construction camps and Offices. • Equipment yards. • Other project allied facilities	Visual Observations and consultations, Grievance Redress/Social Complaint Register, Incident/accident register, Monitoring and Audits	Monitoring and reporting on monthly basis during the construction stage	Contractor during Construction Phase • Compliance monitoring lies with SC during Construction Phase
15.	Chemical Storage and Handling	Safety Data Sheets, Leakage and spills, Segregated handling and storage of chemicals, availability of fire extinguishers,	Main project area (AOI) • Construction camps • Equipment yards. • Other project allied facilities	Visual Observations, Chemical Storage inventory, Incident/accident register, Monitoring and Audits	Monitoring and reporting on monthly basis during the construction stage	Contractor during Construction Phase • Compliance monitoring lies with SC during Construction Phase
Operation Phase						
1.	Leachate Quality	Monitoring of all parameters of effluent as per stringent environmental quality standards.	Project site AOI	Visual checks of laboratory activities Discrete grab sampling and laboratory testing of water samples by SEPA approved Laboratory for monitoring.	Quarterly	SSWMB during O&M Phase
2.	Drinking water	Monitoring of all parameters of drinking water as per stringent environmental quality standards	Project site AOI	Visual checks and monitoring of laboratory activities Discrete grab sampling and laboratory testing of drinking water samples by SEPA	Quarterly	SSWMB during O&M Phase

				approved Laboratory for monitoring.		
3.	Soil Contamination	Soil contamination, uncontrolled solid waste disposal activities at sites	Project site AOI	Visual observations and checks of laboratory activities Sampling and laboratory testing for soil samples.	Quarterly	SSWMB during O&M Phase
4.	Land Resources	Land use Change	Project site AOI	Random visits and visual observations of land use change.	Quarterly	SSWMB during O&M Phase
5.	Dust Emission	Monitoring of PM10 PM2.5 as per stringent environmental quality standards	Project site AOI	Visual checks and monitoring of laboratory activities Onsite Ambient Air Monitoring equipment	Quarterly	SSWMB during O&M Phase
6.	Noise Pollution	Day and night-time noise monitoring in dBA Leq. as per stringent environmental quality standards	Project site AOI	Visual checks and monitoring of laboratory activities Monitoring of noise level at site.	Quarterly	SSWMB during O&M Phase
7.	Fumes and gases including landfill gas	Monitoring of CO, CO2, CH4, H2S, SOx, NOx, HC and PM2.5 PM10 and compliance with stringent environmental quality standards Vehicular emissions as per stringent environmental quality standards.	Project site AOI	Visual checks and monitoring of laboratory activities Onsite monitoring of ambient air quality will be preferred	Quarterly	SSWMB during O&M Phase
8.	Ecological Resources	Disturbance to natural habitat and fauna, uncontrolled floral cutting which can be avoidable.	Project site AOI	Visual checks to ensure that only marked trees within landfill boundary are cut. Monitoring of	Quarterly	SSWMB during O&M Phase

				Wildlife / birds hunting. Inventory of existing trees, cut trees, and planted trees.		
9.	Community around the project areas	Use of common resources. Hindrance to mobility. CHS	Project site AOI	Community Consultation	Quarterly	SSWMB during O&M Phase
10.	Waste Management	Inspection of waste and spoil disposal in accordance with Waste Management Plan	Project site AOI	Visual Observations, Monitoring and Audits	Quarterly	SSWMB during O&M Phase
11.	Labor Management and Working Conditions	As per the LMP of SWEEP which include but not limited to OHS, hygiene facilities, appropriate camps area, etc	Landfill site	Visual Observations, Incident/accident register Monitoring and Audits	Quarterly	SSWMB during O&M Phase
12.	Traffic Safety and Management	As per the TMP which include but not limited to the observation of traffic congestion at bottleneck areas, provision of signs and signal, vehicular inspection, driving safety protocols, etc.	Project site AOI	Visual Observations, Vehicle Logbooks, Monitoring and Audits	Quarterly	SSWMB during O&M Phase
13.	Social aspects including GBV and other Grievances	Social and cultural conflicts, SEA/SH complaints, grievances related to livelihood impacts, child abuse, etc	Project site AOI	Visual Observations and consultations, Grievance Redress/Social Complaint Register, Monitoring and Audits	Quarterly	SSWMB during O&M Phase
14.	OHS; CHS; accidents and incidents	As per O&CHS sub-plan which include but not limited to the inspection of working areas, work	Project site AOI	Visual Observations and consultations, Grievance Redress/Social	Quarterly	SSWMB during O&M Phase

		permits, provision and availability of mandatory PPEs, Community complaints on H&S		Complaint Register, Incident/accident register, Monitoring and Audits		
15.	Chemical Storage and Handling	Safety Data Sheets, Leakage and spills, Segregated handling and storage of chemicals, availability of fire extinguishers,	Landfill site	Visual Observations, Chemical Storage inventory, Incident/accident register, Monitoring and Audits	Quarterly	SSWMB during O&M Phase

9.8 Training & Capacity Building

To strengthen the capabilities of both the Proponent and the Contractor, comprehensive training will be provided regarding the environmental and social aspects of the proposed project, implementation of mitigation measures, and the protocols and reporting mechanisms for monitoring.

In-house training will be conducted for the project staff, including the contractor, consultant, and the supervision staff of the Proponent. This training will consist of a one-day basic training and a one-day advanced training, focusing on the environmental and social considerations of development projects in general, as well as the specific implementation requirements and responsibilities of the PIU of SWEEP and the contractor staff in executing the environmental and social management and monitoring plan. The training protocols will encompass the following areas:

- Methods for monitoring air quality parameters and implementing measures to prevent or minimize air pollution, specifically from sources like haul trucks.
- Procedures for monitoring water quality parameters and implementing measures to prevent or minimize water pollution, particularly from wastewater effluent generated by workshops, machinery washing yards, and the use of harmful chemicals.
- Safe practices for waste management and disposal.
- Ensuring noise levels from construction machinery and equipment are within acceptable limits.
- General guidelines for maintaining cleanliness and good housekeeping.
- Addressing communicable diseases and implementing measures to prevent their spread.
- Safety measures to protect the workforce and local communities from hazards associated with construction activities.
- Enforcing the use of safety equipment by the workforce.
- Other environmental and social topics necessary for the effective implementation of the ESMP.

A training plan along with the required trainer, trainee, schedule, and content for the project staff at site during the construction phase of the proposed subj-project is given below:

Table 9.3: Training Plan for Project Staff During Construction stage

S. No	Training Activity	Participants	Trainer	Mode of Training	Content	Scheduling
1.	Site Orientation and Induction	CC and CSC	PIU SWEEP	Presentation / Lecture	Awareness about Site, working protocols	Once for each individual
2.	ESMP and Environment Code of Practices	CC	CSC and PIU SWEEP	Presentation	Awareness and applicability of ESMP and environmental code of practices	Monthly
3.	Emergency Response and Use of Fire Extinguishers	CC	CSC and PIU SWEEP	Presentation	Potential natural and other hazard/emergencies and dealing with emergency and fire to minimize damage	Quarterly
4.	Livelihood Related Issues and Grievance Redress	CC	CSC and PIU SWEEP	Presentation	Awareness on ESS-5 (Involuntary Resettlement)	Quarterly
5.	Labor Management Procedures	CC	CSC and PIU SWEEP	Presentation	Awareness on ESS-2 (Labor and Working Conditions)	Quarterly
6.	Gender Aspects including GBV/SEA/SH/VAC	CC	CSC and PIU SWEEP	Presentation	Awareness on GBV, gender equality, gender related issues and their redress; awareness regarding GAP	Quarterly
7.	Stakeholder Engagement	CC	CSC and PIU SWEEP	Presentation	Interaction with the PAPs and Other Interested Parties, Awareness on ESS-10 (Stakeholder Engagement)	Quarterly

8.	Awareness workshop regarding COVID 19, and other vector borne diseases	CC	CSC and PIU SWEEP	Presentation	Risk, Prevention, and available treatment	Bi-annual
9.	First Aid and Cardiopulmonary resuscitation (CPR)	CC	CSC and PIU SWEEP	Presentation	Onsite first aid procedures	Bi-annual
10.	Compliance of SEPA NOC (Environmental Approval) and WB ESS	CC	CSC and PIU SWEEP	Presentation	Awareness on SEPA NOC, rules, guidelines, regulation, and standards for satisfactory compliance	Bi- annual
11.	Community Involvement for Ecological Sustainability	CC and Community	KMC, Park and Horticulture Department, Forest Department, Agriculture Department, SC, and PIU SWEEP	Seminar and Workshop	Awareness on Plantation of beneficiary trees, protection of flora and fauna, ecological sustainability	Annual

A comprehensive training manual will be developed and implemented by the Contractor with prior consent of the SC.

9.9 Communication & Documentation

Communication and documentation are essential features of the ESMP, where the key features are:

9.9.1 Data Recording & Maintenance

Standardized formats will be used for documenting information during environmental and social monitoring, ensuring consistency and compatibility with the designated database. To streamline data entry, check boxes will be incorporated wherever applicable. Additionally, a tracking system will be established for each form to facilitate efficient management and organization of collected data.

9.9.2 Database

The database may include the following information:

- Training Programs.
- Staff Deployment
- Non-Compliances
- Corrective Actions
- List of Environmental & Social Data o Soil and land pollution
  - Disposal of waste
  - Water resources
  - Fuel oil and chemical spills
  - Vegetation record o Leachate collection & treatment records
  - Noise pollution
  - Air and dust pollution
  - Socio-economic data
  - Ecological sensitives

9.9.3 Meetings & Reporting

During the construction phase, the SC will convene monthly site meetings to address regular activities, non-compliance issues, and their corresponding corrective actions. Periodic reports, as outlined in the table below, will be generated, specifying the responsible individuals for report preparation and review. Furthermore, meeting minutes will be included in routine environmental and social reports to ensure comprehensive documentation.

Table 9.4: - Periodic Reporting Mechanism

S. No	Report Category	Prepared by	Submitted by	Reviewed by
1.	Monthly	Contractors' environmental and social staff	PIU SWEEP	PIU SWEEP / CSC
2.	Quarterly	Contractors' environmental and social staff	PIU SWEEP	PIU SWEEP / CSC and SEPA (as per the requirement define in NOC)
3.	Quarterly Environmental and Social Monitoring Report	CSC	PIU SWEEP	PIU SWEEP / CSC / WB
4.	Semi-Annual External Environmental and Social	Third Party Monitoring and	PIU SWEEP	PIU SWEEP / CSC / WB

	Monitoring Report (SAEESMR)	Evaluation Consultant		
5.	Annual Report	Contractors' environmental and social staff	PIU SWEEP	PIU SWEEP / CSC
6.	Completion Report	Contractors' environmental and social staff	PIU SWEEP	PIU SWEEP / CSC

9.9.4 Photographic Records

Contractors will be required to maintain photographic documentation throughout the implementation of the project. This photographic record should encompass essential elements such as site photographs, road infrastructure, camp sites, monitoring activities, and more.

9.9.5 Non-Compliance of the ESMP

The successful implementation of the proposed ESMP relies on the collaboration of various stakeholders. The Contractor holds primary responsibility for ensuring the execution of the mitigation measures outlined in the ESMP, which will be included in the contractual agreements. The environmental mitigation costs will be factored into the overall project budget, and the Contractor will receive payment based on monthly compliance reports. However, failure to comply with the ESMP implementation and timely submission of compliance reports may result in deductions from the Contractor's payments allocated for environmental and social components. The compliance status of the ESMP will also be periodically submitted to SEPA for review, as mandated by their environmental approval requirements. Non-compliance may lead to the withdrawal of the environmental approval.

9.9.6 Review of Recorded Data

The CSC and PIU SWEEP will periodically review and examine all the data and communications documented and maintained by the Contractor. Based on their assessment, appropriate actions and recommendations will be provided to the Contractor to enhance the quality of recording and documentation practices.

9.10 Contractor's Obligation & Management

The Contractor will bear primary responsibility for ensuring the effective implementation of the proposed mitigation measures outlined in the ESIA, including the Environmental and Social Management Plan (ESMP). The necessary details of the ESMP will be included in the bidding document and subsequently incorporated into the contract documents of the Contractor. The costs associated with environmental and social mitigation will be included in the overall project budget, and payments to the Contractor will be based on monthly compliance reports, actual work completed on-site, and resource allocation. Additionally, the Contractor will be accountable for developing and executing a site-specific ESMP, also known as the Contractor-ESMP, in accordance with the guidelines specified in the ESIA. Prior approval from the CSC and Project Implementation Unit for Solid Waste Emergency Efficiency Project (PIU SWEEP) will be required for the Contractor's ESMP and all associated sub-plans. Furthermore, the Contractor will ensure the presence of an Environmental and Social (E&S) staff on-site from the project's commencement, and the proposed organizational structure will be subject to dual approval from the SC and PIU SWEEP.

9.11 ESMP Cost

The Environmental and Social Management Plan (ESMP) cost will be included as an integral part of the contract document with the Contractor. It should be noted that the environmental cost will not be treated as a separate entity, as its various components will be accounted for within the bidding document under different expense categories. For example, the cost of tree plantation will be accounted for under the landscaping budget. The annual estimated cost for environmental monitoring, covering both the construction and operational phases of the proposed project, is detailed in Table 9.7. This table includes the sampling parameters, frequency, and associated costs. The total estimated cost for environmental and social management, monitoring, and auditing throughout the pre-construction, construction, and operation and maintenance phases amounts to approximately **PKR 193.3 million**. It is important to note that the annual cost will be regularly updated for future years as per the project requirements. The budget excludes any cost of livelihood restoration, which has been provided in detail in the separate Livelihood Restoration Plan prepared.

Table 9.5: ESMP Cost

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
A	**PRE- CONSTRUCTION PHASE (at Start of project)**						
A-1	**Environmental Monitoring Cost**						
1	Water Resources/ Water Quality	Discrete grab sampling and laboratory testing of drinking water samples by SEPA approved Laboratory for monitoring as per stringent environmental quality standards.	Once	40,000	4 (same points against which monitoring was carried out)	160,000	One-time monitoring will be carried out before the mobilization of Contractor.
2	Groundwater	Discrete grab sampling of groundwater samples by SEPA approved laboratory for monitoring as per stringent environmental quality standards.	Once	40,000	6 (groundwater wells established)	240,000	
3	Leachate	Discrete grab sampling of groundwater samples by SEPA approved laboratory for monitoring as per stringent environmental quality standards.	Once	40,000	2 (same points against which monitoring was carried out)	80,000	
4	Noise Levels	dBA Leq. as per stringent environmental quality standards	Once	5,000	8 (same points against which monitoring was carried out)	40,000	
5	Ambient Air Monitoring	Monitoring of CO, CO_2, CH4, H2S, SOx, NO_x, HC and $PM_{2.5}$ PM_{10} by SEPA approved Laboratory as per stringent environmental quality standards	Once	80,000	8 (same points against which monitoring was carried out)	640,000	

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
6	Soil	Sampling done to understand whether there is any contamination on land prior to starting work.	Once	60,000	4 (points on the sanitary cell area)	240,000	
	Sub-Total (A-1)					**1,400,000**	
A-2	**Tree Plantation Cost**						
1	Tree Plantation Cost	667 trees of Commiphora wightii will have to be moved along with estimated plantation of 5,554 trees in buffer area	Details provided in tree plantation plan			35,341,700	
Sub-Total (A-2)						35,341,700	
Sub-Total A ((A-1) +(A-2))						**36,741,700**	
B	**CONSTRUCTION PHASE**						
B-1	**Environmental Monitoring Cost**						
1	Water Resources/ Water Quality	Discrete grab sampling and laboratory testing of drinking water samples by SEPA approved Laboratory for monitoring as per stringent environmental quality standards.	Monthly	40,000	4 (same points against which monitoring was carried out)	(40,000 per test*4 tests*12 months in 1 year * 2 years) = 3,840,000 PKR	Quarterly monitoring cost for the two-years construction period and will be updated each year based on latest rates during construction timeline of the proposed project.
2	Groundwater	Discrete grab sampling of groundwater samples by SEPA approved laboratory for monitoring as per stringent environmental quality standards.	Monthly	40,000	6 (groundwater wells established)	(40,000 per test*6 tests*12 months in 1 year * 2 years) = 5,760,000 PKR	
3	Noise Levels	dBA Leq. as per stringent environmental quality standards	Monthly	5,000	8 (same points against which monitoring was carried out)	5,000 per test*8 tests*12 months in 1 year * 2 years) =	

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
						960,000 PKR	
4	Ambient Air Monitoring	Monitoring of CO, CO_2, CH4, H2S, SOx, NO_x, HC and $PM_{2.5}$ PM_{10} by SEPA approved Laboratory as per stringent environmental quality standards	Monthly	80,000	8 (same points against which monitoring was carried out)	80,000 per test*8 tests*12 months in 1 year * 2 years) = 15,360,000 PKR	
Sub-Total (B-1)						**25,920,000 PKR**	
B-2	**Environmental and Social Management Cost**						
1	Environment, Social, Medical and OHS specialist of contractor	E&S Personnel will monitor / conduct all environment, social and OHS related activities e.g., TBTs, PPEs, housekeeping, safety signage, emergency preparedness, etc.	Monthly	870,000		20,880,000	This is the tentative monthly cost for two-year period for Team Leader – 300,000 1 Env Officer – 150,000 1 Social Officer – 150,000 1 Medical Officer – 120,000 1 OHS Specialist – 150,000 Monthly
2	OHS and CHS Management	OHS related activities e.g., TBTs, PPEs, housekeeping, safety signage, emergency preparedness, etc.	Lump sum			4,000,000	Cost for PPEs, extinguishers, emergency lights, housekeeping equipment, safety signage and barricade, emergency preparedness kit, first aid kit, etc.
3	Ecological and Biodiversity Monitoring and Management	Monitoring of disturbance of habitats through encroachment, noise, and other construction activities.	Quarterly	150,000		1,200,000	This is the tentative quarterly cost for two-year period for one senior expert along with their monthly logistics.

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
4	Solid and liquid Waste Management	Collection, segregation, transportation, disposal, and management of domestic, commercial, construction wastes (solid and liquid)	Lump Sum			1,000,000	Cost for Collection, segregation, transportation, disposal, and management of domestic, commercial, construction wastes (solid and liquid)
5	Training Cost	Literature preparation, printed material such as posters and pamphlets trainer(s), and venue, etc.	Monthly	300,000 per month		7,200,000	This is the tentative cost for two-year period for one trainer along with logistics at site.
6	Third Party Environmental Consultant	Auditor's checklists and proformas	Quarterly	500,000 per quarter		4,000,000	This is the tentative cost for two-year period for at least two auditors (E&S specialist) along with logistics, travels, charges.
7	Communicable Diseases	Tests should be performed by approved laboratory	Biannually	2,000,000		8,000,000	This is the tentative cost for two-year period for medical tests of kitchen staff at each camp site.
8	Environment, Social and OHS specialists of supervision consultant	E&S Personnel will monitor / supervise all environment, social and OHS related activities	Monthly	1,200,000		28,800,000	This is the tentative monthly cost for two-year period for one E&S Team leader, one environment specialist, one social specialist, one OHS specialist and 02 juniors along with their monthly logistics.
9	E&S Staff specialist of PIU	E&S Personnel will supervise all environment, social and OHS related activities	Monthly	1,200,000		28,800,000	This is the tentative monthly cost for two-year period for E&S staff along with their monthly logistics.
Sub-Total (B-2)						**103,880,000**	

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
Sub-Total B ((B-1) +(B-2))						**129,800,000**	Tentative for two years of construction. The cost will be updated based on the current market prices during construction phase.
C	**OPERATION AND MAINTENANCE PHASE (One Year Cost)**						
C-1	**Environmental Monitoring Cost**						
1	Water Resources/ Water Quality	Discrete grab sampling and laboratory testing of drinking water samples by SEPA approved Laboratory for monitoring as per stringent environmental quality standards.	Quarterly	40,000	4 (same points against which monitoring was carried out)	(40,000 PKR per test * 4 tests * 4 quarters) = 640,000 PKR	Biannually monitoring cost for the one-year O&M Phase and will be reproduced for next years of O&M based on updated rates.
2	Groundwater	Discrete grab sampling of groundwater samples by SEPA approved laboratory for monitoring as per stringent environmental quality standards.	Quarterly	40,000	6 (groundwater wells established)	(40,000 PKR per test * 6 tests * 4 quarters) = 960,000 PKR	
3	Leachate	Discrete grab sampling of groundwater samples by SEPA approved laboratory for monitoring as per stringent environmental quality standards.	Quarterly	40,000	2 (same points against which monitoring was carried out)	(40,000 PKR per test * 2 tests * 4 quarters) = 320,000 PKR	
4	Noise Levels	dBA Leq. as per stringent environmental quality standards	Quarterly	5,000	8 (same points against which monitoring was carried out)	(5,000 PKR per test * 8 tests * 4 quarters) = 160,000 PKR	

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
5	Ambient Air Monitoring	Monitoring of CO, CO_2, CH4, H2S, SOx, NO_x, HC and $PM_{2.5}$ PM_{10} by SEPA approved Laboratory as per stringent environmental quality standards	Quarterly	80,000	8 (same points against which monitoring was carried out)	(80,000 PKR per test * 8 tests * 4 quarters) = 2,560,000 PKR	
6	Soil	Sampling done to understand whether there is any contamination on land prior to starting work.	Quarterly	60,000	4 (points on the sanitary cell area)	(60,000 PKR per test * 4 tests * 4 quarters) = 960,000 PKR	
Sub-Total (C-1)						**5,600,000 PKR**	
C-2	**Environmental and Social Management Cost**						
1	E&S Activities	PMU / SSWMB	Monthly	300,000		3,600,000	This is the tentative monthly cost for one-year period for one E&S staff along with his site visit cost and logistics arrangements.
	Sub-Total (C-2)					**3,600,000**	
	Sub-Total C ((C-1) +(C-2))					**9,200,000**	Tentative for one (01) year project O&M phase. The cost will be reproduced for next years of O&M Phase and updated based on the current market prices during O&M phase.
	Grand Total (A+B+C)					**175,741,700**	
	Contingency Charges		10% of Grand Total			**17,574,170**	
	Grand Total with Contingencies					**193,315,870**	**~ 193.3 million PKR**



November 2023

Volume II – Annexes

Environmental & Social Impact Assessment (ESIA) - Construction of New Sanitary Landfill Cell at Jam Chakro (Package 02)



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ANNEX I - Feasibility Report



FEASIBILITY STUDY

Jam Chakro Landfill Site (Package - 2)

Solid Waste Emergency & Efficiency Project

SWEEP
Solid Waste Emergency and Efficiency Project

THE WORLD BANK

RECORD OF DOCUMENTATION

Project Title	Consultancy Services for Conducting the Feasibility Study, Preliminary Design, Detailed Design and Preparation of Bidding Documents, and Construction Supervision for the Construction of a New Landfill Cell and Six Transfer Stations in Karachi
Project No	RFP No: PK-PIU SSWMB-235479-CS-QCBS
Document Name	Feasibility Study: Jam Chakro Landfill (Package 2)
Document No.	TUMAS/WB/06/2023
Contract Date	10th August 2023
Focal Person from PIU	
Focal Person from the Consultant	

PREPARATION, REVIEW, AND AUTHORISATION

Revision #	Date	Prepared by	Reviewed by	Authorized by
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LIST OF ACRONYMS AND GLOSSARY OF TERMS

BOD	Biological Oxygen Demand
Cantt	Cantonment
Click	Competitive liveable city of Karachi
COD	Chemical Oxygen Demand
COP26	26th Conference of Parties
CPWs	Critical pathways
Db	Decibel
DMC	District Municipal Corporation
EIA	Environmental Impact Assessment
EIU	Economic Intelligence Unit
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMP	Global Methane Pledge
GoS	Government of Sindh
GTS	Garbage Transfer Station
HWM	Hazardous waste management
IEE	Initial Environmental Examination
INDC	Intended Nationally Determined Contributions
ISWM	Integrated Solid Waste Management
JICA	Japan International Cooperation Agency
KSDDP	Karachi Strategic Development Plan
MBT	Mechanical Biological Treatment
MRF	Material Recovery Facility
MSW	Municipal solid waste
Mt CO_2	Metric Tons of Carbon Dioxide
NAP	National Action Plan
NDC	Nationally Determined Contribution
NEP	National Environmental Policy
NEQs	National Environmental Quality Standards
NUA	New Urban Agenda
Pak EPA	Pakistan Environmental Protection Agency
PEPA	Pakistan Environmental Protection Agency
pH	Power of hydrogen
PIU	Project Implementation Unit
RCV	Refuse Collection Vehicle
SCP	Sustainable Consumption and Production
SDGs	Sustainable Development Goals

SEQs	Sindh Environmental Quality Standards
SEPA	Sindh Environmental Protection Agency
SITE	Sindh Industrial Trading Estate
SLF	Sanitary Landfill
SLGA	Sindh Local Government Act
SSWMB	Sindh Solid Waste Management Board
SWEEP	Solid Waste Emergency and Efficiency Project
TDS	Total Dissolved Solids
TMC	Town Municipal Corporation
TUMAS	Turkish Engineering Consulting and Contracting Company
UN	United Nations
UNCCC	United Nations Climate Change Conference
UNDP	United Nation Development Program
USD	United State dollar

EXECUTIVE SUMMARY

(To be included in the Final version of the report once the draft has been reviewed).

1. INTRODUCTION

1.1. Project Background

According to Economist Intelligence Unit (EIU) liveability index 2022 the metropolitan city of Karachi, the largest city in Pakistan, has been ranked the 5th least liveable city in the world (ranked at 168 amongst 173 cities) based on a weighted assessment of various indicators such as culture and environment, health and education provision, liveability, safety and infrastructure provision. Karachi is witnessing rapid and unplanned urban expansion (urban sprawl), inadequate public transport and significant environmental pollution, due to rapid urbanization driven by significant population growth.

The current estimated population of Karachi is 17.236 million (see **Figure 1**). The annual population growth rate is estimated to be approximately 2.3% in 2023.

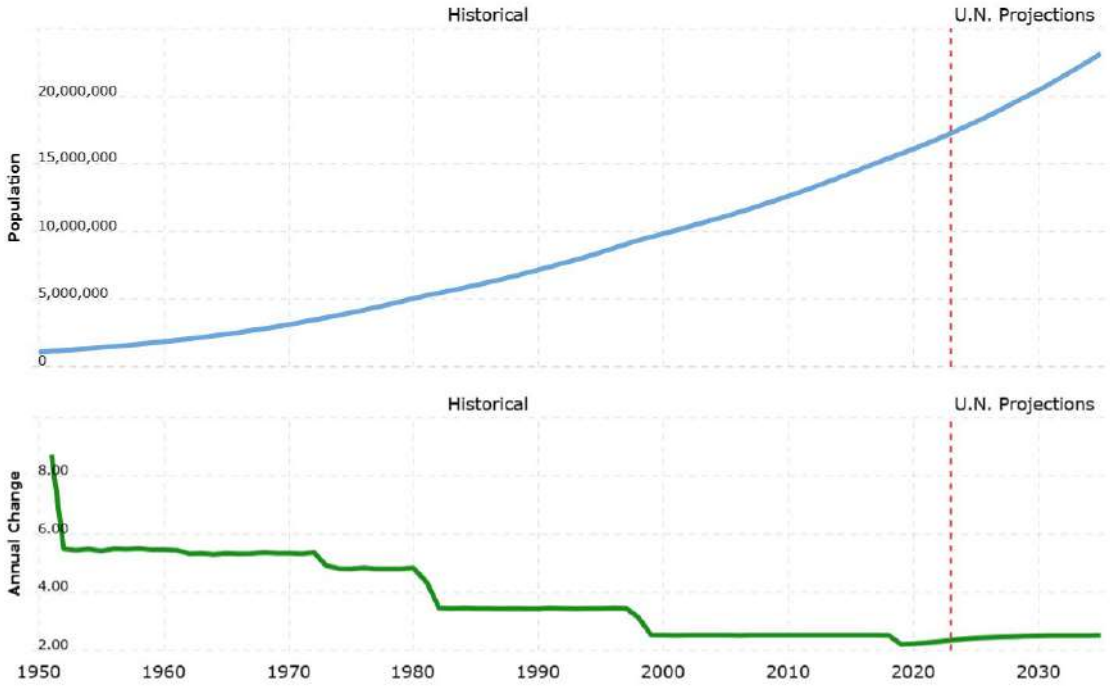


Figure 1: Historical and Projected Population of Karachi Metropolitan Area[1]

The population of the city has more than trebled in the last forty (40) years, creating significant pressures on civic facilities and essential infrastructure, the results of which are manifest in crises in, *inter alia*, drinking water supply and in the management of municipal solid waste (MSW). Continuing rapid urbanization has aggravated the existing challenges.

Karachi is estimated to generate in excess of 10,000 tons/day of solid waste, of which approximately 7,300 tons/day of mixed municipal solid waste (MSW) is collected and delivered to two disposal sites at Jam Chakro and Gondpass. Both sites are open dumps with no engineering controls to prevent the by-

[1] Source: 'https://www.macrotrends.net/cities/22044/karachi/population'>Karachi, Pakistan Metro Area Population 1950-2023. United Nations Department of Economic and Social Affairs, Population Division World Population Prospects

products of waste degradation from polluting the surrounding environment. Both sites are also located in the outer parts of the metropolitan area which are witnessing rapid urban sprawl.

The inexorable rise in the city's population and associated MSW to be managed is placing a significant strain on the city's ability to maintain, let alone improve and enhance, basic municipal services.

The Sindh Solid Waste Management Board (SSWMB) is responsible for solid waste management (SWM) in the city. In the last few years, the SSWMB has attempted to improve the management of MSW by outsourcing the collection of MSW to international companies under a series of put-and-pay (that is, unit rate) contracts at the district level. The outsourced services include:

i) Collection and transportation of the waste to garbage transfer stations (GTSs);
ii) Manual and mechanical sweeping of the streets and roads; and
iii) Mechanical washing of the roads.

Notwithstanding recent improvements, significant issues still remain to be addressed; the Karachi Strategic Development Plan (KSDP 2021) highlighted infrastructure gaps related to waste transfer stations, material recovery facilities and secure waste disposal (sanitary landfills).

The KSDP 2021 proposed to establish:

a) Six (6) strategically located regional GTSs;
b) Material Recovery Facility (MRF) at all six GTSs for the recovery of recyclable materials from the MSW;
c) Three (3) major regional sanitary landfill (SLF) facilities, and
d) A comprehensive hazardous waste management (HWM) system to provide for the proper management of the city's hazardous wastes from industrial, medical, and other sources.

For material recovery it was proposed to start the establishment of MRF facilities with a pilot MRF constructed at one of the six GTSs first and, thereafter, replicate MRFs at other GTSs depending upon the success of the pilot facility. It was also proposed to set up a pilot project for composting of the organic fraction of MSW and the production of 'fertilizer' which would improve the viability of the GTS.

The World Bank is assisting the Government of Sindh (GoS) with essential institutional strengthening and infrastructure investments via two distinct projects:

i) Competitive and Livable City of Karachi (CLICK); and
ii) the Solid Waste Emergency and Efficiency Project (SWEEP) for Karachi.

CLICK supports upstream policy and regulatory framework work improvements, institutional capacity strengthening of the SSWMB, development of sector strategies, and public awareness.

The SWEEP project is aligned with the direction of the KSDP 2021. Building on the inputs from CLICK, SWEEP will begin the incremental upgrading of infrastructure for collection, transfer, final disposal, and treatment of MSW required to improve SWM in Karachi.

The urgency of implementing and initiating these improvements is highlighted by the widespread flooding and public health crisis arising from the 2019 monsoon and subsequent deterioration of SWM services, and other health or economic shocks during the the COVID-19 pandemic. The CLICK and

SWEEP projects will work in tandem for institutional strengthening and infrastructure improvement in Karachi.

1.2. Project Coverage and Beneficiaries

1.2.1. Project Scope

A joint venture of the Turkish Engineering Consulting and Contracting Company - TÜMAŞ (Turkey) and TEKNIK TEMPO International Engineering Company (Turkey) has been engaged by the Project Implementation Unit (PIU), SWEEP, Local Government Department Government of Sindh for the provision of the consulting services under project "Consultancy Services for Conducting the Feasibility Study, Preliminary Design, Detailed Design, and Preparation of Bidding Documents and Construction Supervision for the Construction of a New Landfill Cell and Six Transfer Stations in Karachi." TÜMAŞ is the lead partner in the joint venture. The contract was signed on 10th August 2022.

The locations of the six GTS and the SLF at Jam Chakro are shown on **Figure 2**.

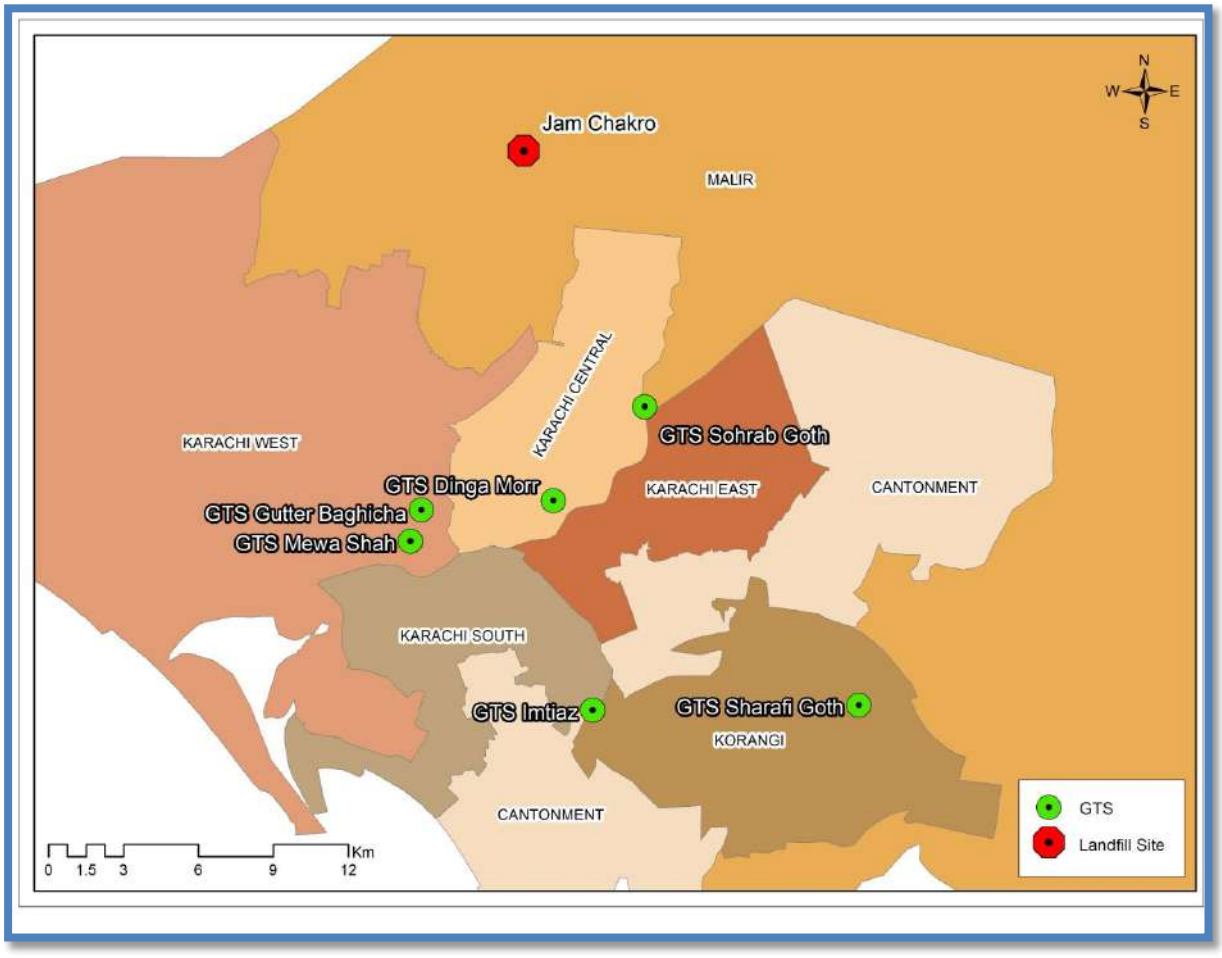


Figure 2: Location of the SWM Facilities to be Developed Under the Project

The facilities are to be designed, tendered and developed in a series of packages, the subdivision of which is as follows:

Package 1:

- Dinga Morr GTS;
- Gutter Baghicha GTS;
- Imtiaz GTS; and
- Sharafi Goth GTS.

Package 2:

- Jam Chakro SLF.

Package 3:

- Mewa Shah GTS; and
- Sohrab Goth GTS.

1.2.2. Administrative Organization

The Karachi metropolitan area is spread over 3,527 square kilometres[2]. Karachi is counted as a Division of Sindh province and is divided administratively into seven (7) Districts after the enactment of the Sindh Local Government Act (SLGA), 2021, These Districts, overseen by District Municipal Corporations (DMCs), are Karachi East, Karachi West, Karachi Central, Karachi South, Malir, Korangi and Keamari.

As per the SLGA 2021 Karachi was sub-divided into twenty-six (26) towns and two hundred and thirty-three (233) Union Committees (UCs). However, as per the websites of the individual Districts Karachi currently comprises twenty-five (25) towns and two hundred and forty-six (246) UCs (**Table 1**). The District Municipal Corporations (DMC) are now designated Town Municipal Corporations (TMCs).

Table 1: Administrative Division of Karachi into Districts, Towns and Union Committees

District	No. of towns	No. of UCs
District Central	5	45
District Korangi	4	37
District Malir	3	30
District West	3	33
District South	2	26
District East	5	43
District Keamari	3	32
Total	25	246

Furthermore, there are six (6) cantonment boards in the City[3]:

- Karachi Cantt. (A);
- Clifton Cantt. (B);
- Faisal Cantt. (D);
- Malir Cantt. (E);
- Manora Cantt. (F); and
- Korangi Creek Cantt (C).

[2] Mahboob, M. A., Atif, I., & Iqbal, J. (2015). Remote sensing and GIS applications for urban sprawl assessment in Karachi, Pakistan. Science, Technology and Development, 34(3), 179–188.

[3] Refer to Figure 3 for the location of the cantonment board, as designated by the letter in brackets after the name of the cantonment board

Figure 3 illustrates the administrative boundaries of the DMCs and cantonment boards.

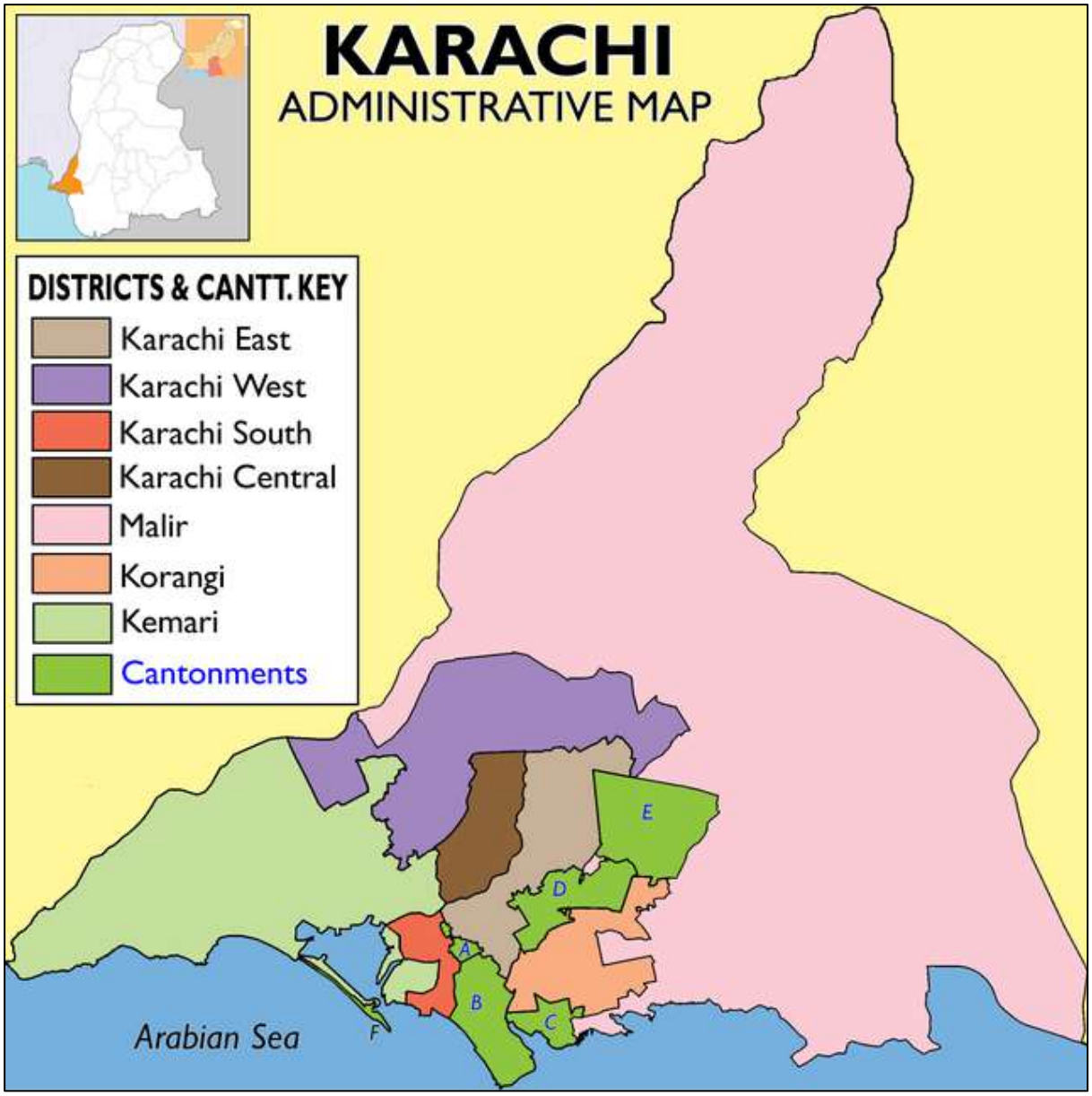


Figure 3: Administrative Map of Metropolitan Karachi, 2022[4]

The authorities responsible for managing the municipal services in such a large metropolitan area face significant challenges in delivering and maintaining public services. One of the major limitations in service delivery is the city's limited or obsolete infrastructure and the lack of sufficient financing to address the gaps in municipal infrastructure.

[4] https://urckarachi.org/2020/12/15/karachi-all-districts-map/

1.2.3. Served Population and Catchment Areas

According to the 2017 census report[5], the city's population was stated to be 16 million (Statistics, 2017), which is now projected to be around 18.3 million[6], considering the annual inter-censual population growth rates of the individual districts declared in the census report given in **Table 2**. The data below reflects the district populations before the creation of the Kemari District. It is noted that this population estimate is approximately 6% higher than the United Nations estimate illustrated on **Figure 1** since the inter-censal growth rates at District level are higher than assumed in the United Nations World Population Prospects.

Table 2: Population of Karachi City by District

District	Census and Projected Population			Annual Population Growth[2] %	Average Household Size	Number of Households
	Year 1998	Year 2017[2]	Year 2022[3]			
East	1,447,529	2,875,315	3,405,085	3.44%	5.64	603,739
West[1]	2,127,765	3,907,065	4,604,611	3.34%	6.13	751,160
South	1,468,579	1,769,230	1,857,638	0.98%	5.43	342,106
Central	2,289,071	2,971,382	3,186,856	1.41%	5.48	581,543
Malir	914,765	1,924,346	2,315,486	3.77%	5.87	394,461
Korangi	1,608,609	2,577,556	2,941,964	2.68%	5.80	507,235
Total	9,856,318	16,024,894	18,311,641			3,180,244
Average				2.60%	5.73	

Note 1: District West comprises Orangi, Baldia, Keamari and SITE town (Keamari was later declared as a separate District under the Sindh Local Government Act, 2021)
Note 2: Census Report 2017, Pakistan Bureau of Statistics
Note 3: Population projection by the Consultant based on the 1998-2017 inter-censal growth rate for each District.

Of the six transfer stations covered under this consulting assignment, five (5) GTSs are currently operational (Imtiaz, Sharafi Goth, Gutter Baghicha, Mewa Shah and Dinga Morr, Figure 2), while Sohrab Goth is non-operational. The GTS at Gutter Baghicha and Mewa Shah currently send MSW to Gondpass dump site, whilst the remaining three GTS send waste to Jam Chakro dump site.

The geographical locations of each operational GTS and their catchment areas are shown in the Figure 4. Further details of the waste transfer system are presented in **Section 3.**

[5] Census Report 2017, Pakistan Bureau of Statistics
[6] Projection by Consultant based on inter-censal growth rates 1998-2017

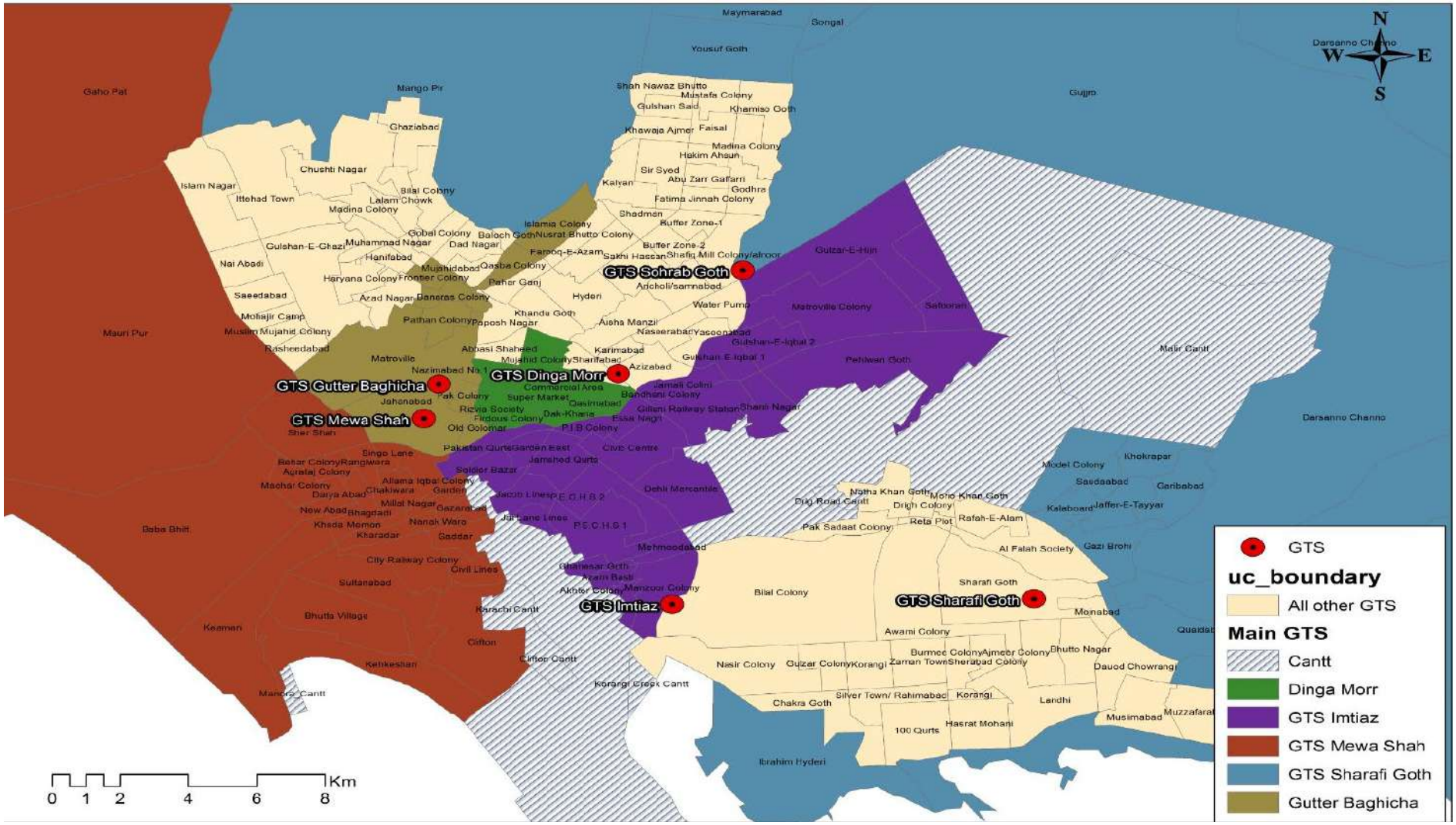


Figure 4: Catchment Areas of Operational GTSs

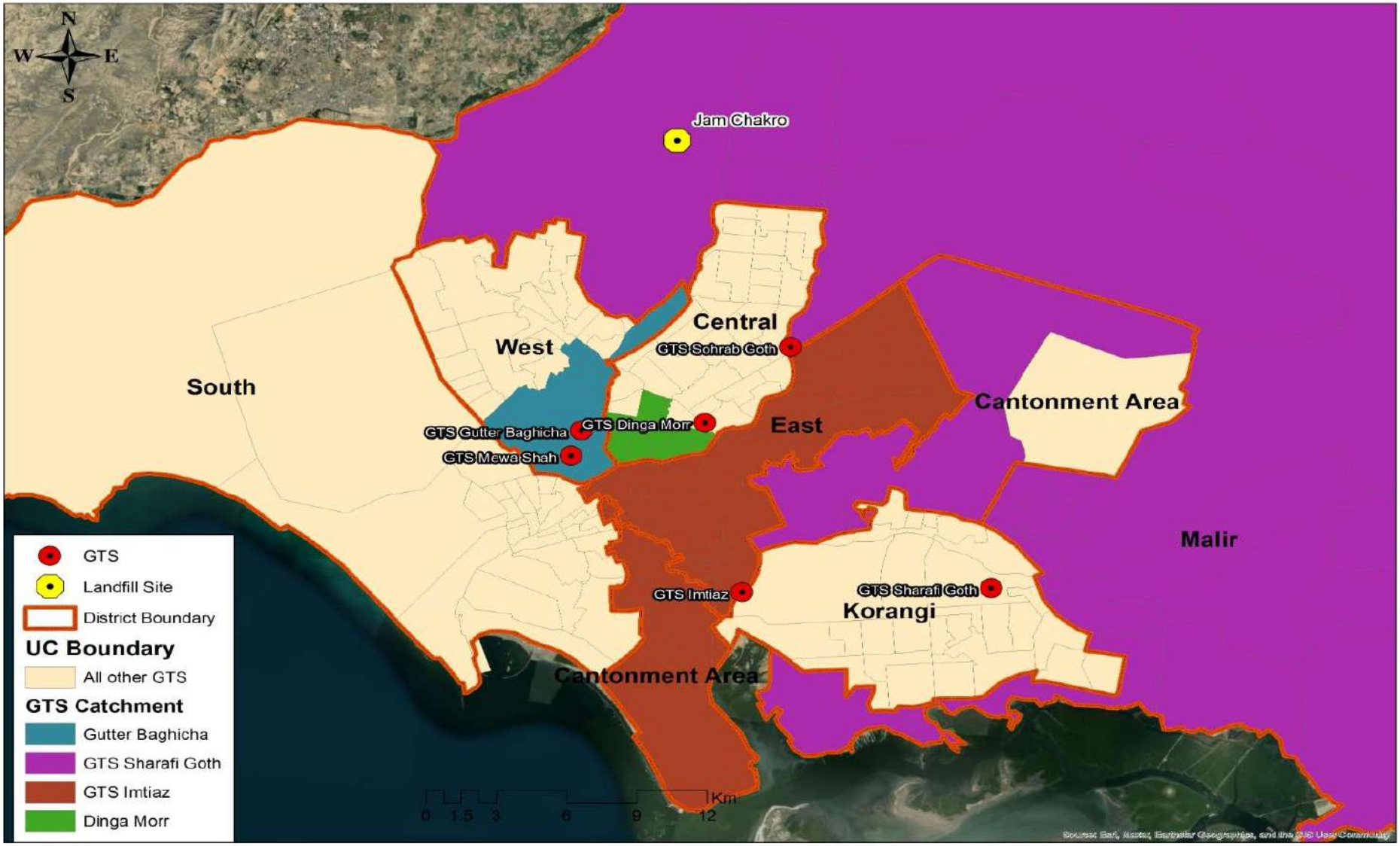


Figure 5: District Boundaries and Catchment Areas of GTSs under Package - 1

1.2.4. Waste Generation

Waste amount and characterization surveys were managed and conducted by SSWMB in six (6) Districts in 2021[7][8]. These surveys addressed, primarily, waste generation and waste composition at household level. The results of the surveys are summarized on **Table 3.**

Table 3: Assessed and Estimated Waste Generation by District

District	Per capita waste generation rates				
	Domestic (A) (kg/cap/day)	Commercial (B) % of A	Bulk (C) % of A	Total A+B+C	Waste Generation (tons/day)[3]
East	0.449[2]	10%	5%	0.52	1,758
West[1]	0.449[2]	10%	30%	0.63	2,894
South	0.449[2]	15%	15%	0.58	1,084
Central	0.450	15%	15%	0.59	1,864
Malir	0.449[2]	10%	30%	0.63	1,456
Korangi	0.447	10%	20%	0.58	1,710
Average	0.449	12%	19%	0.59	
Total					10,766

Note 1: District West comprises Orangi, Baldia, Keamari and SITE town (Keamari was later declared as a separate District under the Sindh Local Government Act, 2021).

Note 2: Waste generation not measured in these Districts. The value quoted is the average per capita waste generation rate based on measurements from District Central and District Korangi.

Note 3: Derived waste generation (tons/day) based on the estimated population of each District for 2022 (Table 2).

Waste generation rates were assessed only for District Central and District Korangi with the assessed average per capita waste generation rate ranging from 0.447 kg/capita/day (District Korangi) to 0.450 kg/capita/day (District Central) and with an overall average of 0.449 kg/capita/day. These averages, however, mask wider variations in generation rates between income groups, with the recorded averages ranging from 0.368 kg/capita/day (low income area, District Central) to 0.495 kg/capita/day (middle income area, District Korangi).

Other sources of waste which contribute to the municipal solid waste stream were not measured but were assumed based on a review of studies from other cities in Pakistan and from other developing countries.

Based on per capita household waste generation rates for District Central and District Korangi, and inclusive of assumed values for commercial waste and bulk waste, the derived waste generation rate for Karachi is estimated to be approximately 0.59 kg/cap/day (Table 3). This equates to a quantity of waste generated of approximately 10,766 tons per day of solid waste in 2022.

[7] Waste Amount Characterization Survey in Malir, South, East & West Districts of Karachi. Final Report, July 2021, Project Procurement International. Report shared by the PIU, SWEEP.

[8] Waste Amount Characterization Survey in Central District and Korangi District of Karachi. Final Report, July 2021, Project Procurement International. Report shared by the PIU, SWEEP.

1.2.5. Waste Management Service Delivery in Karachi

The Sindh Solid Waste Management Board, established in 2014 under the Sindh Solid Waste Management Act, is responsible for collecting and disposing of waste throughout Sindh, including municipal and industrial waste and medical waste. In time, the Board is expected to progressively take charge of SWM functions from the DMCs and other bodies. Until then, DMCs (TMCs) handle solid waste in their respective areas.

According to revenue analysis report[9], the collection efficiency of the SWWMB is reported as 81%. All of the collected waste is dumped at Jam Chakro or Gondpass dump sites. Based on an analysis of the recent data[10] of the weighing station at Gondpass and Jam Chakro, the collection efficiency is estimated to be lower, at approximately 72%. According to the recent datasets provided by PIU from June 2021 until August 2022, 7,235 tons/day of MSW is delivered to both dumping sites, of which Jam Chakro dump site receives, on average, around 4,840 tons/day (67% of daily collection) (see Figure 6).

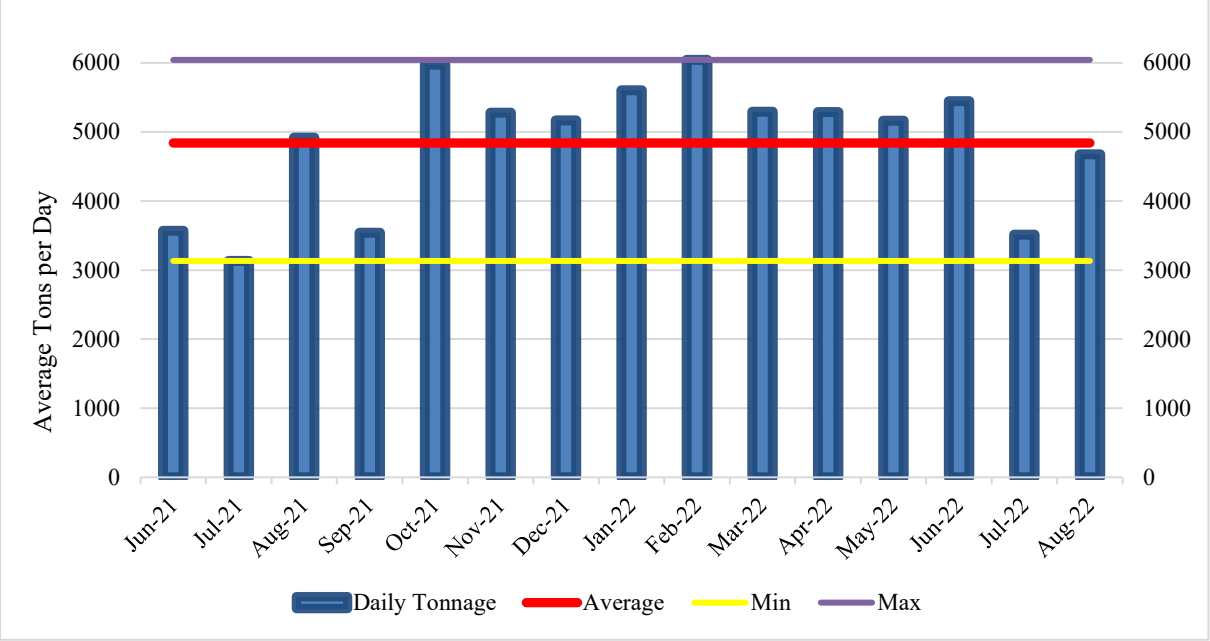


Figure 6: Waste Tonnage Delivered to Jam Chakro Dump Site from June 2021 to August 2022

According to the revenue analysis[11], it is reported that 1,329 tons/day of recyclables are being recovered by the waste pickers; this represents approximately 12.34% of the total estimated waste generated in the city.

To improve the SWM services delivery, SSWMB has outsourced garbage collection systems to international companies under a series of put and pay unit rate) contracts at district level. So far, SSWMB has outsourced the front-end collection to Chinese companies in four (4) TMCs, as listed in **Table 4**. The outsourced services include i) collection and transportation of the waste to garbage transfer

[9] Revenue Analysis of Solid Waste Management in Karachi and Validation of Input data for the design of Solid Waste Management for Karachi, Sindh Solid Waste Management Board, July 2021

[10] Data Provided by the PIU

[11] Revenue Analysis of Solid Waste Management in Karachi and Validation of Input data for the design of Solid Waste Management for Karachi, Sindh Solid Waste Management Board, July 2021

stations (GTSs), ii) manual and mechanical sweeping of the streets and roads, and iii) mechanical washing of the roads. This outsourcing has helped SSWMB in inducting the infrastructure required for storage (i.e., containers, communal bins, litter bins, etc.), primary collection, transportation to the GTSs, and streets and road sweeping and washing.

Table 4: Front End Collection and Responsible Entities

District Name	Name of Service Provider
Central	Sindh Solid Waste Management Board/TMC
Korangi	Sindh Solid Waste Management Board/TMC
Malir	M/S Hangzhou Jinjiang Group of Sanitation Services Co. Ltd
West	M/S Hangzhou Jinjiang Group of Sanitation Services Co. Ltd
South	M/S Changyi Kangjie Sanitation Engineering Co. Ltd
East	M/S Changyi Kangjie Sanitation Engineering Co. Ltd

Source: Sindh Solid Waste Management Website.

1.3. Scope and Objectives of the Feasibility Study

This Feasibility Study covers only the development of the sanitary landfill at Jam Chakro under Package 2.

This Feasibility Study is based on the findings of the following:

- Site assessments and investigations;
- Waste generation and composition analyses;
- Environmental and social assessments conducted by EMC under a separate contract with PIU-SWEEP; and
- Options for landfill design discussed with the PIU based on engineering analysis and recommendation from the Consultant.

The objectives of the Feasibility Study are to:

- Explore the technical suitability of the pre-identified site based on the investigations and surveys of the site;
- Project future waste quantities to be disposed to establish the required design capacity of the site along with components sizing of the facilities.
- Explore design options for the design of the sanitary landfill;
- Recommend the option and approach considered most suitable for landfill development.
- Prepare budgetary cost estimates for landfill development; and
- Determine the economic/environmental merit of the recommended option through economic and financial appraisal.

1.4. Organisation of Report

This Report is organized into a further Seven (7) sections, the contents of which are as follows:

Section 2, which provides an overview of the regulatory framework pertaining to solid waste management (SWM) in Pakistan and to which project development must adhere/comply.

Section 3 presents an overview of the physical, environmental, and social setting of the Jam Chakro site, together with an assessment of the suitability of the site to serve as a sanitary landfill. Key issues to be considered for site development are also highlighted.

Section 4 discusses the options considered for managing MSW in Karachi, including a comparative assessment of different methods of treatment prior to final disposal;

Section 5 provides a brief discussion for the main options considered for the design and operation of the landfill. The Section also examines the principal design criteria and provides an overview of the key components of the proposed landfill design, based on an assessment of the available area, existing site conditions and the characteristics of the waste streams to be managed;

Section 6 presents an assessment of potential institutional arrangements under which the landfill may be developed and operated; and

Section 7 provides an assessment of the economic viability of the proposed investments required for both construction and operation of the sanitary landfill.

2. REGULATORY FRAMEWORK

2.1. Introduction

The enactment of comprehensive legislation on the environment, covering multiple areas of concern, is an on-going phenomenon in Pakistan. The basic policy and legislative framework for the protection of the environment and overall biodiversity in the country is now in place. The detailed rules, regulations and guidelines required for the implementation of the policies and enforcement of legislation are also in place.

2.2. Overview of the Policies Related to Solid Waste Management

2.2.1. Overview of the National/Provincial Development Plan

There are three major development policies at national and provincial level. Though none of them deals with solid waste management (SWM) as a separate issue from sanitation/environment, all of them briefly touch on the issue. Thus, it can be concluded that improvement of SWM is in line with the national and provincial governments' policy.

National Vision 2025

Based upon its seven pillars, the Vision 2025 states that the government will focus on seven key areas including:

- Developing social and human capital;
- Achieving sustained, indigenous and inclusive growth;
- Governance, institutional reforms and modernization of the public sector;
- Energy, water and food security;
- Private sector-led growth;
- Developing a competitive knowledge economy; and
- Modernizing transportation infrastructure and greater regional connectivity.

These seven pillars of Vision 2025 are fully aligned with the Sustainable Development Goals (SDGs), providing a comprehensive long-term strategy for achieving inclusive growth and sustainable development. SWM is not dealt with directly in Vision 2025; however, due to linkage with the SDGs, the importance of improved and sustainable SWM is evident. As discussed below, there are around seven (7) SGDs goals out of seventeen (17) which are directly and/or indirectly linked with the management of the solid waste and associated services delivery.

National Vision 2030

This policy document provides the vision of the Pakistan Government for the year 2030 in the world's context. Its main objectives are as below:

- To realise industrialised, prosperous, just and developed Pakistan through sustainable development in a resource-constrained economy by knowledge inputs; and
- To join the league of upper middle income countries with a Gross Domestic Product (GDP) of around USD 4,000 by 2030.

It deals with SWM in the context of strategies for refuse recovery and electricity generation. In addition, it aims at strengthening urban management and municipal services in universities, including solid waste management.

SDGs and National Action Plan

SWM is an essential service for the sustainable development of societies in both developing and developed countries. The related indicators for the 2030 agenda and their forerunners have been driving SWM reform for decades, particularly regarding public health, environment, conservation of natural resources, and, more recently, accounting for greenhouse gas (GHG) emissions and the effects of climate change. SWM affects living conditions, public health, sanitation, terrestrial and marine ecosystems, and exploitation/damage to natural resources.

From a social, environmental, and economic perspective, SWM plays a key role in achieving at least 7 of the 17 SDGs, i.e., SDG 3 (good health and well-being), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), SDG 13 (climate action), and SDG 14 (life below water). **Table 5** provides an overview of the specific SDG targets that an improved SWM system can help to achieve.

Table 5: Specific Targets of the Sustainable Development Goals Related to SWM[12]

Sustainable Development Goals	Specific Targets
SDG 3: Good health and well-being	3.2 End preventable deaths of children under 5 years of age 3.3 End malaria, combat water-borne and communicable diseases 3.9 Reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination
SDG 6: Clean water and sanitation	6.3 Improve water quality by reducing pollution, eliminating dumping, and minimizing the release of hazardous chemicals and materials, substantially increasing recycling and safe reuse
SDG 7: Affordable and clean energy	7.2 Increase renewable energy share in the global energy mix
SDG 11: Sustainable cities and communities	11.1 Ensure access for all to adequate, safe, and affordable basic services, upgrade slums 11.6 Reduce environmental impacts of cities, particularly municipal and other waste management
SDG 12: Responsible consumption and production	12.1 Sustainable consumption and production national action plans or targets incorporated into national policies 12.2 Sustainable management and efficient use of natural resources 12.3 Halve per capita global food waste at the retail and consumer levels and reduce food loss during production, supply chains, and post-harvest steps 12.4 Environmentally sound management of chemicals and waste to minimize their adverse impacts on human health and the environment 12.5 Promotion of 3Rs to substantially reduce waste generation
SDG 13: Climate action	13.2 Integrate climate change measures into policy and planning 13.3 Build knowledge and capacity to meet climate change
SDG 14: Life below water	14.1 Prevent marine pollution, particularly from land-based activities

[12] Rodić, L. and Wilson, D.C., 2017. Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries. Sustainability, 9(3), p.404.

Pakistan is a signatory to the SDGs (Agenda 2030) and was one of the first countries to ratify all the SDC goals and 196 targets. Improved SWM systems can address multiple SDGs, both directly and indirectly. Effective household SWM practices related to SDGs 11, 12, and 14 can help protect the environment to a great extent, especially at the municipal and local levels. On an even larger scale, a developed municipal SWM system could help to diversify the global energy mix by adding cleaner energy systems (SDG Target 7.2) and adopting integrated solid waste management (ISWM) systems, such as energy recovery through anaerobic digestion (biogas production).

The National Action Plan provides a comprehensive and holistic long-term vision, aligned with Vision 2025, and other national policies notified from time to time. Keeping in view the National Framework for the SDGs, Critical Pathways (CPWs) II and V are directly linked for the provision of the improved sanitation services, integrated solid waste management planning with a focus on substantially reducing waste generation through prevention, reduction, recycling and reuse, and reducing the per capita environmental impact of cities.

Furthermore, Objectives 2 and 3 of the National Action Plan (NAP) on SCP for sustainable buildings and cities strongly emphasized the following goals:

i) Review of the legal framework on SWM including rules and by-laws;

ii) Efficient institutional set-up;

iii) ISWM planning at the provincial level;

iv) Improved national awareness on waste management;

v) Capacity development of the service providers through training for better management of the waste;

vi) Centralized treatment of healthcare waste;

vii) Improved mechanism for the enforcement of applicable regulations;

viii) Standard designs for collection, transfer and safe disposal of waste for major rural and urban areas of Pakistan;

ix) Development of monitoring mechanisms for the SWM service delivery to ensure transparency;

x) Identification of the regional dumpsites and their gradual conversion to the engineered/sanitary landfills; and

xi) Plans for waste to energy interventions for the longer terms.

2.2.2. SWM-Specific National Policies and Guidelines

Five national policies are directly or indirectly related to SWM services which are briefly presented in **Table 6**. The SWM Guidelines of 2005 (Draft) are often referred to as a guiding document for SWM planning across Pakistan. However, there are no SWM-specific policies at the national or provincial level.

Table 6: National SWM-Specific Policies

Policy	Brief Description
National Environmental Policy (2005)[13]	The National Environmental Policy (NEP) was adopted in 2005 by the Federal Government driven from the National Environment Action Plan (approved in 2001) by Pakistan Environmental Protection Council. The NEP supplies an overarching framework for addressing Pakistan's environmental issues, particularly pollution of freshwater bodies and coastal waters, air pollution, lack of proper waste management, deforestation, biodiversity loss, desertification, natural disasters, and climate change. It also gives directions for addressing the cross-sector issues as well as the underlying causes of environmental degradation and meeting international obligations. *NEP addresses SWM under Section 3.3, Waste Management. The purpose is to prevent and reduce pollution caused by liquid and solid waste.*
National Sanitation Policy (2006)[14]	The National Sanitation Policy of Pakistan provides a broad framework and policy guidance to the Federal Government, Provincial Governments, federally administered territories, and the local governments to enhance and support sanitation coverage in the country through the formulation of their sanitation strategies, plans, and programs at all respective levels for improving the quality of life of the people of Pakistan and the physical environment necessary for a healthy life. *The Policy envisions creating an open defecation-free environment with safe disposal of liquid and solid waste and promoting health and hygiene practices in the country.*
National Drinking Water Policy (2009)[15]	The national drinking water policy was approved to improve the quality of life of the people of Pakistan by reducing the incidence of death and illness caused by waterborne diseases by ensuring the provision f an adequate quantity of safe drinking water to the entire population at an affordable cost and in an equitable, efficient, and sustainable manner. While the Policy does not address issues related to waste management, its policy guidelines can be applied to the provision of waste management services.
National Climate Change Policy (2012)	The national climate change policy was established in 2012 to ensure that climate change is mainstreamed in the country's economically and socially vulnerable sectors and to steer Pakistan toward climate-resilient development. The Policy addresses issues related to waste management in the context of climate change mitigation in the energy field.
National Hazardous Waste Management Policy 2022	A policy to help the implementation of international treaties and conventions at national level to improve Hazardous Waste Management (HWM) for better environmental management, clarify institutional responsibilities related to HWM, and strengthen the management of hazardous and other wastes.

[13] National Environmental Policy, 2005
[14] National Sanitation Policy, 2006
[15] National Drinking Water Policy

Pakistan Environmental Protection Agency has developed guidelines for Solid Waste Management in collaboration with JICA and UNDP.

The SWM guidelines of 2005 (draft) address the management of municipal solid waste and hazardous waste, i.e., hospital waste and the focus is on municipal waste. According to the Guideline, the overall aim of the SWM strategy for Pakistan is "to provide an effective, efficient, affordable, safe and sustainable SWM system for all the urban and rural settlements in Pakistan". The Guideline suggests different options on different operational levels, from generation and primary collection to disposal, including capacity building of the concerned departments.

Within the Guideline, a strategy for SWM in Pakistan is proposed (Part A, Chapter 7). The strategy is intended to provide a framework for an effective, efficient, affordable, safe and sustainable waste management for all urban and rural settlements. Seven strategic measures were proposed to achieve the strategic objective including:

i) improvement in waste collection and transportation infrastructure;
ii) improvement in waste disposal and introduction of intermediate treatment systems;
iii) reduction in waste generation rate and maximizing the recovery rates;
iv) introduction of separate collection and disposal of hazardous waste;
v) strengthening institutional framework and capacity building for better delivery of services
vi) attaining financial sustainability; and
vii) increased involvement of key stakeholders.

In addition, provinces have also developed guidelines for SWM. However, all these guidelines are still in draft and only followed informally for SWM-related project planning.

2.3. International Treaties and Agreements

2.3.1. New Urban Agenda

Solid waste-related targets under the transformative commitments made by UN-Habitat member states in the 2016 New Urban Agenda (NUA)[16], pledges to realize universal access to sustainable waste management systems, minimize landfills and convert waste into energy, the NUA commits to "environmentally sound management and minimization of all waste."

The NUA aims to integrate circular economy principles, sustainable waste management, and materials reuse into urban waste disposal and metabolic systems. Waste disposal to open spaces and even landfills cause GHG emissions, so finding sustainable ways of waste management such as energy generation (waste to energy options) are of particular importance. Cities should consider waste-to-energy technologies for disposal instead of open dumping which is often combined with open burning, currently practiced widely across the country or even at landfill sites.

2.3.2. Paris Agreement and Nationally Determined Contributions

As part of the international climate policy regime, national governments are obligated to submit their Intended Nationally Determined Contributions (INDC) to achieve stabilization of GHG in the atmosphere within a timeframe that adequately allows for adaptation to climate change. Thus, an NDC

[16] https://habitat3.org/the-new-urban-agenda/

indicates a country's contribution to achieving the universal target set in the Paris Agreement and the accompanying compliance mechanism at the country level.

Although waste is a low emission contributing sector (4.4%) in the overall emissions trajectory (489.89 Mt CO_2e for the year 2018) but with the unprecedented increase in the urbanization rate and forecasted GDP growth, the emissions are expected to grow exponentially in the future. Pakistan, one of the fastest urbanizing countries in Asia, foresees a logical increase in GHG contributions from the waste sector. Projected emissions for the waste sector for 2030 are estimated at 89 Mt CO_2e (5.6% of the total emission).[17]

2.3.3. Global Methane Pledge

The United States and the European Union launched the Global Methane Pledge (GMP) at the November 2021 United Nations Climate Change Conference (COP26). Thus far, 112 countries have joined the Pledge. They are collectively responsible for 50% of global anthropogenic methane emissions. The Pledge's main goal is to reduce global methane emissions by at least 30% by 2030 (vs. 2020 levels). According to the Pledge, this initiative has the potential to avert 0.22°C warming by 2050. Pakistan has also joined the Pledge and is committed to reduce the methane emissions to meet the Pledge's objectives.

2.4. Regulatory Framework and Enforcement Mechanism

So far there is not a single law at national level that is specific to SWM and covers in a comprehensive mannerly all aspects of SWM. This makes it difficult for government officials to understand their work and responsibilities. Another issue concerning laws and regulations is their inefficient implementation. The summary of the national and provincial regulatory framework related to environment/SWM is provided in the following section.

2.4.1. National Regulatory Framework

Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997 (the Act) is the basic legislative tool. The Act is applicable to a broad range of issues and extends to air, water, soil, marine and noise pollution, as well as the import and handling of hazardous waste. For the discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the National Environmental Quality Standards (NEQS) specified by the Pakistan Environmental Protection Agency (Pak EPA), penalties have been prescribed for those contravening the provisions of the Act. The powers of the Federal and Provincial Environmental Protection Agencies (EPAs), established under the Pakistan Environmental Protection Act 1997, have also been enhanced considerably under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental law, either of their own accord or upon the registration of a complaint.

The requirement for environmental assessment is laid out in Section12 (1) of the Act. The Section 12 (6) of the act states that this provision is applicable only to such categories of Projects as provided in Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000.

[17] Updated Nationally Determined Contributions, 2021 https://www4.unfccc.int/sites/ndcstaging/publisheddocuments/PAKISTAN%20FIRST/PAKISTAN%20UPDATED%20NDC%202021.PDF

Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000

The Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 (the Regulations) prepared by the Pakistan 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 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.

The Solid Waste Emergency and Efficiency Project is deemed to fall under Schedule-II. Therefore, the project proponent should conduct an EIA of the Project.

National Environmental Quality Standards (NEQS), 2000

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

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged 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; and
- Maximum allowable noise levels from vehicles.

These standards also apply to the gaseous emissions and liquid effluents generated by 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 yet been prescribed.

NEQS for Liquid Effluent

The National Environmental Quality Standards for discharge of effluent from industry are presented in **Table 7.**

NEQS for Gaseous Emission

The National Environmental Quality Standards (NEQS) for permissible limits of gaseous emission from industry are presented in **Table 8** .

NEQS for Vehicular Emission

The National Environmental Quality Standards (NEQS) for permissible limits of exhaust emissions from vehicles are presented in **Table 9.**

Table 7: NEQS for Liquid Effluent Discharges (mg/L)

Parameters	Existing Standards	Revised Standards		
		Into Inland Waters	Into Sewage Treatment	Into Sea
Temperature	40°C	=<3°C	=<3°C	=<3°C
pH Value	6-10	6-9	6-9	6-9
Biological Oxygen Demand $(BOD)_5$	80	80	250	80
Chemical Oxygen Demand (COC)	150	150	400	400
Total Suspended Solids (TSS)	150	200	400	200
Total Dissolved Solids (TDS)	3,500	3,500	3,500	3,500
Grease & Oil	10	10	10	10
Phenolic Compounds (as phenol)	0.1	0.1	0.3	0.3
Chlorides (as Cl')	1,000	1,000	1,000	SC
Fluoride (as F')	20	10	10	10
Cyanide (CN') total	2	1.0	1.0	1.0
An-ionic Detergents (as MBAs)	20	2.0	20	20
Sulphate (SO'')	600	600	1,000	SC
Sulphide (S')	1.0	1.0	1.0	1.0
Ammonia (NH^3)	40	40	40	40
Pesticides	0.15	0.15	0.15	0.15
Cadmium	0.1	0.1	0.1	0.1
Chromium (trivalent & hexavalent)	1.0	1.0	1.0	1.0
Copper	1.0	1.0	1.0	1.0
Lead	0.5	0.5	0.5	0.5
Mercury	0.01	0.01	0.01	0.01
Selenium	0.5	0.5	0.5	0.5
Nickel	1.0	1.0	1.0	1.0
Silver	1.0	1.0	1.0	1.0
Total Toxic Metals	2.0	2.0	2.0	2.0
Zinc	5.0	5.0	5.0	5.0
Arsenic	1.0	1.0	1.0	1.0
Barium	1.5	1.5	1.5	1.5
Iron	2.0	8.0	8.0	8.0
Manganese	1.5	1.5	1.5	1.5
Boron	6.0	6.0	6.0	6.0
Chlorine	1.0	1.0	1.0	1.0

Source: NEQS, Pakistan Environmental Protection Agency

Table 8: NEQS for Gaseous Emissions (mg/Nm^3)

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

Source: NEQS, Pakistan Environmental Protection Agency

Table 9: NEQS for Vehicular Emissions

Parameters	Standards (Maximum permissible limits)	Measuring Method
Smoke	40% or 2 on the Ringleman Scale During engine acceleration mode	To be compared with Ringleman chart at a distance of 6 meters or more
Carbon Monoxide	Emission Standards: New Vehicle = 4.5% Used Vehicle = 6%	Under idling conditions: non-dispersive infrared detection through gas analyzer.
Noise	85 db (A)	Sound meter at 7.5 meter from the source

Source: NEQS Pakistan Environmental Protection Agency

Sindh Environmental Quality Standards (Self-Monitoring and Reporting by Industry) Rules, 2014

The Sindh Environmental Protection Agency has promulgated rules that classify specific industries into one of three Schedules (A, B and C). with separate schedules for liquid and gaseous emissions. For those industries so classified the rules indicate priority parameters to be monitored and reported by industry using certified laboratories. Waste management sites, including waste disposal sites, are not notified under any of the Schedules.

National Hospital Waste Management Rules, 2005

Hospital waste in Pakistan is regulated by the Hospital Waste Management Rules, 2005. Sindh has not drafted and implemented any rules for the management of the healthcare waste.

2.4.2. Provincial Regulatory Framework

Local Government Act 2021

Under Article 32 of the Constitution of Pakistan, it is the state's responsibility "to encourage local government institutions composed of elected local representatives and to provide special representation for peasants, workers and women". The 18th Amendment to the Constitution, adopted in 2010, requires provinces to pass legislation establishing local government systems and devolve political, administrative, and financial responsibility and authority to the elected local representatives. The Sindh Local Government (Amendment) Bill, 2021 having been passed by the Provincial Assembly of Sindh on 5th July 2021 and assented to by the Governor of Sindh on 03rd August, 202. Under the Local Government Act 2021, the municipal services delivery is the responsibility of the local governments through Sindh Solid Waste Management Board.

Sindh Solid Waste Management Act 2021

The Sindh Solid Waste Management Act, 2021 was passed by the Provincial Assembly of Sindh on 11th December 2021 and assented by the Governor of Sindh on 17th December 2021 to provide for the collection and disposal of solid waste, arrange effective delivery of sanitation services and provide for pollution free environment and matters ancillary thereto, and for the purpose establish the Solid Waste Management Boards in the Province of Sindh.

Sindh Solid Waste Management Board Act 2014

The Sindh Solid Waste Management Board Act, 2014 having been passed by the Provincial Assembly of Sindh on 10th February 2014 and assented to by the Governor of Sindh on 7th March, 2014 to provide for the establishment of a Board called as the Sindh Solid Waste Management Board for the collection and disposal of solid and other waste in the Province of Sindh. The act lays down the functions and the powers of the SSWMB, its chairman and managing director. It also provides mechanism for the financing and accountability of the SSWMB.

Sindh Environmental Protection Act 2014

Post the adoption of the 18th Constitutional Amendment in 2011, the subject of environment was devolved, and the provinces have been empowered for environmental protection and conservation. Subsequently, the KP Government amended PEPA 1997 as Sindh Environmental Protection Act (SEPA) 2014 the Provincial Assembly of Sindh on 24th February 2014 and assented to by the Governor of Sindh on 19th March 2014.

The Act is applicable to a broad range of issues and extends to air, water, soil, marine and noise pollution, as well as the import and handling of hazardous waste. The discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration, or level more than the Sindh Environmental Quality Standards (Sindh-EQS)/NEQs or load permitted in the conditions of environment permit or environmental approval or license ("*No Objection Certificate*") (Section11), and penalties have been prescribed for those contravening the provisions of the Act (Section8). The powers of the Provincial Environmental Protection Agency (PEPAs), established under the Environmental Protection Act 2014, have also been considerably enhanced under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental law either of their own accord, or upon the registration of a complaint. Under the SEPA Act, 2014, Sindh Environmental Protection Council (Section 3) has been established under the chairmanship of Chief Minister. One of the responsibilities of the council is to "*liaise and co-ordinate with other Provinces and Federal Government, through appropriate inter-provincial forums, or Government Agency regarding formulation and implementation of standards and policies relating to environmental matters with an inter-provincial impact*". The council is further authorized by the Section 4(d) to "*provide guidelines for the protection and conservation of species, habitats and biodiversity in general, and for the conservation of, renewable and non-renewable resources, solid waste management and water sanitation".*

The Act is particularly relevant to solid waste management infrastructure development including, transfer stations, landfill sites and wate sorting facilities as included under SWEEP. The requirement for environmental assessment is laid out in Section12 (2) of the Act wherein it is desired to acquire "*No Objection Certificate*" pursuant to EIA/IEE for all SWM development projects from the Environment Protection Department of government of Sindh.

2.5. Environmental Guidelines

2.5.1. Environmental Protection Agency's Environmental Guidelines

The Pak EPA has prepared a set of guidelines for conducting environmental assessments. The package of regulations, of which the guidelines form a part, includes the PEPA 1997 and the NEQS. The guidelines themselves are listed below:

- Guidelines for the Preparation and Review of Environmental Reports;

- Guidelines for public consultation;
- Guidelines for Sensitive and Critical Areas; and
- Sectoral Guidelines.

It is stated in the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 that the EIA or IEE must be prepared, to the extent practicable, in accordance with the Pakistan Environmental Protection Agency guidelines.

2.5.2. World Bank Environmental Guidelines

The principal World Bank publications that contain environmental guidelines are as follows:

- Pollution Prevention and Abatement handbook 1998: Towards Cleaner Production, (WB/UNIDO/UNEP, 1999).
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral issues, (WB, 1991).

2.6. Site Selection Guidelines

Guidelines have bene published that prescribe criteria against which the location and suitability of a proposed site for a sanitary landfill should be assessed during a site identification and selection process. These guidelines include:

- US Environmental Protection Agency (EPA) guidelines for the solid waste disposal facilities (https://www.epa.gov/sites/default/files/2016-03/documents/landbig.pdf);
- World Bank Guidance for sanitary landfill design and siting criteria. (https://documents1.worldbank.org/curated/en/461871468139209227/pdf/337800rev0landfillsitingdesign.pdf); and
- National regulation/guidelines on waste disposal and landfill establishment.

Failure to comply with any specified criteria is, in itself, not fatal but is a significant consideration particularly in the identification and assessment of the suitability of greenfield sites.

2.7. Implications of Legislation for the Project

There is no legislation or regulation in Pakistan and Sindh that is specific to the provision of solid waste management services and, in particular, that govern the design, construction and operation of waste disposal facilities. There are, however, individual regulations and guidelines that impact the development of solid waste disposal facilities, the chief of these being:

- The necessity to implement an Environmental Management Plan effectively during construction and operation; and
- The necessity to ensure that, where applicable, discharges and emissions at any waste disposal site comply with the prescribed NEQS.

3. SITE DESCRIPTION

3.1. Introduction

The project team has prepared a Diagnostic Report of the landfill site under Package 2. The scope and objectives of this Diagnostic Report was as follows:

- To identify and compile any pre-existing information available for the Jam Chakro site;
- To summarize the findings of surveys conducted at the proposed site for the sanitary landfill in order to establish prevailing site conditions;
- To determine the suitability of the site to be developed as a sanitary landfill based on exclusionary and community criteria; and
- To identify any specific site constraints that need to be addressed in the subsequent engineering design of the sanitary landfill.

The Diagnostic Report is intended to provide an in-depth analysis of the suitability of the pre-identified site for the design and construction as a sanitary landfill. The Diagnostic Report covers the site's geographical setting, topography, geological, hydrogeological and hydrological conditions, environmental and social setting, and identifies any potential risks such as the probability of seismic and flood hazards. Such an assessment underpins the project's planning and design deliverables and identifies any significant constraints that must be overcome in the engineering design of each site. Where such constraints are deemed critical this may require re-consideration of the suitability of the site for its intended development.

The Diagnostic Report is reproduced in **Annexure A**. Key aspects of the report are summarized below.

3.2. Site Location and Area

The Jam Chakro site is located along the Surjani Town link road at 25˚2'24.78"N and 67˚1'42.54"E. Five hundred (500) acres has been allocated to SSWMB for use as a disposal site for MSW. Presently, the southern portion of the site has been utilized for waste disposal (open dump), whilst the northern part of the area is currently free of MSW and unutilized.

The land allocated for the sanitary landfill is illustrated on **Figure 7** and comprises the following areas:

- The northern half of the area coloured brown on **Figure 7**;
- The northern third of the area coloured yellow on **Figure 7**; and
- Access to the landfill site through the area coloured blue on **Figure 7** which is otherwise reserved for future Waste-to-Energy projects.

The total area allocated for the landfill is approximately 214 acres, excluding the corridor for the access road.

3.3. Existing Dump Site Operations

The southern part of the Jam Chakro site has been, and continues to be used, as an open dump for the disposal of MSW. The site receives waste from the GTS at Imtiaz, Sharafi Goth and Dinga Morr and also by direct delivery from the Central, East, Korangi, Malir and West Districts and, very rarely, from the South District. Two-thirds of the waste delivered to Jam Chakro in 2022 was from the Central and East Districts (Source: weighbridge records received from the PIU-SWEEP).

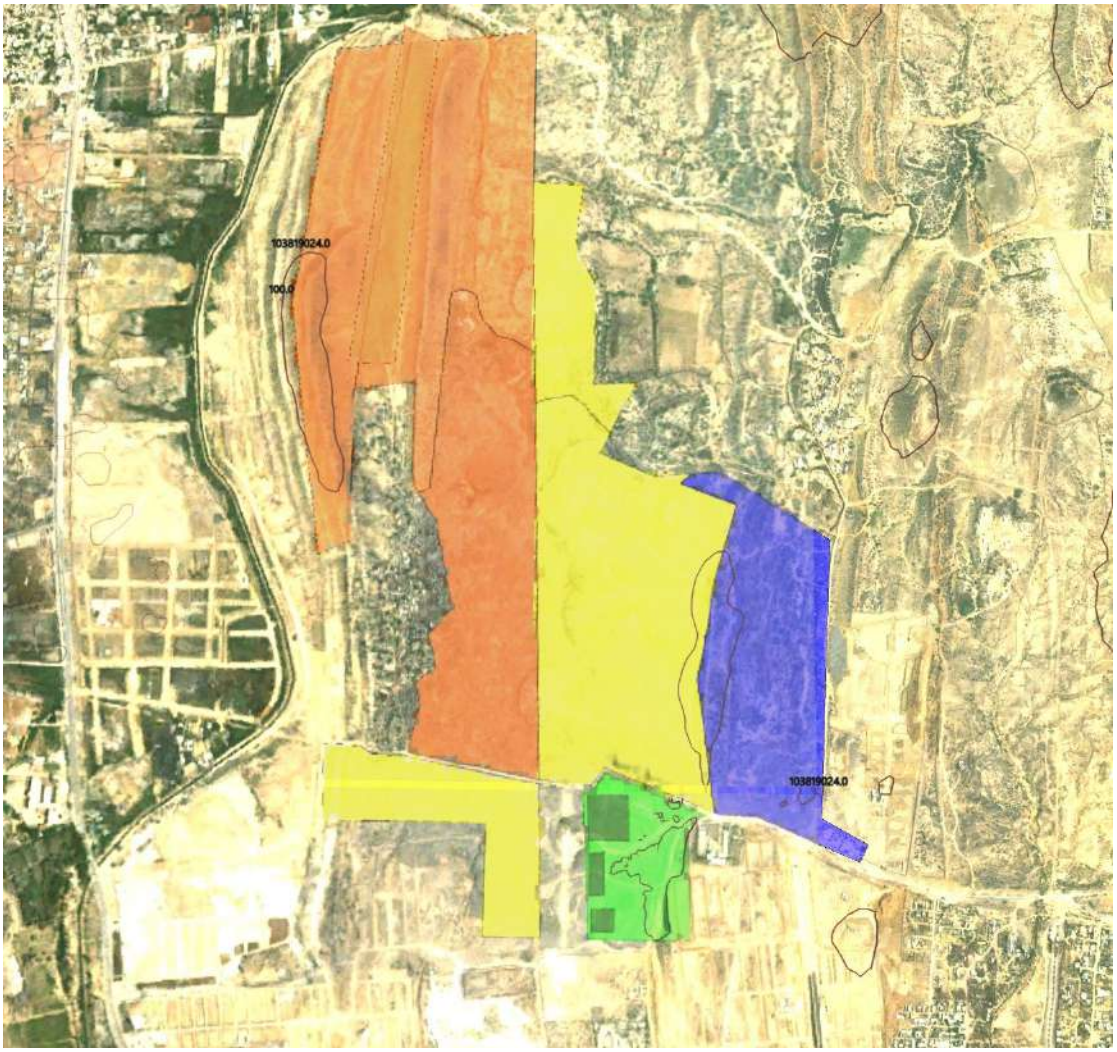


Figure 7: The Jam Chakro Site

Table 10 summarizes data on waste quantities from weighbridge records at Jam Chakro for 2022.

Table 10: Summary of Findings from Analysis of Weighbridge Records at Jam Chakro

Item	2022 Value
Total waste recorded as received in 2022	1,782,573 tons
Average quantity of waste received per month	148,548 tons
Average quantity of waste received per day	4,884 tons
Maximum quantity received in one month	217,845 tons (December 2022)
Minimum quantity received in one month	98,473 tons (July 2022)
Total number of waste delivery trips in 2022	73,440
Average number of waste delivery trips per month	6,120
Average number of waste delivery trips per day	201
Maximum number of waste delivery trips in one month	9,184 (December 2022)
Minimum number of waste delivery trips in one month	4,001 (July 2022)
Average waste load per delivery trip	24.27 tons
Peak hour of waste delivery trips	10.00-11.00 am
Minimum hour of waste delivery trips	05.00-06.00 am
Average number of trips in the peak hour	18

The quantity of waste received per month at Jam Chakro was relatively constant during the first two-thirds of 2022, varying between 100,000 tons and 150,000 tons per month; however, from September 2022 onwards, the quantity increased progressively to exceed 200,000 tons both in November and December 2022.

The site receives waste twenty-four (24) hours per day, with the majority of waste deliveries received between 7.00 am and 4.00 pm (**Figure 8**).

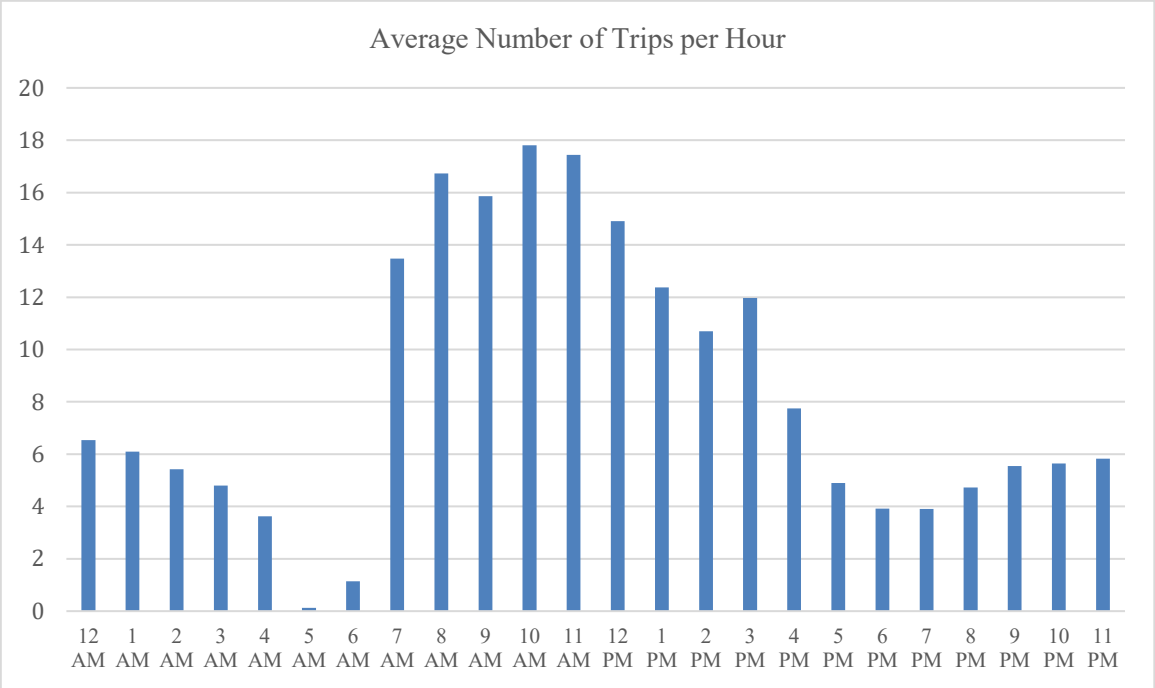


Figure 8: Average Number of Waste delivery Trips per Hour at Jam Chakro in 2022

The results of composition analyses of waste received from the GTS are summarized on **Figure 9** (Source: Waste Characterization Study, March 2023, Tumas). The data indicate that the majority of waste is organic in nature; organic and inert wastes comprise 65-75% of the total waste stream. Thin film plastics are the next largest component (at 14.22%) with only 1.48% to 2.98 % of the remaining waste being recyclables which potentially could be recovered. All the waste is received mixed and cross-contamination between different waste components is high.

There are four (4) dozers, four (4) loaders, one (1) tractor and one (1) water bowser at the dump site. None of this equipment was seen to be in active operation during visits to the site; all were parked adjacent to the site office. There is a single weighbridge of 100 ton capacity.

Twenty-seven (27) people are reported to work at the facility in three shifts. Waste is dumped in small heaps in areas specified by site staff. Haul roads to parts of the site that are not currently active are closed off by boulders. Waste is spread out but not compacted. No cover materials are applied. Waste is often set on fire to both reduce its volume and to make the recovery of certain recyclables easier (**Figure 10**). As a consequence ambient air quality on the dump site is very poor.

The informal sector collects recyclable items from the waste. A survey conducted by the ESIA Consultants indicate 1,065 waste pickers are operational at the site. The majority of these waste pickers reside adjacent to the dump site in Haji Ibrahim Goth, located immediately to the west of the existing dump site.

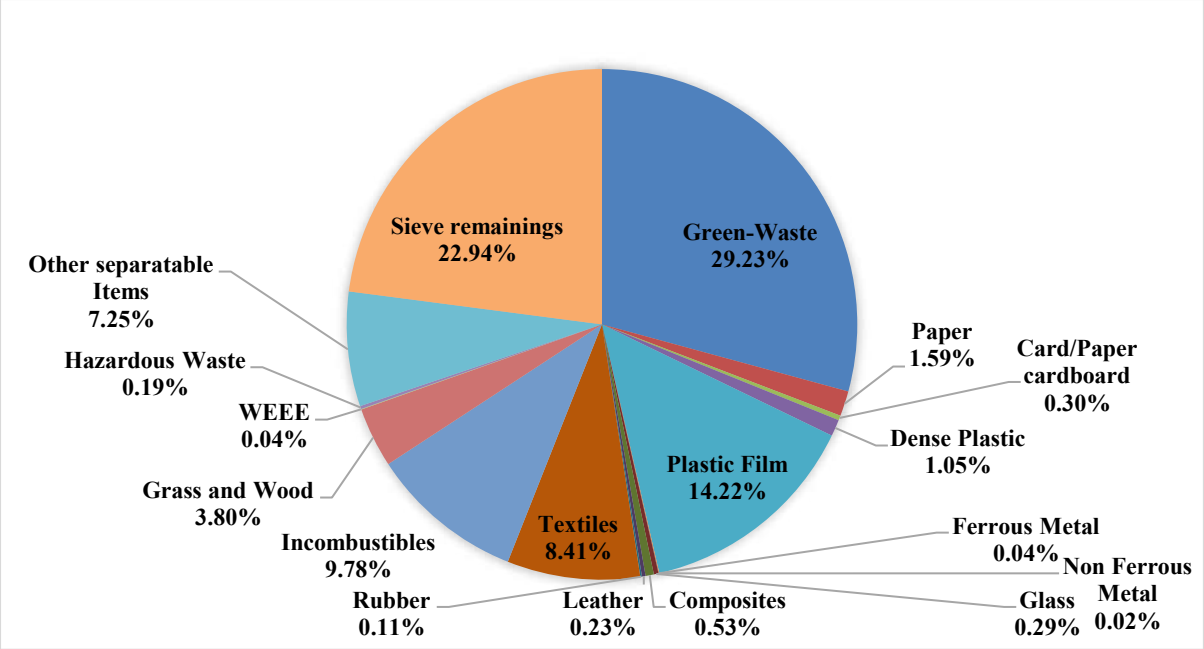


Figure 9: Weighted Average of Waste Composition Received at Jam Chakro



Figure 10: Waste Pickers and Scavenging Livestock at the Dump Site, Jam Chakro

3.4. Topography of the Sanitary Landfill Site

Within the site proposed for the sanitary landfill there are three discrete topographic terrains:

- A western valley bounded by steep-sided slopes both to the west and the east;
- An area of gently sloping topography in the eastern part of the site, bounded on the west side by a steep-sided ridge; and
- In the southern part an area of elevated topography which forms part of the existing dump site.

A Digital Elevation Model (DEM) of the proposed landfill site and surrounding area is reproduced in **Figure 11**, whilst typical profiles through the topography site of the sanitary landfill are reproduced in **Figure 12** – Section D-D' (West to East) and Section J-J' (South to North). The topographic survey plan for the site area is reproduced in **Annexure B**.

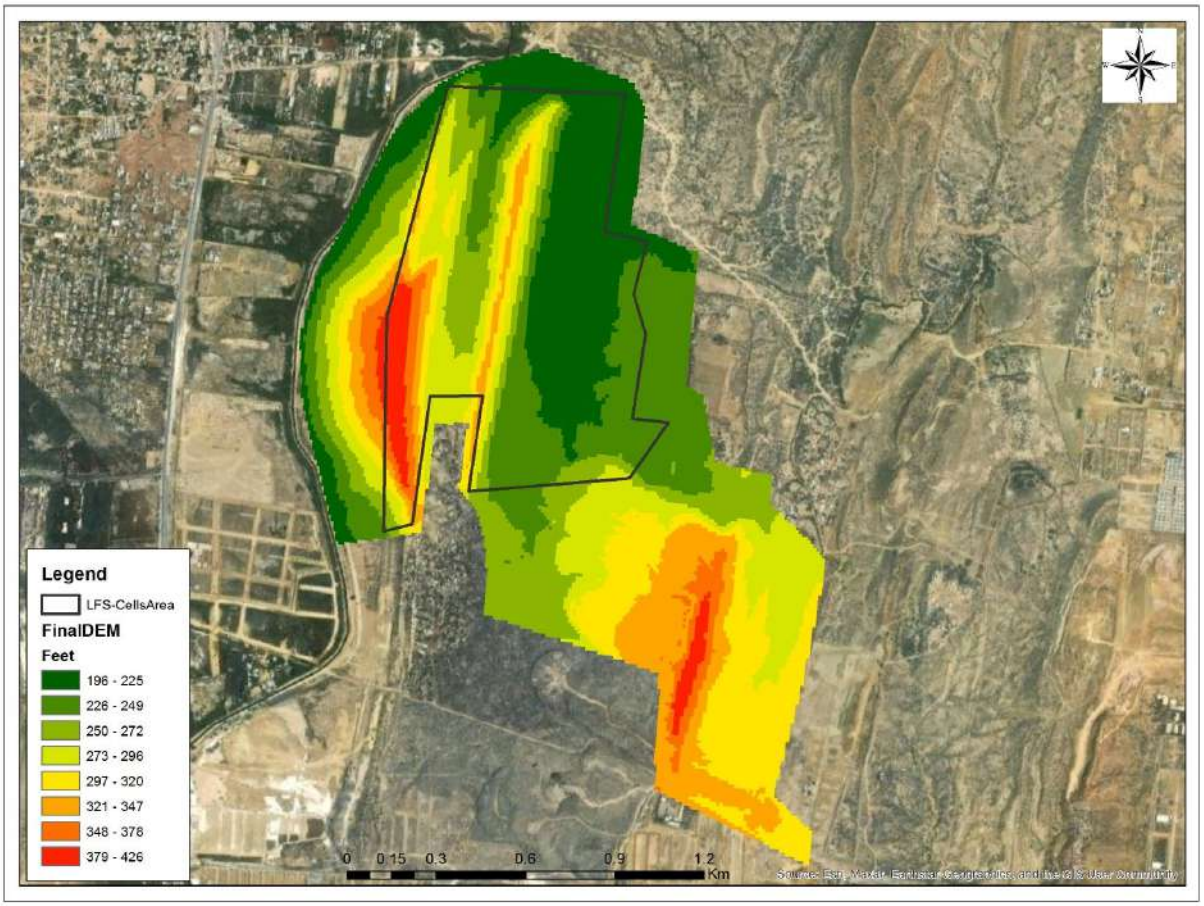


Figure 11: Digital Elevation Model of the Jam Chakro Site

The western valley slopes from south to north at approximately 1V:50H (2%). The valley floor slopes from an elevation of 275 feet (southern end) to approximately 220 feet (northern end) over a distance of 2,750 feet. The valley floor is widest in the south and narrows progressively in a northerly direction, decreasing from 800 feet to approximately 200 feet in width. It is flanked by side slopes that range typically from 1V:3H (33%) to 1V:5H (20%) and which reach a maximum height of 426 feet along the south-western margin of the valley, approximately 150 feet above the valley floor. The western ridge declines in elevation northwards to an elevation of approximately 300 feet. On the east side of the valley the ridgeline is lower at an elevation of approximately 330-340 feet. The top of the ridgeline is more or less at a uniform height and forms the western margin of the eastern part of the site.

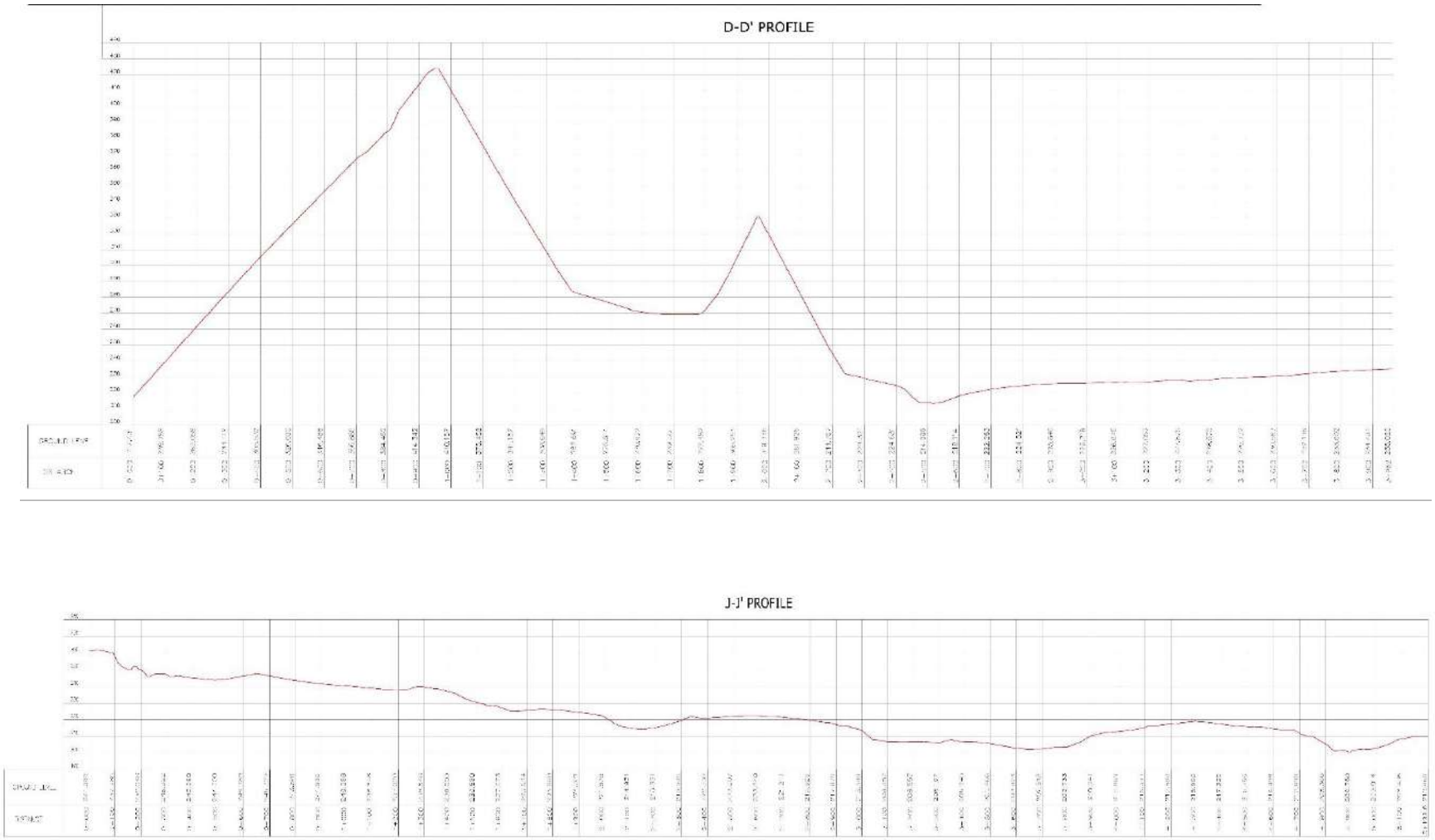


Figure 12: Typical Cross-sections of the Existing Topography Through the Site Proposed for the Sanitary Landfill

From the ridgeline the site the ground surface decreases at a slope of approximately 1V:3H (33%) to the east to a low-lying, slightly entrenched, shallow valley at the foot of the slope (**Figure 12**, Profile D-D'). Leachate from the northern margin of the existing dump site flows through this valley. Thereafter the ground rises slightly (**Figure 13**). Overall the ground slopes from south to north and from the east margin of the site westwards to the valley at the foot of the slope. Ground elevation varies from about 235 feet along the eastern and southern margins of the site and declines to the north to a minimum elevation of 195 feet near the north-east corner of the site. The overall gradient from south to north is less than 1V:200H (0.5%).



Figure 13: Eastern Part of the Site Looking Eastwards

In the area of the existing open dump, the ground rises to an elevation in excess of 310 feet, with high slopes in waste, greater than 60 feet high, as steep as 1V:2H (50%).

3.5. Geology of the Sanitary Landfill Site

The geological map of the site is illustrated on **Figure 14**. The site is underlain by bedrock formations of Oligocene and Eocene age and appear to comprise the eastern limb of a north-south-oriented anticline. The bedrock strata comprise various rock types including limestone, sandstone and shale which dip at between 10º and 20º to the east.

One fault line is recorded passing across the northern end of the site (**Figure 14**). This latter fault line offsets the northern extension of the western ridgeline to the west by approximately 250 feet. There is no known activity on this fault line in recent times. According to the Building Code of Pakistan- Seismic

Provisions 2007, the project area may be placed in Seismic Zone 2B corresponding to a Peak Horizontal Ground Acceleration of 0.16g to 0.24g.

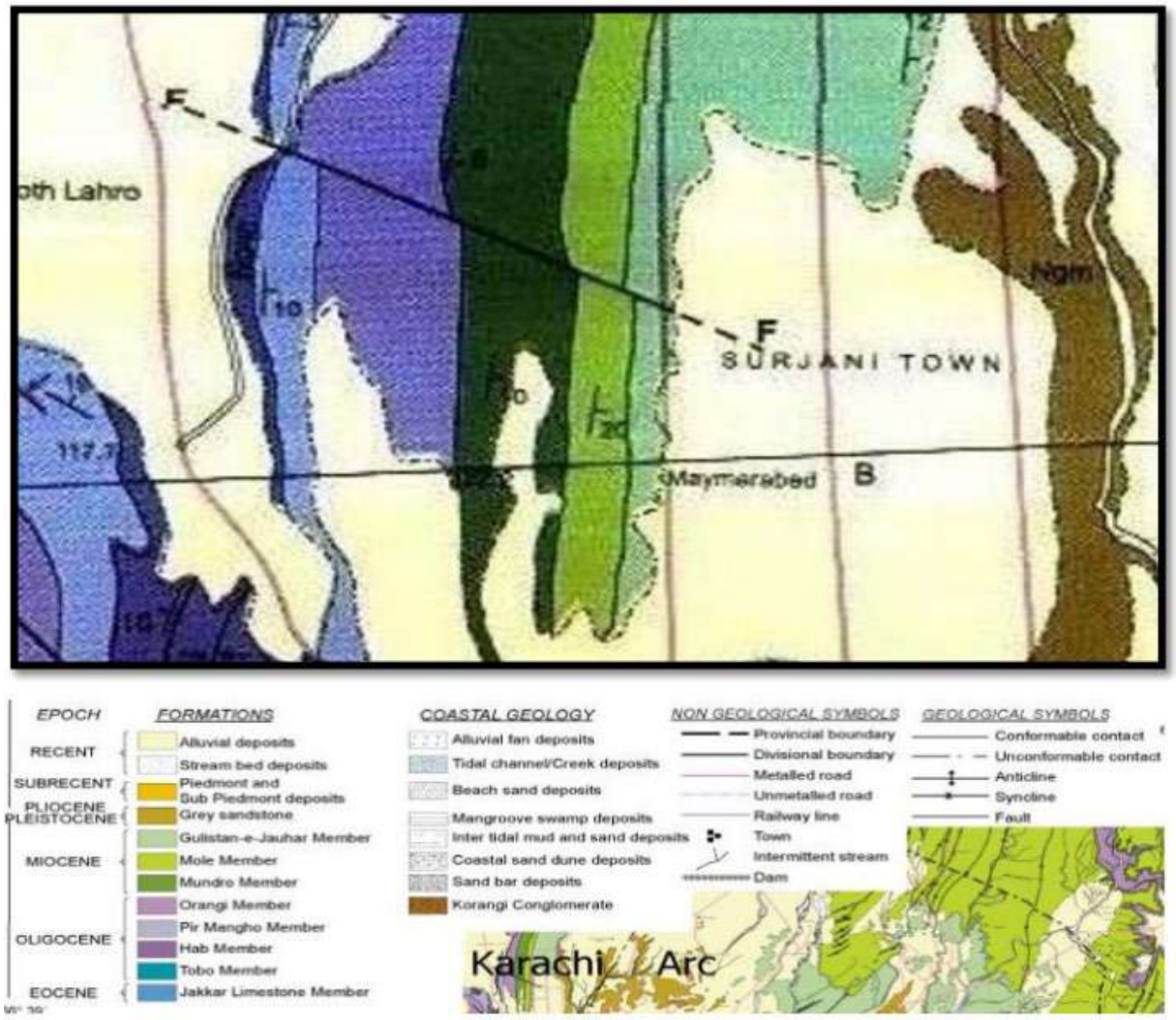


Figure 14: Geological Map of the Project Site

The geotechnical survey conducted at the project site is reproduced as **Annexure C**. Bedrock was encountered at shallow depth across the whole of the site area, except in the southern part of the site in the area overlain by deposited waste in the open dump.

Three principal bedrock strata were proven during drilling:

- Yellowish brown to off-white, weak, slightly to highly weathered, moderately fractured, thickly bedded, arenaceous LIMESTONE, with occasional thin interbeds of sandstone, shale and claystone (**Figure 15**);
- Brownish grey to yellowish brown, extremely weak to weak, slightly to highly weathered, fractured, thickly to very thickly bedded, SANDSTONE and FRIABLE SANDSTONE (**Figure 16**);
- Brown to brownish grey, extremely weak, highly weathered and fractured, thickly bedded SHALE and CLAYSTONE.

There is a variable thickness of superficial materials above the shallow bedrock, ranging from 0 feet up to maximum recorded of thickness of about 15 feet. In the majority of areas on site the superficial

materials are less than 5 feet thick and on the limestone ridges superficial materials are extremely thin or absent.



Figure 15: Exposed Limestone on the Western Flank of the Ridge in the Centre of the Site



Figure 16: Sandstone Exposed at the Base of the Ridge in the Centre of the Site

Municipal solid waste was recorded in three boreholes from the southern part of the site. The maximum recorded thickness was 20 feet in BH 18 at the southern margin of the site.

The limestone units form the two ridges and intervening valley in the western part of the site area. Limestone is also recorded in three (3) boreholes in the southern part of the site to the east of the central

ridge (BH 28, BH 30 and BH 35). Limestone was recorded in twenty-five (25) boreholes and formed the only rock type intersected below superficial materials in all but one borehole (BH 7).

Where exposed the limestone is seen to dip eastwards at approximately 14° to 18°. Whilst the limestone is highly weathered in places no voids were recorded during drilling. The limestone is competent with occasional fractures that are oriented roughly south to north and west to east. The fractures are tight on the slopes but open up at the top of the central ridge line, producing large blocks of limestone both along the crest of the ridge and on the western slope of the central ridge (**Figure 17**) where blocks have broken off the crest.



Figure 17: Blocks of Limestone on the Western Slope of the Central Ridge

The limestone typically increases in strength with depth but is classified as weak throughout. Moisture content is low, usually less than 1%, and the unit weight lies normally in the range 2.30-2.35 g/cm^3.

To the east of the central ridge the predominant bedrock lithologies are friable sandstone and sandstone. Friable sandstone was recorded in ten (10) boreholes but only formed the majority of drilled depth in three (3) boreholes (BH 7, BH 12 and BH13) in the central eastern part of the site. Elsewhere, friable sandstone passed into sandstone after a few feet. The friable sandstone is classified as extremely weak to weak. Moisture content is low, ranging between 5% to less than 1%, and the unit weight is somewhat variable ranging between 2.00 and 2.30 g/cm^3 and more typically in the range 2.10 to 2.20 g/cm^3.

Sandstone was recorded in sixteen (16) boreholes in the eastern part of the site where it was the predominant lithology intersected. The sandstone is classified as weak, occasionally very weak, but is comparatively much stronger than the friable sandstone. Moisture content and unit weights are similar to those reported for the friable sandstone.

Extremely weak shale was intersected as thin interbeds, five (5) to ten (10) feet thick, in five (5) boreholes in the eastern and south-eastern part of the site and for the full depth drilled in three (3) boreholes along the alignment of the proposed access road east/south-east of the site of the sanitary landfill. Moisture content and unit weights are similar to those reported for the friable sandstone and sandstone.

Very weak claystone was recorded in one borehole (BH 33) in the southern central part of the site, again with moisture content and unit weights similar to those reported for the friable sandstone, sandstone and shale.

Superficial materials, primarily gravelly sand and silty sand, were intersected in the majority of boreholes and trial pits constructed at the site. The materials can be grouped into four categories:

- Yellowish brown, dense silty-clayey SAND with occasional to some gravel, classified as SM-A4 (AASHTO) or 'SM' (USCS), with greater than 35% passing the 0.075 mm sieve;
- Yellowish brown, very dense, SAND with some to much gravel and traces of silt and clay, classified as SM-A-1-b (AASHTO) or 'SM' (USCS);
- Yellowish brown, very dense, gravelly SAND with traces of silt and clay, classified as SP-SM-A-1-b (AASHTO) or 'SP-SM' (USCS); and
- Yellowish brown, dense, gravelly SAND with traces of silt and clay, classified as SW-SM-A-1-b (AASHTO) or 'SW-SM' (USCS).

Particle size data for the superficial sands is plotted on **Figure 18** (borehole samples) and **Figure 19** (trial pit samples). These show a differentiation between the results obtained by different sampling methods, with those obtained from trial pits deemed to be more representative of the materials present at the site.

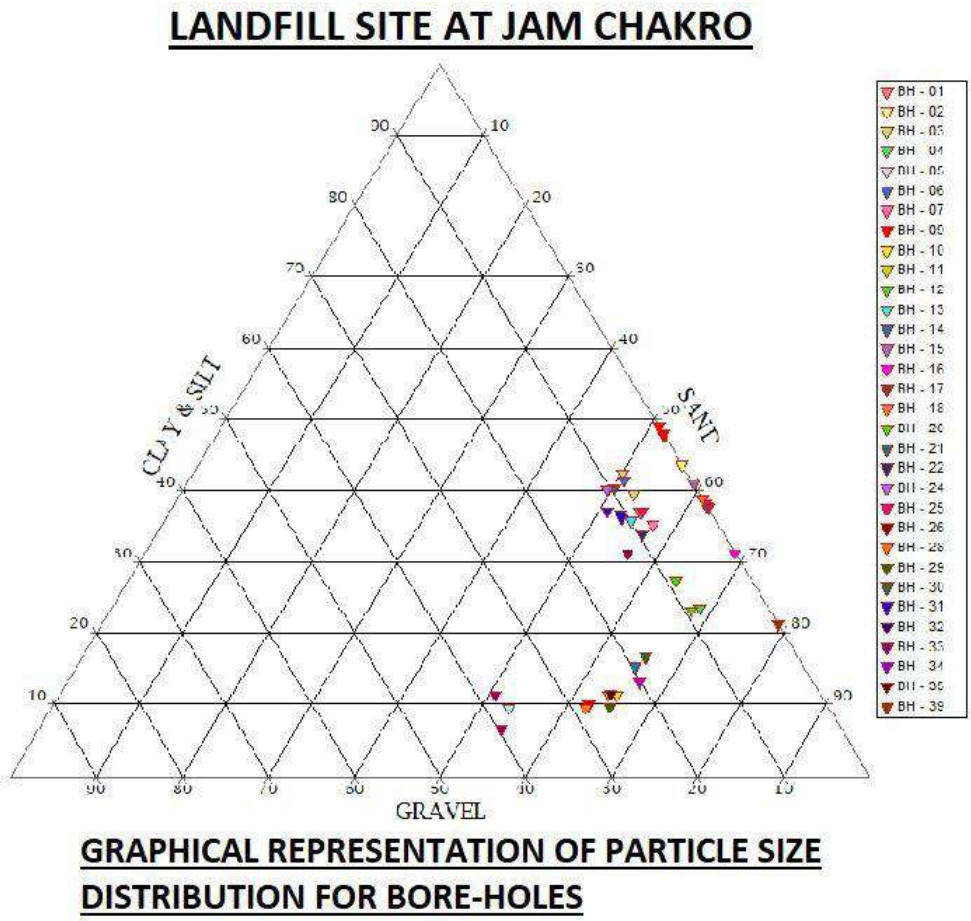


Figure 18: Particle Size Data for Superficial Materials (Boreholes)

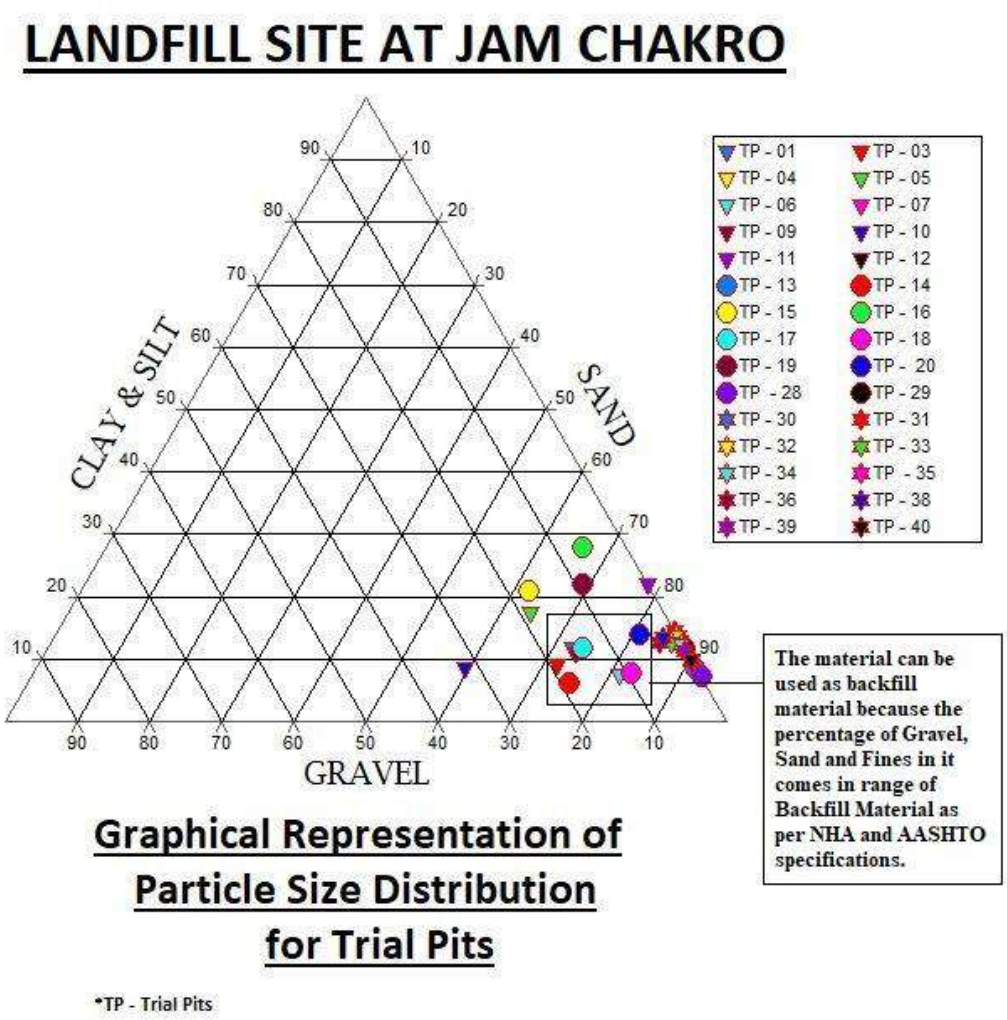


Figure 19: Particle Size Data for Superficial Materials (Trial Pits)

Chemical analyses of the soil indicated sulphate contents ranging from 0.01% to 0.04% and chloride contents ranging from 0.01% to 0.05%. These values are low and thus Ordinary Portland Cement can be used at the site.

Proctor compaction and California Bearing Ration results show a range of values as summarized on **Table 11**.

Table 11: Overview of Proctor Compaction and CBR Results

	Max Dry Density	Optimum Moisture Content	California Bearing Ratio (CBR)			
	(g/cm3)	(%)	100%	98%	95%	90%
Minimum	1.81	7.9	9.8	8.5	6.3	2.8
Maximum	2.09	11.6	16.8	14.0	11.5	10.0

Detailed laboratory test results are reproduced in **Annexure C**.

3.6. Hydrogeology of the Project Site

Groundwater was not encountered in any of the shallow boreholes or trial pits excavated at the project site. Groundwater, however, was struck in five (5) boreholes that were converted to water monitoring wells. Struck groundwater levels are summarized on **Table 12**.

Table 12: Struck Groundwater Levels in Water Wells at the Project Site

Converted Borehole No.	Ground level (feet)	Depth to groundwater below ground level (feet)	Reduced Elevation of groundwater (feet)
1	223.58	149.93	73.65
6	219.82	125.34	94.48
11	276.71	165.02	111.69
24	274.54	155.18	119.36
31	226.25	155.18	71.07

Groundwater levels are highest in the west and decline to the east and north.

In situ permeability tests were conducted in both the limestone and sandstone bedrock, typically at three (3) depths in eight (8) locations. The results obtained are summarized on **Table 13**.

Table 13: In Situ Permeability Results

Rock Type	Minimum Recorded Hydraulic Conductivity (cm/sec)	Maximum Recorded Hydraulic Conductivity (cm/sec)
Limestone	3.99E-05	2.74E-04
Sandstone	4.37E-05	6.87E-04

Results for both rock types are similar; for both rock types hydraulic conductivity values decrease slightly with increasing depth. The hydraulic conductivity is relatively high and likely to be governed by the presence of extensive fractures and fissures as recorded in the borehole logs.

3.7. Environmental and Social Setting

There are a number of settlements located all around and within 1 km of the proposed landfill site; to the north, to the west, to the south and to the east (**Figure 20**). The closest settlement is at Haji Ibrahim Goth, immediately south of the south-western boundary of the proposed sanitary landfill site and immediately west of the existing open dump site. This settlement is illegal and occupied by waste pickers (scavengers) that work the dump site.

The nearest recognized and legal human settlement is 400 m east of the perimeter of the proposed landfill area. Further dense residential settlement is located at a similar distance to the west of the western boundary of the proposed landfill site. A small settlement is also located approximately 150 m north of the northern boundary of the landfill site. New residential and commercial areas are under development immediately south and south-east of the existing open dump site.

The Hub Dam Canal, which carries freshwater supplies for Karachi City, comes to within approximately 30 m of the north-western corner of the proposed sanitary landfill site. The canal transports freshwater water to a filtration plant located approximately 2 km south-west of the sanitary landfill site. The Hub

Dam Canal is conveyed through an open concrete channel which is elevated above existing ground level adjacent to the landfill site. The Hub Dam Canal is a source of water for residents in Haji Ibrahim Goth.

A major electrical transmission line runs west of the proposed landfill site at a distance of approximately 650 m. However, the settlements immediately adjacent to, and east of, the proposed landfill site do not currently have any mains electrical supply. Power supply in these settlements supported from solar panels and car batteries.

In the settlements adjacent to the proposed sanitary landfill wastewater drainage and sewerage is through a combination of open pit latrines and open drainage channels.

There are small areas of irrigated and rainfed agriculture immediately adjacent to the eastern boundary of the proposed sanitary landfill site. Industrial units are located west of the proposed sanitary landfill to the west of the Hub Dam Canal.

There are three educational facilities located south of the existing open dump site. These are Idra Al Khair Campus 2, Idra Al Khair Campus 3 and Idra Al Khair Technical Center. There is one dispensary and medical facility located at the south-western end of Haji Ibrahim Goth.

Environmental monitoring has been conducted adjacent to the proposed landfill site by Global Environmental Lab (Pvt.) Ltd. (GEL). The test results, as reported in the draft Environmental Monitoring Report for SWEEP (Consolidated Report) dated April 2023, indicate the following:

- Ambient air quality - NO_2 levels, $PM_{2.5}$ levels and PM_{10} levels exceeded prescribed Sindh Environmental Quality Standards (SEQS) limits in a number of locations around the proposed project site;
- Noise level - daytime limit (65 dB) was exceeded around the site, possibly due to commercial activities and traffic, whilst noise levels overnight remained within the prescribed nighttime limit (55 dB). The average noise level for the entire day was recorded as 61.2 dB, indicating a consistently high noise environment throughout the day;
- Drinking Water - Drinking water samples were found to be within the prescribed limits, except for the presence of elevated Barium and Total coliform counts in the water samples obtained from Masjid Al Noor in Hassan Brohi Goth;
- Groundwater - None of the groundwater samples analysed samples were assessed to be fit for human consumption when compared with Sindh drinking water quality standards; all samples had elevated levels of chloride, TDS and turbidity and all had objectionable taste. In addition, five of the seven samples indicated the presence of coliforms;
- Leachate – parameter assessed exceeded the prescribed limits with respect to temperature, boron, Biological Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), phenolic compound, chloride, fluoride, sulphate, ammonia, pesticides, barium, iron, total nitrogen, total phosphorus, and p-cresols; and
- Wastewater - elevated levels of COD, BOD_5 and Chloride indicate the wastewater is highly organic and may contain harmful microorganisms, which can pose a risk to human health. Microbiological analyses confirmed the presence of coliforms and faecal coliforms.

The land uses surrounding both the existing dump site and the site proposed for the sanitary landfill are illustrated on **Figure 20**. There are no sensitive receptors within the limits of the proposed sanitary

landfill, nor any there any existing structures or utility connections located within or immediately adjacent to the proposed project site.

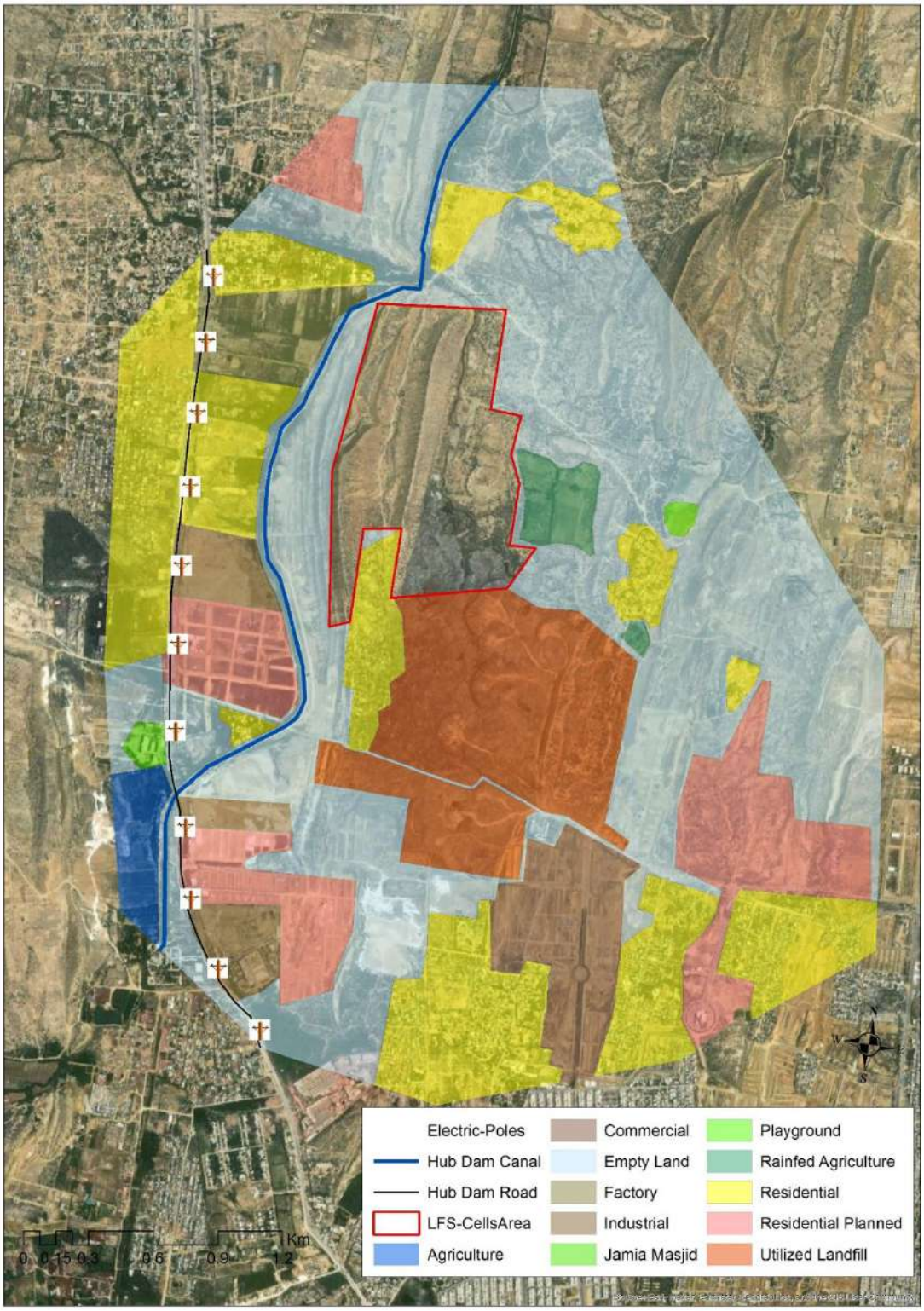


Figure 20: Land Use Adjacent to the Jam Chakro Site

3.8. Summary of the Site Suitability and Constraints

The Diagnostic Report (Annexure A) considered the suitability of the site to be developed as a sanitary (engineered) landfill . The conclusions of the Diagnostic Report are as follows:

3.8.1. Sites Suitability

Overall, the site is deemed suitable to be developed as a regional sanitary landfill, albeit with limited site life, based on the following considerations:

- While the sanitary landfill site lies close to the Hub Dam Canal, there is no history of flooding recorded at the site arising from stormwater flows from the surrounding land;
- There are no protected sites of historical, archaeological, religious, or cultural significance within 1 km of the site;
- The site has served as a waste dumping site for many years, with most of the site covered by existing waste deposits. The site does not impact any adjacent agricultural land;
- The site does not impact any wetlands and protected or endangered flora and fauna habitats;
- The site's location does not lie within the exclusion zone of major transportation networks, such as airports and airspace restrictions;
- Landfill site is of adequate size to be re-developed as a short-term modern landfill site, with sufficient space to incorporate buffer zones around the site margin and with room for all required infrastructure, including, but not limited to, roadways, support facilities (for example, parking) and stormwater drainage;
- The landfill site has good access to major road networks for transportation of MSW by road from the transfer stations; and
- The natural ground beneath surface waste has adequate bearing capacity for constructing the landfill and supporting infrastructure.

3.8.2. Site Constraints

Notwithstanding that the site is considered suitable to serve as regional sanitary landfill, some constraints must be considered in the future design of the site. These are as follows:

- Residential development has sprung up around the margins of site and has been subject to increasing densification over time. Accordingly, provision must be included in the design for screening the site activities as far as practicable and for incorporating an adequate buffer zone between the residential development and the construction of site facilities;
- Landfill site design should incorporate facilities for mitigating the potential environmental impacts of site operation, particularly concerning odour, noise, dust, litter, and the prevention of contaminated water migrating from the site;
- There are significant accumulations of waste in the southern portion of the site, from which leachate flows are recorded. Measures will need to be established to constrain and capture existing leachate flows whilst, at the same time, minimizing the impact on any existing waste accumulations. The access road, however, will need to pass through an area of existing waste

deposits; therefore, appropriate measures need to be put in place to minimize potential slope instability adjacent to the access road;

- The natural gradient of the site is suitable for leachate drainage by gravity in the western valley; however, in the eastern part of the site the gradient is too low to effect leachate drainage by gravity. Accordingly, site preparation works will need to enhance the gradients on the base of the landfill for effective leachate drainage. Inevitably, it will be necessary for leachate in this area to be pumped out to any treatment facility; and

- The site lacks an adequate electrical power supply and any stormwater and wastewater drainage, although available in the neighbourhoods. Provision needs to be made to include suitable utility connections and drainage.

4. OPTIONS FOR MANAGING MUNICIPAL SOLID WASTE

4.1. Introduction

The generation of municipal solid waste (MSW) in the all districts of Karachi in 2022 is estimated to be approximately 10,800 tonnes per day (tpd). The quantity of MSW is projected to double over the next twenty (20) years; it is estimated to reach approximately 20,000 tpd by 2045.

Continuation of the current method of managing all districts of Karachi MSW primarily by open dumping, is not sustainable in the medium- to long-term for a variety of reasons, including:

- The large land take required for disposal of waste above ground;
- Urban expansion and increasing density of development, competing for available land;
- The projected large increases in MSW requiring management over time;
- The environmental and social impacts of current disposal practices, including, but not limited to, water quality, air quality and environmental health impacts; and
- Loss of resources by, for example, sterilising potentially recoverable materials through burial and the failure to recover energy from the waste stream.

There is a strong desire to improve current SWM practices, particularly in the manner in which MSW generated and collected is ultimately managed and to reduce the requirement for final disposal of MSW to land.

There are currently no plants in Karachi for treating or for disposing of MSW in a sanitary and environmentally-secure manner.

This Section explores potential treatment options available in the short- to medium-term for providing more effective management of the waste stream, thereby reducing the detrimental environmental impacts of current disposal practices and improving the recovery of resources.

4.2. Waste Management Hierarchy

The waste management hierarchy (**Figure 21**) is a tool that establishes an order of preference for action to reduce and manage waste based on the concept of sustainability.

The waste hierarchy aims to extract the maximum practical benefits from products and to minimize the amount of waste generated. The proper application of the waste hierarchy can have several benefits. It can help prevent emissions of greenhouse gases, reduce pollutants, save energy, conserve resources, create jobs and stimulate the adoption of circularity in project design and the development of green technologies.

The most preferable approach is avoidance and minimization in order to reduce the amount of waste produced in the first instance. The preference for any waste that is produced is to re-use the materials, wherever practicable, or to recycle the material to form new products, thereby conserving natural resources. A lower priority is to recover resources from the waste (for example, energy) in preference to final disposal either by burial or by destruction (in the absence of energy recovery).

Avoidance and reduction/minimization strategies (for example, cleaner production and implementing regulations regarding packaging) will not contribute significantly, in the short-term, to reducing the ever-increasing quantities of waste to be managed in the all districts of Karachi. The adoption of appropriate measures should be developed as part of a solid waste management (SWM) plan designed to limit any increase in per capita waste generation in the longer-term.

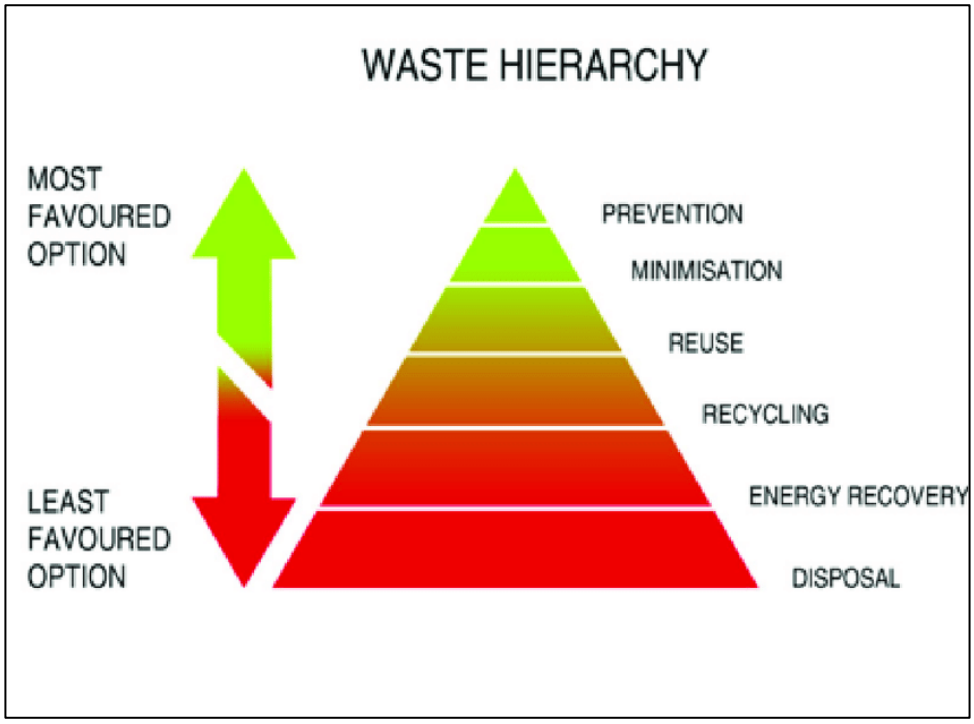


Figure 21: The Waste Management Hierarchy

In the context the immediate and short to medium-term needs, attention has focused on assessing readily available and proven technologies for:

- Treating and managing MSW; and
- Disposing of any residual waste that is not treated/cannot be treated, because of non-availability of treatment capacity, in an environmentally safe and acceptable manner.

4.3. Potential Options for Final Disposal

4.3.1. Overview

Two broad types of landfills are commonly recognised:

- 'Open dumps' in which landfilling is uncontrolled and there are no barriers to the dispersion of any pollutants arising from the degradation of the waste into the surrounding environment; and
- Sanitary (engineered) landfills in which waste disposal is controlled and operated using the principle of 'containment'. Landfilled waste is separated from the environment by engineered barriers (liners), and both leachate and landfill gas are collected and treated, including after the closure of the landfill.

Currently, all MSW disposed to land in Karachi is to open dumps.

4.3.2. Inputs

The technical barriers to landfilling are relatively few. All MSW, and also most industrial and hazardous wastes, can be accepted by landfill.

4.3.3. By-Products

The degradation of organic (biodegradable) wastes in a landfill creates leachate and landfill gas.

Leachate is any liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed. Leachate is also produced from the decomposition of carbonaceous material (organic matter), giving rise to a wide range of other by-products such as gases (for example, methane and carbon dioxide) and a complex mixture of organic acids, aldehydes, alcohols and simple sugars and other undesirable materials (for example, heavy metals) in elevated concentrations. If these contaminated liquids enter the environment, they pollute surface and groundwater, potentially rendering the water unsuitable for consumption or use and potentially toxic to life forms.

Leachate from a landfill varies widely in composition depending on the age of the landfill, the type of waste that it contains and the rate at which different materials degrade over time.

Landfill gas is a complex mix of different gases created by the action, primarily, of microorganisms under anaerobic (oxygen depleted) conditions within a landfill. Landfill gas is approximately forty percent (40%) to sixty percent (60%) methane (CH_4), with the remainder being mostly carbon dioxide (CO_2). Trace amounts of other volatile organic compounds (VOCs) comprise the remainder (< 1%). These trace gases may include a large array of species, mainly simple hydrocarbons.

Both methane and carbon dioxide are greenhouse gases, with methane being 25-30 times more powerful than carbon dioxide. Methanogenesis in landfills (both open dumps and engineered landfills) is a significant source of methane emissions to the atmosphere. Methane gas can build up in confined spaces and create explosive conditions or cause asphyxiation.

4.3.4. **Outputs**

The only potential output from landfills is landfill gas, which, if collected and extracted, can be used to generate energy (either biogas or electricity). A schematic representation of the inputs and outputs associated with landfilling of MSW is shown on **Figure 22**.

4.3.5. **Assessment**

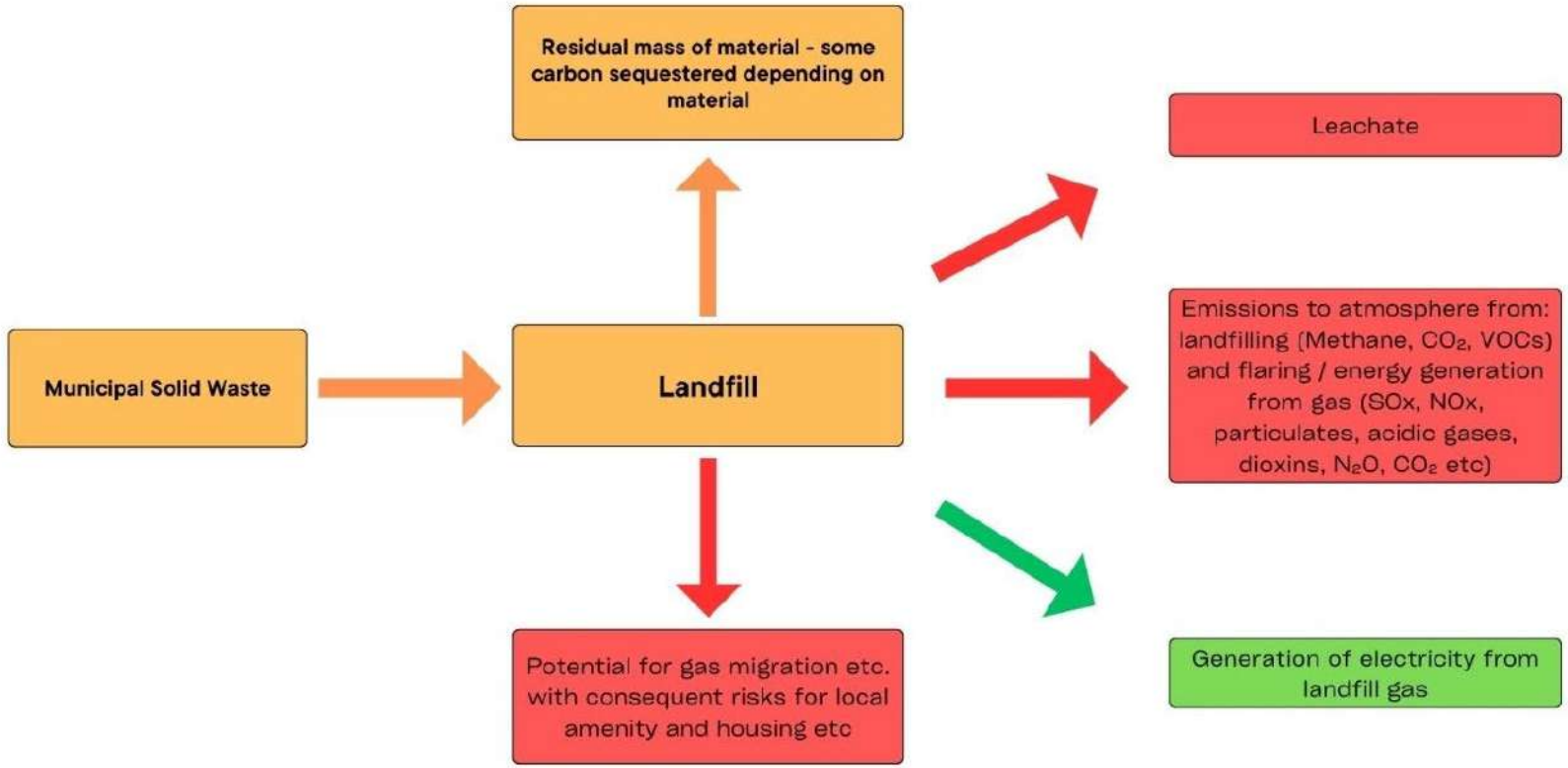
Final disposal of MSW to land (‘landfilling’) is a continuing necessity in all countries of the world. A landfill is a fundamental component of the waste management system, regardless of the extent to which MSW is diverted for treatment or is captured for recycling or re-use. All treatment of MSW gives rise to residual waste as a by-product of the process. There is, thus, a fundamental requirement to provide ongoing disposal capacity to cater for:

- Residual waste that cannot be managed in any other way (for example. by recycling); and/or
- MSW that is not directed for treatment because of lack of suitable treatment facilities or plant capacity.

A comparative assessment of open dumping and sanitary landfill is presented on **Table 14**.

Open dumping is the current disposal method for the majority of MSW collected in the all districts of Karachi. However, from an environmental perspective, the 'dilute and disperse' method of landfilling is no longer considered an appropriate method of operation in view of the serious risk posed by leachate to groundwater and surface water supplies and the potential uncontrolled accumulation, and movement, of landfill gas.

The risks of leachate generation can be mitigated by a properly designed and engineered landfill such as those that are constructed on geologically impermeable materials or sites that use impermeable liners made of geomembranes or engineered clay. Similarly, the potential impacts of uncontrolled landfill gas migration can be mitigated by engineered barriers allied with the capture, extraction and utilisation of the gas (either by flaring or by conversion to electricity).



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 22: Schematic Representation of Landfill Inputs and Outputs

Table 14: Main Differences Between Open Dumping and Sanitary Landfills

Criteria	Open Dump	Sanitary Landfill
Filling Method	Land raise – typically above ground	Usually mix of land fill and land raise – below and above existing ground
Efficiency of Use of Land Area	Low efficiency, no to minimal compaction of waste, low *in situ* density	Moderate efficiency, compaction by mobile plant, initial *in situ* compacted density typically 0.8-1.0 t/m^3
Deposited waste thickness	Usually a few metres, requiring large land take	Greater overall thickness as site is planned and engineered
Land take	Very large	Large but less than open dump since land take can be reduced by developing excavated void
Control of emissions (leachate, landfill gas, smoke, litter, dust, odour, etc.)	None	Use of engineered barriers to control leachate generation and emissions. Landfill gas can be controlled via installation of gas collection and extraction system. Systems and measures in place to mitigate landfill fires, odours and escape of fugitive dust and litter
Control of potential disease vectors (e.g. insects and rodents)	None	Standard operating practices for pest control – use of cover materials and regular fogging, fumigation and baiting
Treatment of pollutants	None – uncontrolled dispersion into the environment	Leachate treatment plant to reduce pollution load to acceptable standards prior to discharge or leachate re-circulated to the waste mass Landfill gas can be flared off or converted to electricity
Energy recovery	None	Capture and utilisation of landfill gas; conversion to electricity possible
Access control	Poor – usually no restrictions	Controlled access – can preclude waste pickers and animals
Capital cost	Very low – usually no infrastructure provided	Much higher than open dumps because of installation of engineering control measures but less than other treatment and management options
Operation Cost	Very low since minimal plant and equipment in use	Higher than open dumps – greater use of plant and equipment for compaction, treatment of leachate and control of landfill gas
Closure and restoration	Site usually abandoned with little or no restoration	Engineered barrier and soil cover over completed areas
Aftercare post closure	None	20+ years of post-closure maintenance, treatment of leachate and control of landfill gas

The quantities of leachate and gas can be reduced, and potential impacts mitigated further, if biological treatment of the residual waste is undertaken to stabilise the waste before landfilling (via, for example, mechanical biological treatment).

The financial costs of developing and operating a sanitary landfill are considerably higher than for open dumping; however, when the environmental costs are considered, together with the potential for energy recovery from landfill gas utilisation, sanitary landfilling is assessed to be a more cost-effective solution for disposing of residual waste providing high standards of operational performance are achieved and maintained.

New sanitary landfills developed to modern international standards include the following key engineering measures:

- Basal and top containment systems (engineered liner);
- Leachate collection and transfer system;
- Leachate treatment system;
- Landfill gas collection and extraction system;
- Landfill gas utilisation system;
- Surface water drainage measures; and
- Specified standard operational procedures.

Typically, to justify the capital investments in the above measures, a minimum site life of fifteen-twenty (15-20) years is warranted. The actual site life will be determined, *inter alia*, by the quantity of waste received, the quantity of waste diverted successfully for treatment (if any), the *in situ* density of the compacted waste, the degree of waste decomposition in the landfill and the available void capacity that can be established.

4.4. Potential Options for Waste Treatment

4.4.1. Overview

Potential technologies to reduce the quantity of waste going to final disposal fall into three main categories, either individually or in combination:

- Processing of the organic components of the waste stream (biological treatment);
- Recovery of recyclable or re-usable components of the waste stream; and
- Thermal treatment of the waste stream (for example, incineration).

The suitability of the available technologies in the context of waste management has been assessed against the following criteria:

- Appropriateness, based on the overall physical and chemical composition of the waste stream;
- Requirements for the feedstock – that is, can the technology handle mixed MSW as delivered currently or does it require a clean feedstock free of contaminants;
- Additional requirements for pre-treatment, if any;
- Level of sophistication of the technology and whether it has been proven commercially.
- Types and quantities of residual waste produced, measured as the rate of diversion from final disposal to land; and
- Cost effectiveness, based on the estimated capital and operating costs and by-products generated.

4.5. Materials Recovery

Materials recovery is not a treatment technology *per se* but a means of diverting potentially valuable resources away from final disposal (burial) or destruction (incineration). As such, it lies higher as a preferred option on the waste management hierarchy since it has the potential for:

- Reducing the requirement for virgin materials;
- Preserving raw materials already used and making them available for re-use, potentially with a lower overall carbon footprint;
- Avoiding or reducing potential emissions of pollutants released from waste degradation to the surrounding environment; and
- Reducing the quantity of MSW ultimately disposed.

Two main types of materials recovery facility (MRF) are in operation, depending upon the nature of the waste input:

- A 'dirty' or mixed MSW MRF, which receives mixed waste and from which individual recyclable materials are extracted either through manual or mechanical means; and
- A 'clean' MRF in which dry, source-separated, wastes are sorted into different categories. This can be undertaken manually but is more usually undertaken mechanically using a variety of screening techniques.

The type and quantity of recyclables recovered depend upon the composition of the waste fed into the plant. Higher recoveries (efficiencies) are possible in clean MRFs because the level of contamination of materials is reduced significantly by separation at source, thereby avoiding the potential for contamination from wet/organic waste.

Manual sorting of MSW provides employment opportunities but, at the same time, exposes sorters to potential health risks. Automatic systems have a higher capital investment. Typical recoveries in a dirty MRF are up to 20-30%, but often lower, whilst in a clean MRF the recovery rate can be as high as 95% depending upon the quality of source-separation achieved.

Equipment required for plant operation may include:

- Mobile plant (loading);
- Hoppers;
- Bag splitter/opener;
- Conveyor belts;
- Trommel screen;
- Disc/star screen;
- Ballistics separator;
- Electromagnetic/Eddy current separator;
- Near infrared or optical sensors; and
- Baler.

Potential outputs typically recovered are:

- Glass;
- Ferrous and non-ferrous metals;
- Various types of plastic, including PET, HDPE, PP, PVC, rigid and film plastics; and
- Clean dry paper and cardboard.

The recovery of materials from MRFs may involve potential conflicts with the adoption of other treatment technologies, such as incineration, that compete for the same types of materials (for example,

higher calorific wastes such as plastics and paper and cardboard). In addition, the impact of the development of formal material recovery systems on existing informal materials recovery systems needs to be assessed carefully since the latter also competes for the same types of recyclable materials.

Scavengers remove recyclable materials at the following points in the waste management system in Karachi:

1. At source (household level);
2. During collection and transfer (waste pickers);
3. At final disposal (waste pickers at dump sites).

Recyclables removed at point 1 do not physically enter the waste stream; however, their absence from the waste stream has the potential to affect the economics of any downstream MRF by removing the most valuable and most easily-recoverable materials.

The quantity of recyclables removed at point 2 and 3 is not known with any degree of accuracy.

4.6. Biological Treatment

4.6.1. Overview

The largest component of MSW by weight and by volume is organic matter. It is also the component of the waste stream that, when disposed to land and buried in a landfill, gives rise to the generation of leachate and landfill gas as the waste decomposes and degrades over time. There is, thus, considerable merit in attempting to treat or divert this component of the waste stream in order to reduce the volume of waste disposed to land, as well as to attempt to reduce the potential environmental impact of any waste disposed.

Modern farming techniques often remove organic matter and nutrients from agricultural soils at a faster rate than such matter is being replenished. The loss of carbon in soils over time can be traced partly to the increasing dependence on the use of inorganic fertilizers. The benefits of organic matter in agricultural soil include:

- Improved soil structure, porosity and density, improving the root environment;
- Increased infiltration and permeability, reducing runoff and erosion;
- Improved water holding capacity, reducing water loss and leaching in sandy soils;
- Supply of macro and micronutrients;
- Control/suppression of soil-borne pathogens;
- Improvement of the Cation Exchange Capacity of soils/growing media, thereby increasing its ability to hold nutrients for plant use;
- Supply of beneficial micro-organisms to soils and growing media;
- Improvement and/or stabilization of soil pH;
- Potential to bind and degrade some pollutants; and
- Potential to facilitate associations with mycorrhizal fungi in soil, which are important in facilitating the uptake of micronutrients from the soil.

There are perceived to be considerable benefits from returning organic matter to soils and one mechanism for doing this can be achieved by the biological treatment of the organic fraction of MSW.

Two principal methods of biological treatment are recognised:

- Aerobic processing, normally termed composting; and
- Anaerobic processing, normally termed anaerobic digestion.

4.7. Composting

Composting is the biodegradation of organic matter through a self-heating, solid phase, aerobic process. This converts organic matter into a stable humic substance. The microorganisms that carry out this process fall into three groups; bacteria, fungi and actinomycetes. While there are no strictly defined boundaries, the biological activity can be seen in three stages:

- Stage one is the consumption of easily available sugars by bacteria which causes a rapid rise in temperature;
- Stage two involves the break-down of cellulose by bacteria and actinomycetes; and
- Stage three concerns the break-down of the tougher lignin's by fungi as the compost cools.

For this to take place efficiently, five key factors need to be considered: temperature, air supply, moisture content, the porosity of the material and its carbon to nitrogen ratio.

Open air windrow is a low technology system requiring minimum investment in terms of equipment and finance. Raw materials are heaped into long, low piles during the active composting phase before being set aside and left for a further period to mature. This method is best suited for garden and yard waste.

In addition to open air windrowing there are a wide range of other technologies available for producing compost. These include reactor systems, tunnels and static piles. The more intensive technologies are used to compost wastes such as sewage sludge and food waste. These latter methods allow greater control over the process, so any pathogens present are more likely to be destroyed. The initial degradative phase can also be completed in a shorter time than with windrow systems, which is valuable if rapid processing of material is required.

All the systems require the material to be left for some time in piles for maturation or curing. The duration of this phase varies widely with technology and end-product requirements, with potting (horticultural) applications requiring a very high maturation degree (usually achievable through a 90-120 days overall processing time).

There are few major problems with composting processes, as long as the material is well aerated so that the process does not become anaerobic. This is relatively straightforward to ensure. The degree to which aeration and/or turning occurs also has implications for the requirements in terms of the structural stability of the input material (**Table 15**).

Table 15: Principal Methods of Compost Operations

Principles for feeding and turning	Demands on structure-stability of input material	Type of Facility	Possibilities for control of odours
Batch-wise	Very high	Mattress/bed	Poor
Static	High	Windrow	Poor
Batch-wise and Static	High	Aerated-windrow	Moderate
	High	Semi-permeable cover	Good
	High	Container/box/tunnel-static	Excellent
Continuously and agitated	Medium	Indoor-mattress/agitated-bed	Excellent
	Medium	Channel/agitated-bay	Excellent
	Medium	Tunnel-agitated	Excellent
	Medium	Tower multi-floor	Excellent
	Low	Drum	Excellent

Satisfactory levels of pathogen reduction can be achieved through ensuring the material reaches specific temperatures for specified minimum periods of time.

4.7.1. Inputs

In order to produce good quality composts, effectively free of contaminants and certified for horticultural and agricultural use, the process is largely confined to source-separated fractions of biodegradable materials. It is important to appreciate that, as far as MSW is concerned, paper and card can also be composted as can some textiles. All kitchen wastes and garden wastes can be composted.

4.7.2. By-Products

Emissions from the composting process (**Figure 23**) include:

- Emissions to air, including:
  - Gaseous emissions such as CO_2 (the most prevalent gas released during processing), ammonia (NH_3), CH_4, and some VOCs;
  - Bioaerosols, usually most prevalent when materials are being turned;
  - Odours (although these can be controlled in enclosed processes through using biofilters); and
  - Dust;
- Emissions to land, related to reject fractions (which can be minimized through source separation). To the extent that these are not biodegradable, or have been stabilized, they are less likely to give rise to problematic emissions if landfilled; and
- In open processes, where no controls exist, leachate.

The most problematic of these are issues associated with odour and bioaerosols.

4.7.3. Outputs

The characteristics and quality of the end products are very much determined by:

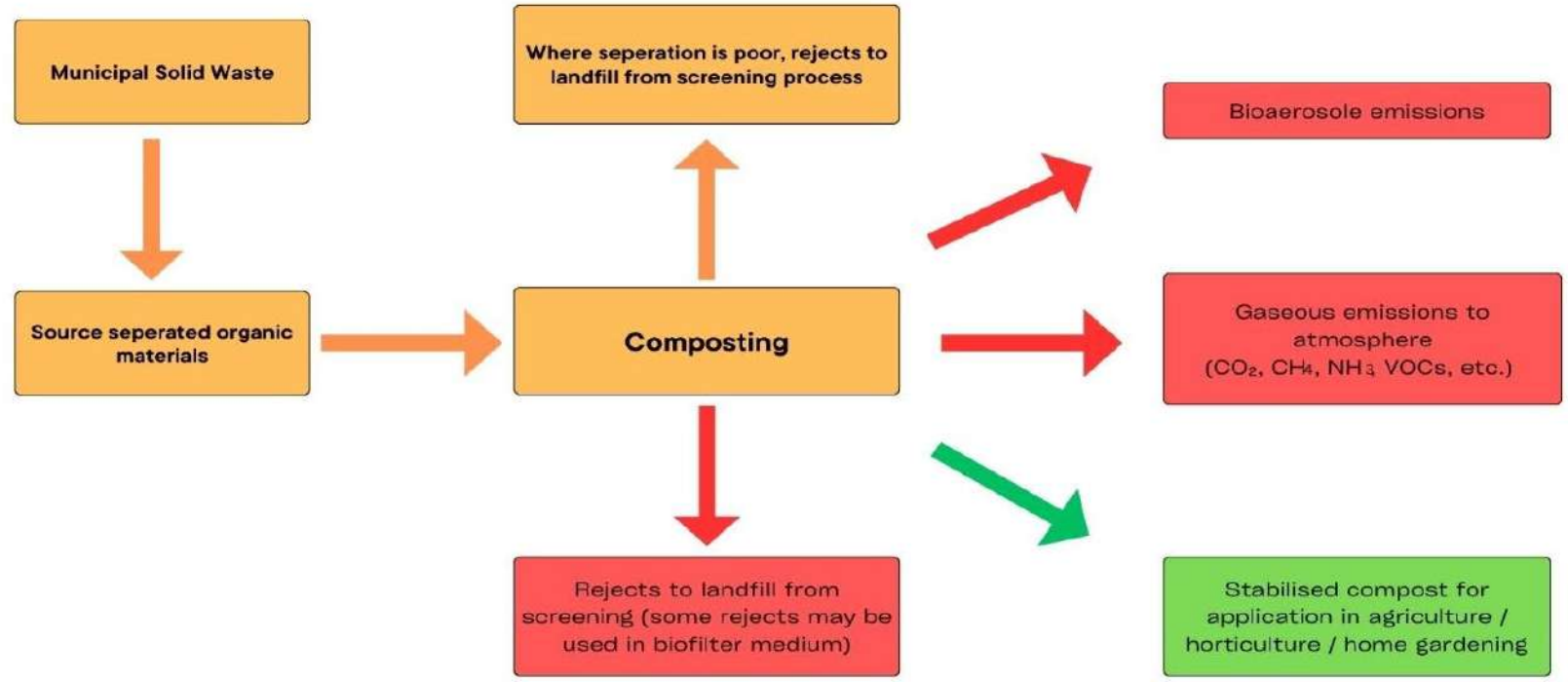
- The quality of the feedstock (how pure);
- The nature of the feedstock (its composition); and
- The extent of product maturation.

These, as well as process control, will determine product quality. This in turn determines the potential market for the product.

Impurities in the feedstock (mixed MSW) lead to poor quality products. Such products can undermine the markets for quality composts. In this context, standards act as a means of maintaining markets for quality composts and their absence makes it less likely that such markets can be developed reliably. Products made from cleaner feedstocks and with longer maturation times are more likely to reach quality markets (such as horticultural markets), but the nature of feedstock (for example, the relative mix of kitchen and garden waste) will also determine the nature of the product. 'Fresher' products (with shorter maturation times) are more likely to be appropriate for agricultural purposes.

4.8. Anaerobic Digestion

Anaerobic digestion (AD) is the bacterial decomposition of organic material in the (relative) absence of oxygen. The by-products of this process include biogas (comprising principally CO_2 and CH_4, which is capable of combustion to generate energy), as well as a semi-solid residue, referred to as a digestate. With further treatment, normally through composting, the digestate from source-separated organic waste may be used for agricultural or horticultural purposes.



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 23: Schematic Representation of Composting Inputs and Outputs

The high degree of flexibility associated with AD is one of the most important advantages of the method, since it can treat several types of waste, ranging from wet to dry and from clean organics to grey waste. AD of MSW has been commercially available for approximately 25-30 years and in that time, the heterogeneous and variable nature of the feedstock has given rise to a considerable number of different processes in operation in many different countries.

The inclusion of other feedstocks, such as sewage sludge or cattle manure, alters the quantitative aspects of digestate. However, it is important to note that the mixing of household waste with these feedstocks may improve both the environmental and economic aspects of the process. For example, the addition of sewage to the organic fraction of MSW will increase the nutrient level as well as adding moisture content. The heavy metal concentration in sludge, however, needs to be considered in relation to the quality limits for composted products.

Anaerobic digestion generally involves three stages:

- Pre-treatment;
- Anaerobic digestion; and
- Post-treatment.

As with composting, source separated MSW makes materials handling much easier. Even source-separated MSW, however, requires further separation to remove wrongly sorted materials, such as plastics, metals and oversized components. Separation can be carried out under wet or dry conditions. Following this, a process of size reduction is used to create a more homogenous material which aids fermentation and facilitates processing. Size-reduction can be achieved using screw-cutting, milling, drumming, pulping or shredding machines.

A variety of techniques can be employed for the digestion phase, distinguished on the basis of operating temperature (thermophilic plants operate at around 55ºC and mesophilic at around 35ºC) and the percentage of dry matter in the feedstock (dry systems have more than 20% dry matter, wet systems have less than 20% dry matter).

In-vessel, technologies employed include:

- Wet single-step, in which MSW is converted to a slurry with process water to provide a diluted feedstock for feeding into a mix tank digester. The process can be used for MSW on its own, but the wet process lends itself to co-digestion with diluted feedstocks such as animal manure and organic industrial wastes;
- Wet multi-step, in which MSW is again converted to a slurry and fermented by hydrolytic and fermentative bacteria to release volatile fatty acids which are then converted to biogas in a high-rate industrial wastewater anaerobic digester. The system lends itself to digestion of MSW and wet organic waste from food processors;
- Dry continuous, in which a digestion vessel is continuously fed with a material with 20-40 percent dry matter through batch loading. In both mixed- and plug-flow variants, the heat balance is favourable to thermophilic digestion;
- Dry batch, in which a batch is inoculated with digestate from another reactor and left to digest naturally. Leachate is re-circulated to maintain moisture content and redistribute methane bacteria throughout the vessel; and
- Sequencing batch, essentially a variant of the dry batch process, in which leachate is exchanged between established and new batches to facilitate start up, inoculation and removal of volatile materials from the active reactor. After digestion becomes established, the digester is uncoupled from the established batch and coupled to a new batch in another vessel.

After digestion, if the feedstock is wet, the material may be spread directly to land (especially where co-digestion with other wastes has occurred). Alternatively, solid and liquid fractions can be separated in which case, after two (2) to four (4) weeks' maturation (sometimes longer depending upon the application), a fully stabilized compost will have been developed. The liquid fraction may either be recycled for dilution of fresh waste, applied to land as a liquid fertilizer, or sent to a wastewater treatment plant (often following some separation of solids).

4.8.1. **Inputs**

Stimulating markets for the outputs of the process requires maximizing the nutrient content and minimizing the presence of toxic and unwanted materials (including heavy metals, pathogens and inert materials). Whilst the process is an important aspect, the quality of the feedstock has the biggest effect and so it is vital to maximize its quality; admissible waste types and separation processes are, therefore, important considerations.

There are a number of possible feedstocks which can be used in AD, including source separated food waste, sludge, agro-industrial by-products, manure, slurries, and yard waste. One of the main limitations of the AD process is its inability to degrade lignin (a major component of wood), in contrast to the process of aerobic bio-degradation.

Anaerobic digestion is better suited to waste with a higher moisture content than composting which requires 'drier' wastes. The process of AD can occur between 60% and 99% moisture content. Therefore, kitchen waste and other putrescible wastes, which by themselves may be too wet and lacking in structure for aerobic composting, provide an excellent feedstock for AD. Woody wastes contain a higher proportion of lignocellulosic materials and are better suited to aerobic composting. Liquids are often added to the AD processes (either water or recycled effluent) to maintain a high moisture content.

Any non-biodegradable components of MSW which are fed into an anaerobic digester, will not be affected by the process and are simply taking up unnecessary space. To maximize the benefit (both environmental and economic) and minimize the cost it is important to minimize their presence in the AD feedstock. Minimizing the quantity of potentially toxic materials is also an important consideration for the quality of the end-product. As with composting, the method of MSW collection has a bearing on both.

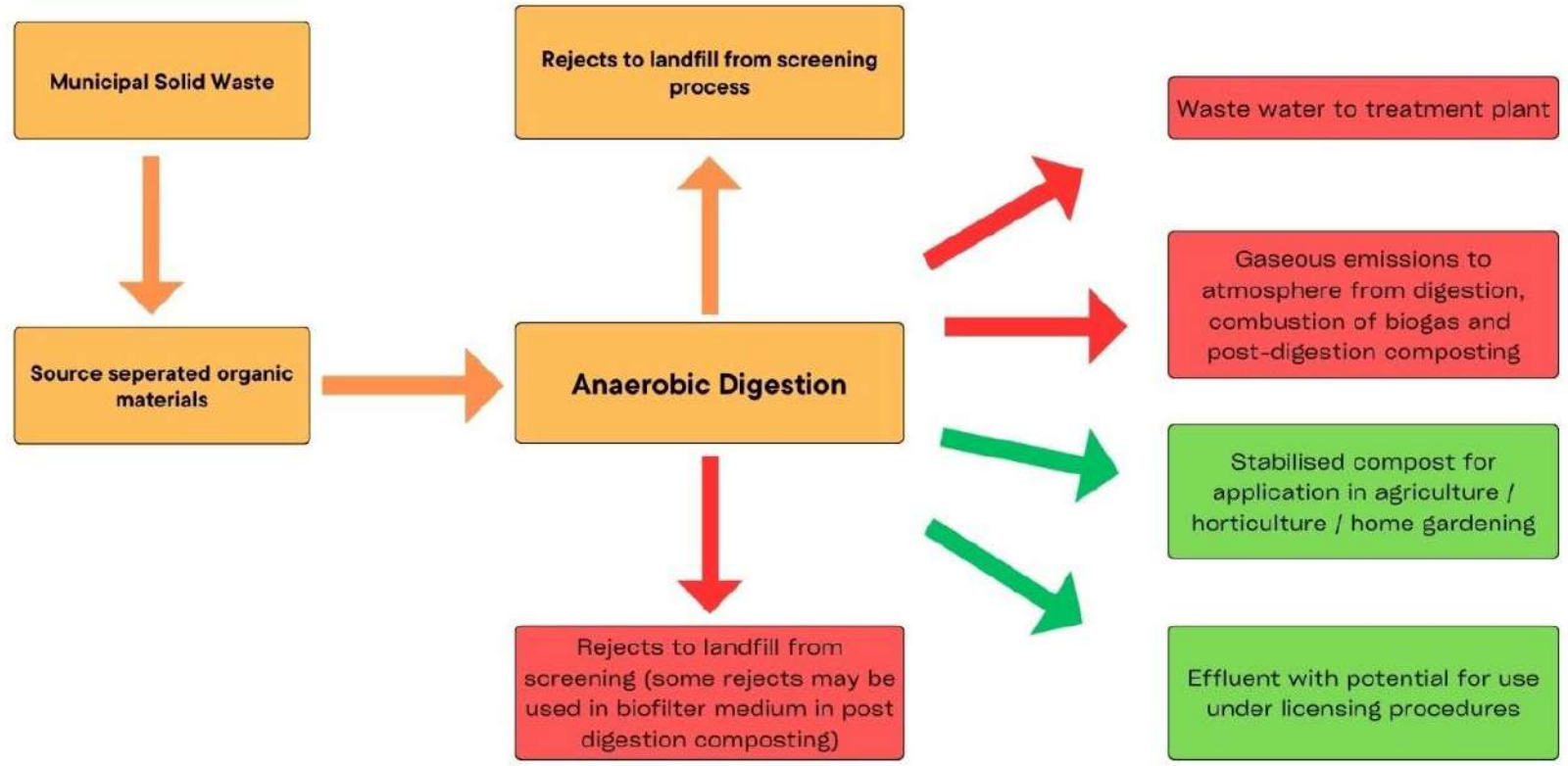
4.8.2. **Outputs**

There are two main products from AD – biogas and digestate.

The production of biogas from controlled AD (as against uncontrolled AD in a landfill) is one of the principal advantages of the process. Stabilization in the AD process is linked to methane production. On average AD produces 100-200 m3/ton of biodegradable MSW processed, with a typical composition of 55-70% CH_4, 30-45% CO_2 and 200-4,000 ppm hydrogen sulphide (H_2S). There are also other constituents in smaller concentrations, including carbon monoxide (CO), hydrogen, nitrogen and oxygen (**Figure 24**).

Biogas generation is very sensitive to feedstock, a larger proportion of inorganics and polluting substances in the process will lead to smaller amounts of a 'dirtier' biogas.

The constituents of biogas (other than CO_2 and CH_4) can be quite important in its end-use. The presence of H_2S is a particular issue where the gas is to be used for heat or power generation. Because of its corrosive qualities, care must be taken in the design of plant and the choice of materials which will come into contact with the gas. Removal of H_2S can be achieved by scrubbing the gas using iron salts. H_2S also poses the largest risk to personnel.



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 24: Schematic Representation of Anaerobic Digestion Inputs and Outputs

Biogas produced under optimum conditions has an energy content of around 20-25 MJ/m^3. Electrical conversion efficiencies vary according to combustion plant and range typically between 25% and 36%. Overall conversion efficiency can be increased to 65-85% if water is heated from the engine's exhaust. Utilization of electricity by the plant vary a great deal and can range between 20% to 65% depending on plant size and configuration. Biogas can also be burnt in boilers to produce hot water and steam for industrial purposes or used as an alternative fuel in light and heavy-duty vehicles.

In order to extract the maximum recovery value from the organic waste input, the digestate from AD should have a useful purpose and positive benefit should be derived from its production. In practice this varies from use as landfill cover material, through direct application of the digestate to land for agricultural benefit, to further maturation and refinement of the digestate to produce a quality soil conditioner. The post-digestion composting phase is likely to be important to make the end product attractive to potential users in agriculture and elsewhere. As well as the main product from the process, a solid digestate, small quantities of surplus liquor are also available which can be dewatered to provide liquid fertilizer.

Feedstock and process controls have a significant effect on the quality of the end-product. A high nutrient content is important for use as a quality soil conditioner or fertilizer, as is a low concentration of potentially toxic materials such as heavy metals, inerts and pathogens.

4.9. Assessment: Processing of Organic Waste

Experience worldwide of attempts to derive 'compost' from mechanical separation of mixed residual waste have tended to reveal two things:

- The end-product is generally of low quality. This has led to significant problems, and ultimately rejection of the product, when attempts have been made to use the material on land. Typical contaminants are heavy metals, glass and plastics; and
- The attempt to market such materials can compromise severely the market for materials of higher quality, derived from source-separated materials. Where the utilisation of compost from source-separated MSW is most highly developed, attempts to derive 'usable products' from mixed MSW are not considered viable, and are even prohibited in some locations, except for very specific, low-grade applications.

Table 16 provides a comparison of the requirements and outputs of composting and AD. For high quality compost/digestate, the key requirement, as noted above, is for source-separated waste in order to mitigate potential contamination. In the absence of source-separation, composting or AD of mixed MSW is unlikely to be a viable treatment process in the longer-term, except where it is undertaken specifically for the production of low-grade compost (for example, to use as landfill cover and in landfill restoration) and the mitigation of the generation of leachate and landfill gas in waste disposed to landfill.

The quality of the ‘compost’ may be produced should be acceptable as a viable soil enhancer. As discussed above, however, it is considered unlikely that the compost produced from mixed MSW, would meet international standards, such as the USDA National Organic Program Regulations or BSI PAS 100:2018 or equivalent, to be certified as compost for horticultural use.

4.10. Mechanical Biological Treatment

Mechanical biological treatment (MBT) is a process designed to optimise the use of resources remaining in residual waste. Usually, it is designed to recover materials for one or more purposes, and to stabilize the organic fraction of residual waste. The benefits of this process are that materials and energy may be recovered, void space requirements at the final disposal site are reduced and gas and leachate emissions from landfill are reduced significantly.

Table 16: Comparison Between Composting and Anaerobic Digestion

Criteria	Composting	Anaerobic Digestion
Waste acceptance	Principally, source-separated biodegradable waste since organic matter and nutrients are to be recovered with minimal contamination – composting of residual waste or separated fractions is increasingly uncommon and not advocated	Principally, source-separated biodegradable waste since organic matter and nutrients are to be recovered with minimal contamination – composting of residual waste or separated fractions is increasingly uncommon and not advocated
Acceptance of Wet Organic Fraction (kitchen wastes)	Yes, often conditional on the presence of some structural material	Yes
Acceptance of Garden and Park Waste	Yes	Not usually
Acceptance of Organic Waste from Hotels and Restaurants	Yes	Yes
Acceptance of Paper and Board	Yes	No
Excluded waste fractions	Metal, plastic, glass, mixed MSW as far as possible	Metal, plastic, glass, animal waste undesirable at plants without sterilization. Degradation of lignin requires post-digestion composting
Proven technology/track record	Yes. Very common	Yes. Becoming common
Basic principle	Degradation by aerobic micro-organisms	Degradation by anaerobic micro-organisms
Cost of treatment	Low to medium	Medium to high
Nutrient recovery	Yes; 2 -4 kg N / ton 1 - 2 kg P / ton 1 - 2 kg K / ton	Yes; 4.0-4.5 kg N / ton 0.5-1 kg P / ton 2.5-3 kg K / ton
Energy recovery	No	Yes; 100-250 kWh (0.4-0.9 MJ) per ton of waste
Total solid residuals, depending on waste (ton/ton waste)	0.4 - 0.6	0.3 - 0.6
Quality products for recycling (recovery, ton/ton waste)	Compost (0.5)	Fibres (0.3)
Other residuals or re-use with restrictions (ton/ton waste)	-	Fluids (0.6)
Residuals for landfilling or other waste treatment	Overflow sieving (0.02 - 0.1) + solid residuals	Overflow sieving (0.02 0.1) + solid residuals

The mechanical treatment phase involves segregation and conditioning of wastes. The process involves primarily the shredding / crushing and screening of materials in order to:

- Open waste bags (where necessary);
- Extract undesirable components that may obstruct subsequent processing;
- Optimise particle size for subsequent processing;
- Segregate biodegradable materials in the underflows of primary screening, to be sent to the biological treatment process;
- Segregate materials with high calorific value, such as textiles, paper and plastics, in the overflows of primary screening, to be sent for refuse-derived fuel (RDF) production. Also, segregate those suitable for further material recovery or to be landfilled; and
- Homogenise materials destined for biological treatment.

The type of shredding and crushing machinery to be used will be determined by the materials to be handled, the objectives of the treatment and the required processing capacity. The permutations regarding the design of the plant are many and varied. In principle, however, all materials can be accepted at such a plant, the intention often being in some cases to pre-treat / separate prior to landfill / thermal treatment / recycling / recovering specific fractions.

In **Figure 25**, it is assumed that the plant is designed to separate a biodegradable fraction from residual waste for biological treatment prior to landfilling, or perhaps, one-off landscaping applications ("grey compost" or "stabilised biodegradable waste"). Apart from this, the plant may include equipment for metals recovery, extraction of mineral fractions, and for partitioning of high calorific fractions which could be sent for thermal treatment (sometimes through manufacture of RDF). Inert fractions may be landfilled / recycled as appropriate.

4.11. Thermal Treatment

4.11.1. Overview

There are three main forms of thermal treatment used for the processing of MSW:

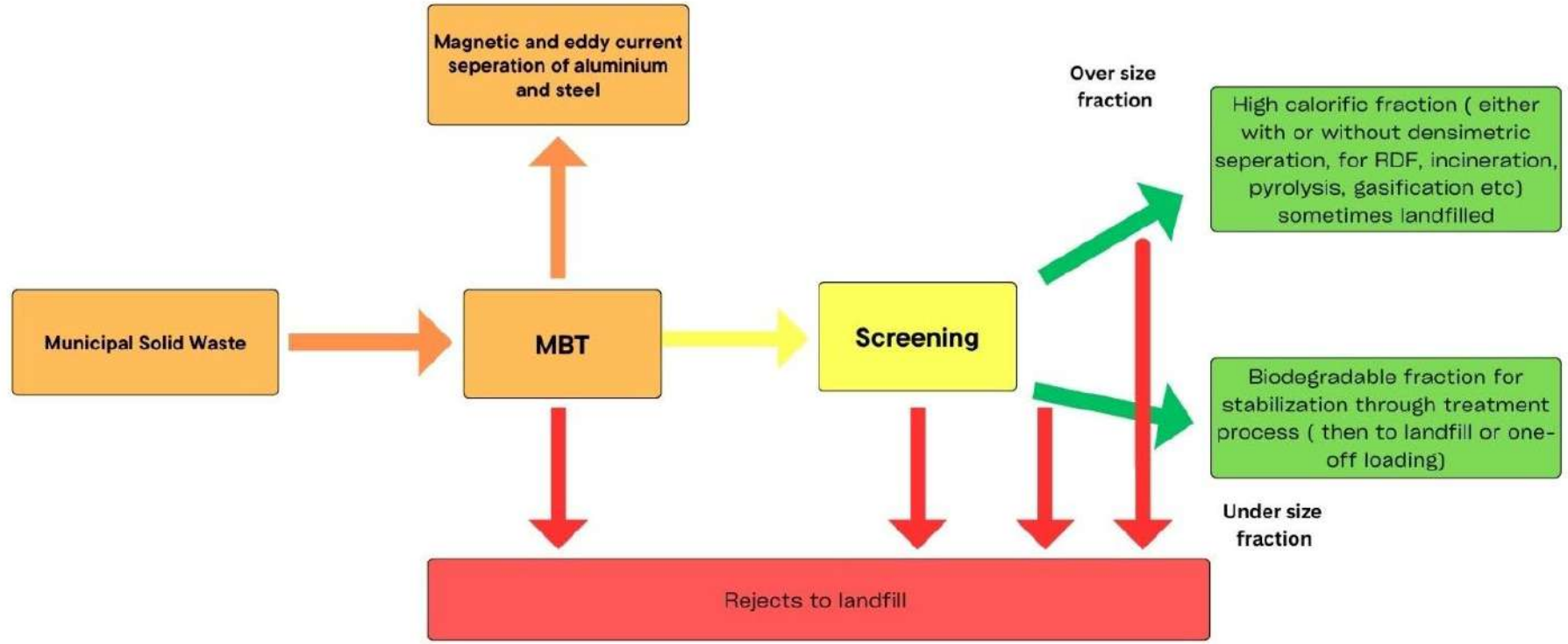
- Incineration;
- Pyrolysis; and
- Gasification.

Incineration is by far the most common process and is used widely in some countries where the availability of land for waste disposal is severely restricted (for example, Singapore) or for the generation of electricity.

4.12. Incineration

Mass burn incineration is the most common form of incineration adopted for MSW. Other methods available include fluidized bed incineration and incineration of RDF.

In mass burn incinerators, waste is first fed into a feed chute where a ram pushes the waste on to the first section of the incinerator grate. The grate may comprise a series of rocking sections (Rocker Grate), rotating rollers (Rolling Grate) or alternate fixed and moving sections (Reciprocating Grate). Each grate design aims to move the waste through the combustion chamber (furnace) with maximum exposure to oxygen at a high temperature. As the waste is propelled through the furnace, the carbonaceous/hydrogenous waste is dried and oxidised (combusted) with air supplied through the grate. The reaction leaves ash and flue gases to be quenched prior to cleaning and emission to the atmosphere.



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 25: Schematic Representation of Mechanical Biological Treatment Inputs and Outputs

RDF is manufactured by sorting wastes to remove wet putrescibles and heavy inerts (stones, glass, etc.) so as to leave combustible material. After sorting the remaining waste is shredded and either burned directly or pelletised prior to combustion (usually where the material is burned off-site, so that a densified fuel reduces transport costs). Manufacture of RDF is often an objective of MBT plants.

Fluidized bed incinerators operate with a bed of hot sand. The feedstock is prepared so that it is all of an equal size, sometimes using methods similar to that for RDF. The particles of sand and the feedstock are maintained under constant motion (fluidized) by a gaseous agent (air), which ensures good mixing of oxygen and the feedstock. The feedstock is maintained in the furnace until the carbonaceous and hydrogenous matter within the waste is combusted, leaving ash and flue gases for cleaning and subsequent emission to the atmosphere. Variations on the basic design exist, but with all, either the sand never leaves the bed, or else it is re-circulated.

4.12.1. **Inputs**

Incineration can, depending upon waste composition (which typically exhibits seasonal variation), handle unsorted/mixed MSW as well as wastes from which materials have already been separated. Different incineration technologies may require specific fractions of waste to be removed from the waste stream. For example, garden wastes may be best treated through composting both because of their seasonal nature, and due to the fact that much of the material (for example, grass clippings) may have quite low calorific value.

An issue of significance for the operation of incineration plants is the calorific value of the input waste. Mass-burn grate incinerators tend to be designed for operation using material of a reasonably well-known calorific value. If the calorific value increases or decreases significantly, then the input of waste to the plant has to be reduced or increased to reflect the change. With fluctuations in the composition of wastes, the efficiency of the combustion process may change, altering the associated emissions. Where wastes reach very high calorific values, or where they are very wet, either changes in composition (separation at front-end, or mixing) may be required, or desirable. In extreme cases, the process itself may find the composition of waste difficult to cope with. This is generally less of a problem for fluidized bed incinerators.

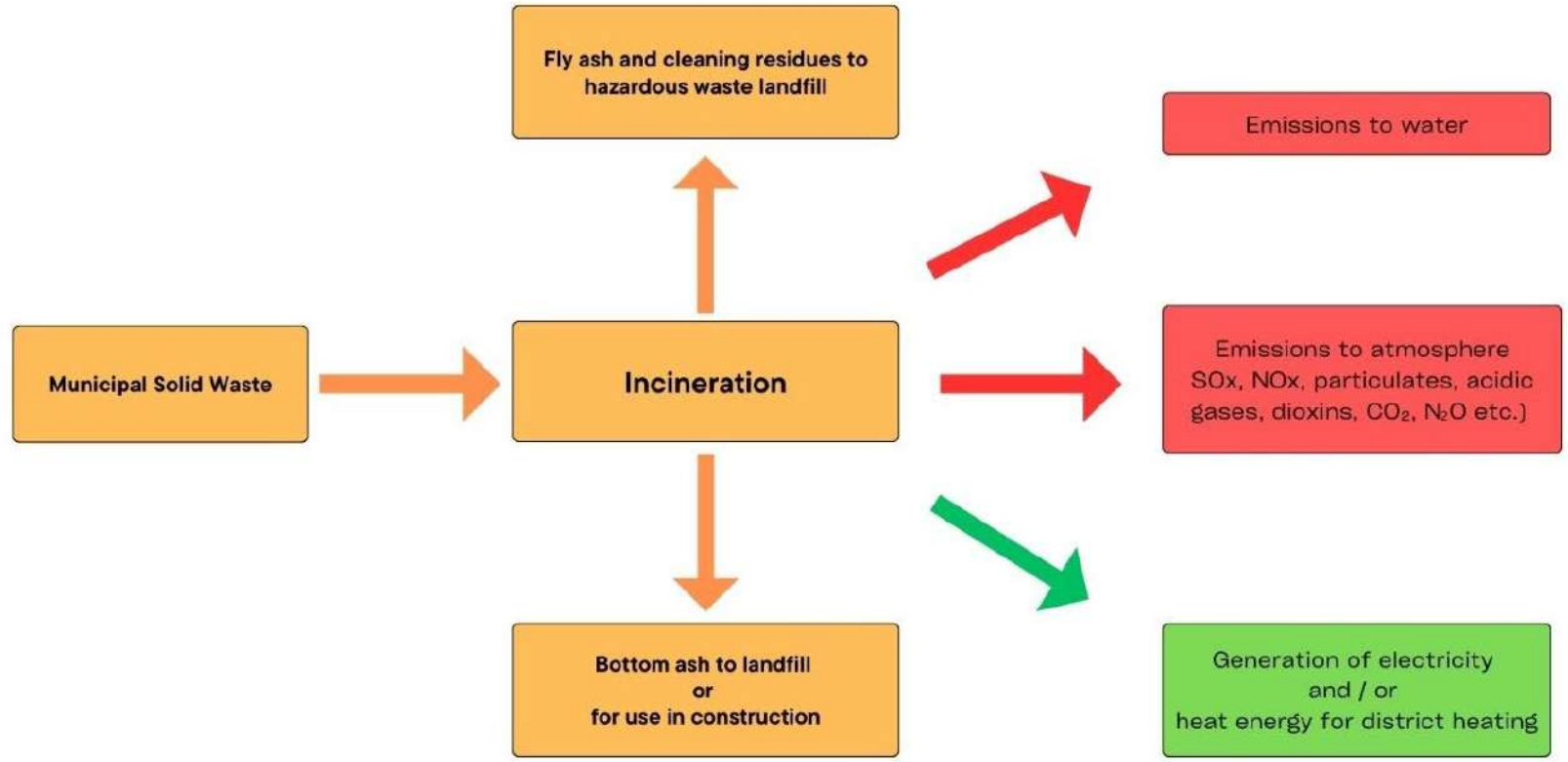
Most mixed municipal wastes can be handled by incinerators as long as the constraints in respect of composition and calorific value are respected. Larger fractions may pose problems and may be inappropriate if they compromise the completeness of the combustion process.

4.12.2. **By-Products**

Final residues include bottom ash and fly ash, as well as waste waters (**Figure 26**).

Various gaseous emissions from incinerators are known to have impacts upon human health. Accordingly, much emphasis is now placed on flue gas cleaning. Depending upon the system used, a combination of solid and liquid residues will result from this process. These solid and liquid residues then have to be dealt with. In the case of fly ash, the toxic nature of residues requires careful handling and disposal to hazardous waste landfill facilities. Fly ash generation tends to be greater at fluidized bed incinerators.

Bottom ash is often used in construction applications, although some concerns remain as to the potential stability of this material in the long-term. In some countries fly-ash is also used in construction post-stabilisation.



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 26: Schematic Representation of Incineration Inputs and Outputs

4.12.3. **Outputs**

Energy recovery is obtained by the combustion gases transferring their heat to refractory-lined water tube sections as well as convective heat exchangers - both of which feed the boiler. Steam from the boiler can be used for district heating or in a turbine for power production to an electricity grid.

It is also possible to extract metals, such as steel and aluminium, from the bottom ash. Indeed, this may be an advantage where wastes consist of mixed materials. However, the price paid for recovery of this material is usually far lower than in cases where the material has been source-separated, since they are usually contaminated (being derived from the slag).

4.13. Pyrolysis

Pyrolysis is a process which transforms waste into a medium calorific gas, liquid and a char fraction in the absence of oxygen, through the combination of thermo-cracking and condensation reactions. Pyrolysis involves indirect heating of carbon rich materials.

The aim is to achieve thermal degradation of the material at a temperature of some 500°C (a range 450-600°C is observable) in the absence of oxygen and under pressure. The temperature is usually maintained through indirect heating.

The chemical reactions involved are influenced by three factors:

- Input materials (chemical composition, water content);
- Reactor design (vertical shaft or batch reactor, rotating tubular or fluidized bed reactors, under vacuum or controlled atmosphere); and
- Operating conditions (temperature, pressure, reaction time).

There are three main types of pyrolysis:

- Slow pyrolysis or carbonisation;
- Conventional pyrolysis; and
- Fast/flash pyrolysis (further separated into vacuum and fluidised bed).

In fast pyrolysis, the carbonaceous material is fed into a chamber and rapidly heated to medium temperatures (400-700ºC) such that it reaches vapour phase almost instantly. It is then extracted from the chamber and quenched (cooled) rapidly. The very fast heating/rapid quenching means that few of the long carbon-hydrogen chains are broken and so the vapours condense into a liquid fuel (bio-oil), as opposed to a gas, as would be the case for slower heating and quenching.

In vacuum fast pyrolysis, the feedstock is introduced to the reactor in a vacuum, where it is pyrolyzed on a transported bed at 450ºC. Some gas is evolved and provides heat for the process. The vacuum technique has been developed primarily for the recycling of chemicals from tyres to the chemicals industry, since large quantities of pyrolytic oils can be obtained. Fast pyrolysis usually occurs in a reducing atmosphere, with a complete absence of oxygen to avoid widespread gasification, thereby maximising bio-oil recovery.

The fact that the gaseous, liquid and solid fractions are relatively homogeneous makes thermal valorisation less problematic (at least in theory) than in the case of incineration. Residence times in the furnace vary, usually being shorter for rotating kiln or fluidized bed designs and longer for fixed bed designs.

The cost of pyrolysis depends on the technology employed and varies from medium to high. When compared with AD the cost is similar, but it is typically higher than the cost of an incineration facility. On the other hand, the plant scale is usually much smaller. Such facilities may be better-suited than

incineration to scenarios where residual waste is mechanically separated into a smaller fraction for pyrolysis.

4.13.1. Inputs

Suitable feedstocks that can be treated by a pyrolysis facility include sewage sludge, agricultural wastes, mixed organic waste including food waste, garden waste, paper pulp and pre-separated residual waste.

For processing MSW, the major technical constraints relate to the input materials since these have to be relatively homogeneous in order for the process to function without problems. For this reason, plants tend to be equipped with front-end equipment designed to transform the waste through pre-processing to ensure the proper operation of the facility (such as a shear shredder to adjust the particles size of the feedstock). Equally, pyrolysis may be a suitable process for treating the output of MBT plants.

4.13.2. Outputs

Pyrolysis produces gas, liquid and solid char (**Figure 27**). Specifically:

- Gas stream (uncondensed gases from pyrolysis), containing CO, CO_2, H_2, CH_4, C_2H_6, C_2H_4;
- Tar/oil (condensed gases from pyrolysis) - acetic acid, acetone, methane; and
- Char - pure carbon, with other inert material and heavy metals.

The relative proportions of these products depend on the type of pyrolysis employed and the reaction parameters. The process may be followed by a combustion step and/or extraction of pyrolytic oil. High reaction rates minimise the formation of char, to maximise bio-oil production (up to 80% mass yield of bio-oil). The degree of 'vacuum' is a key influence on the quantities produced. Higher temperatures result in greater gas formation. Energy for reaction can be provided directly or indirectly.

The char, which is evacuated through an airlock system, is typically screened for various metal fractions. There is usually some contamination with heavy metals. Following screening, in integrated processes, the fuel may be sent to a combustion or gasification unit. Alternatively, it may be washed. If the pyrolysis process has incorporated liming in the process, this can lead to leaching out of chlorine as calcium chloride, enabling the remaining fine coke residue to be used as auxiliary fuel in industrial applications, such as coal-fired power plants and in cement rotary kilns.

Where the desired output is chemicals for synthesis, a second gasification process is used to generate syngas, which is converted chemically into methyl alcohol or ethanol. The synthesis gas can be used either to substitute natural gas or to generate electricity.

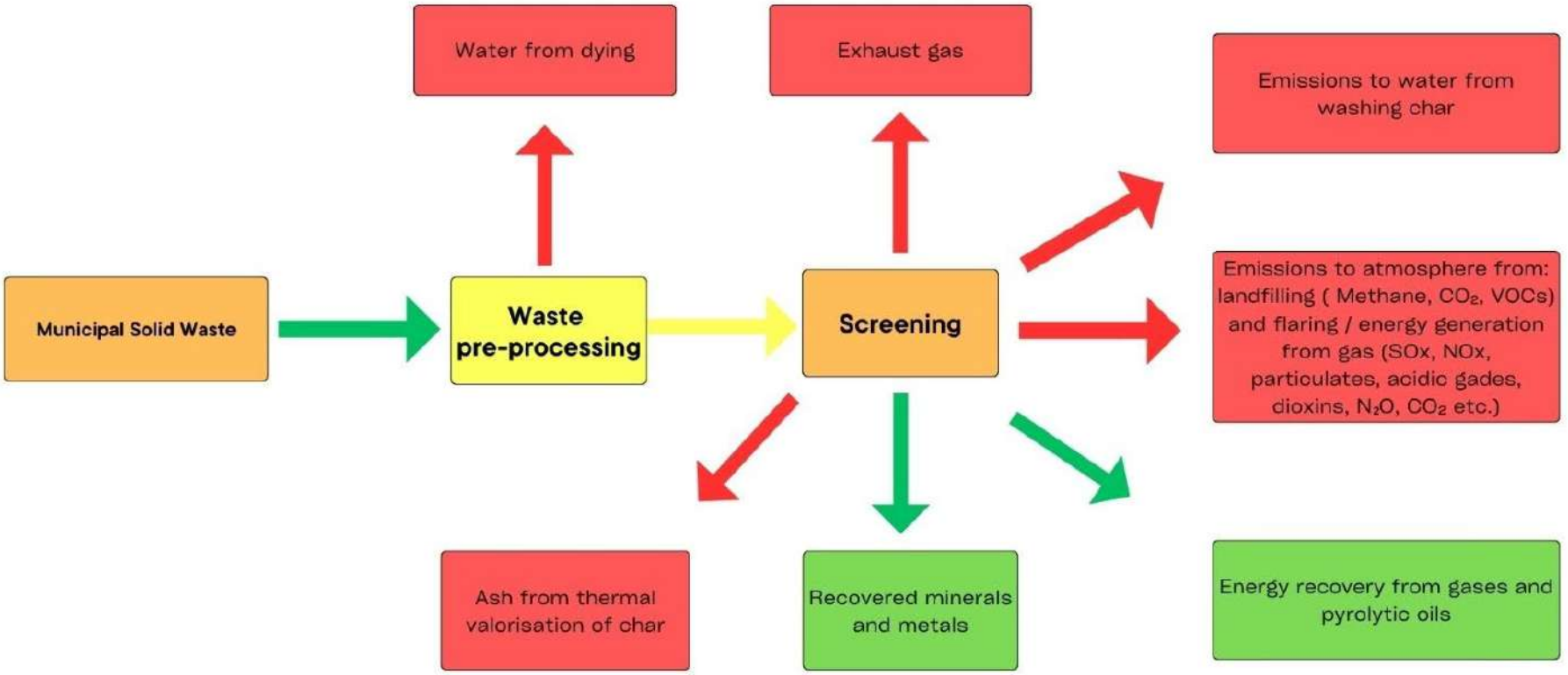
The recoverable energy content varies from 200 to 400 kWh/t of waste. Energy production and greenhouse gas production are lowered due to the starved air conditions. Less volatile heavy metal species remain in char while volatile species need to be captured by gas cleaning systems and treated as hazardous materials.

Regarding the flue gases and wastewater generated by the facility these can be treated by means of common pollution prevention technologies. The heat from the flue gas can be recovered by means of a boiler with a super heater and economizer for the generation of high-pressure steam.

4.14. Gasification

Gasification involves heating carbon-rich waste in an atmosphere with slightly reduced oxygen concentration. The majority of the carbon is converted to a gaseous form leaving an inert residue from the break-down of organic molecules.

Gasification is a thermos-chemical process involving several steps:



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 27: Schematic Representation of Pyrolysis Inputs and Outputs

- First, carbonaceous material is dried to evaporate moisture;
- Depending on the process, pyrolysis then takes place in a controlled, low air environment in a primary chamber, at around 450ºC, converting the feedstock into gas, vapourised liquids and a solid char residue; and

Finally, gasification occurs, in a secondary chamber at between 700-1000ºC (dependent on gasification reactor type

In the gasification stage, pyrolysis gases and liquids and solid char undergo partial oxidation into a gaseous fuel, comprising a variety of gases (dependent on reactor configuration and oxidant used). These gases include carbon monoxide, carbon dioxide, hydrogen, water, and methane (and much smaller concentrations of larger hydrocarbon molecules, such as ethane/ethene). Oils, ash tars and small char particles are also formed in the reaction, acting as contaminants. The heat source for the gasification process can be heated coke. Superheated steam can also be injected at this point to facilitate the conversion into gaseous fuel.

The process varies for different specific technologies and is generally patented. The conversion process can utilise air, oxygen, steam or a combination of these gases. Gasification using air - the most widely used technique - produces a fuel gas suitable for boiler/engine use, but it is difficult to transport in pipelines. Nitrogen is evolved since air is used in the oxidation process.

Gasification using oxygen (which is more expensive due to cost/hazard of oxygen generation) produces a medium heating value (MHV) gas which can either be used as a synthesis gas (for example, for conversion to methanol) or for limited pipeline distribution. Steam (or pyrolytic) gasification produces a MHV gas.

A variety of gasification reactors (running at either atmospheric pressure or pressurised) have been developed, including fluidized and fixed bed. There are numerous advantages and disadvantages to each configuration. Circulating fluidized bed gasifiers are seen as more versatile since char can be recycled.

4.14.1. **Inputs**

As for pyrolysis.

4.14.2. **By-Products**

Incomplete oxidation due to reactor design and feedstock anomalies can contaminate the product gas, and where air is used, this will result in higher-than-expected NOx emissions.

Small quantities of hydrochloric acid, hydrofluoric acid, hydro baric acid, sulphur dioxide and nitrogen oxides and particulates are produced along with trace metals or heavy metals, notably cadmium and mercury.

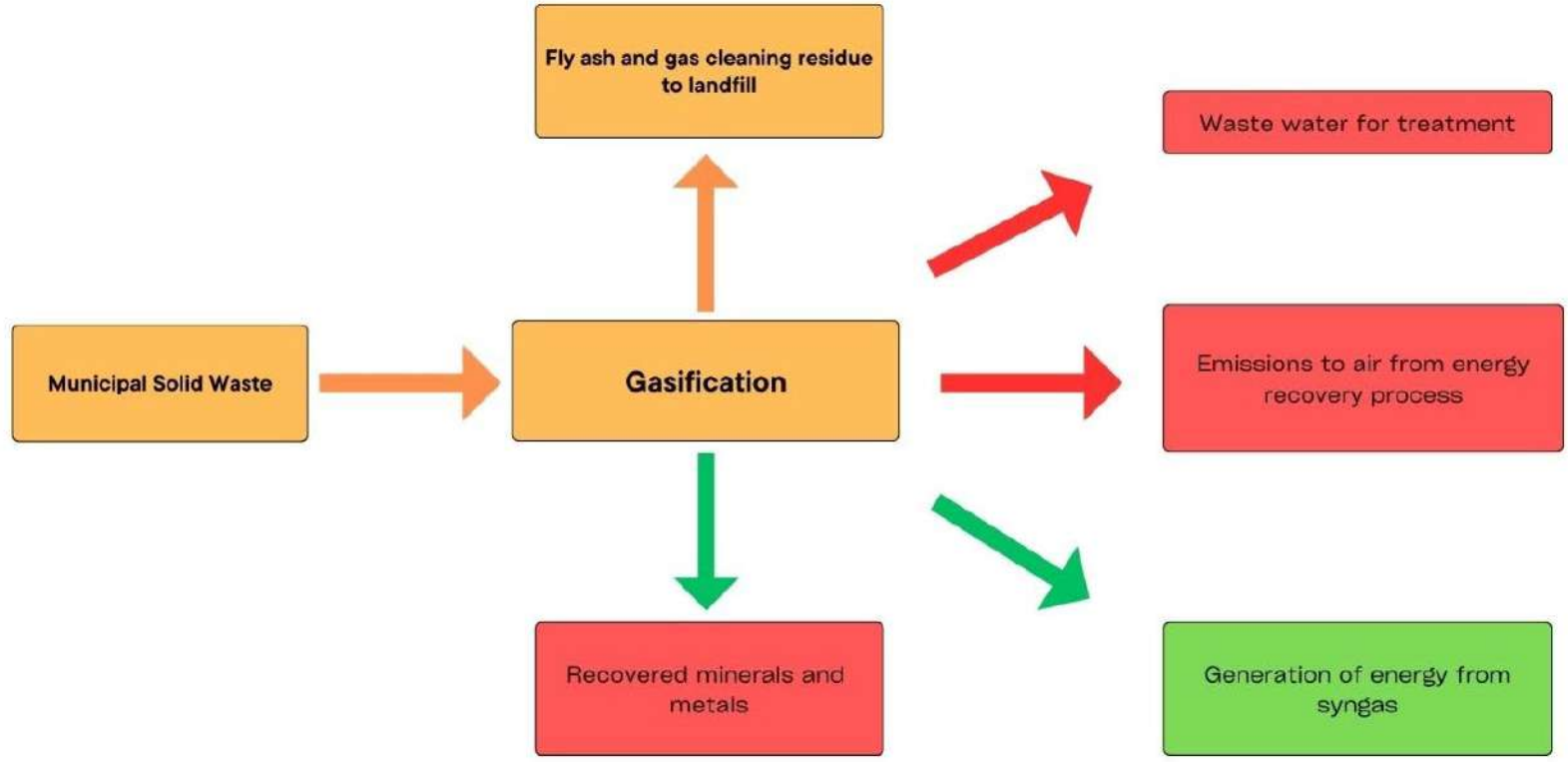
4.14.3. **Outputs**

The fuel gas can be used in:

- Thermal combustion engines to produce energy;
- A steam turbine or a boiler; or
- As a raw material resource to produce methanol, hydrogen or methyl acid.

Syngas includes CO_2, CH_4, CO, H_2, nitrogen (N_2) and ammonia (NH_3).

Figure 28 provides a schematic overview of the inputs and outputs of gasification.



Note: Brown arrows represent residual material
Red arrows represent 'negative outputs' and impacts (environmental costs)
Green arrows represent 'positive outputs' and impacts (environmental benefits)

Figure 28: Schematic Representation of Gasification Inputs and Outputs

4.15. Assessment of Thermal Treatment

One of the principal constraints on the use of incinerators is public opposition. In many countries, people simply do not want to live near these plants owing to problems of dis amenity, and the emissions of NOx, SOx, HCl, particulates, heavy metals and dioxins associated with the plant. The first five of these are known to have effects upon human health.

Major technical issues with pyrolysis include: heat transfer to the waste material; precise process control to achieve the desired mix and yield of products; and product separation and collection, especially of bio-oil, which needs to be condensed. Process energy is self-propagating. Pyrolysis tends not to be an efficient energy conversion technology since much of the fuel produced is consumed within the operation.

Gasification is widely considered as an energy efficient technique for reducing the volume of solid waste and for recovering energy. Useable energy of some 500 to 600 kWh per ton of waste is generated by gasification.

Gasification technologies have been operated for over a century for coal producing "town gas" and have long been promoted as being a viable, cleaner alternative to incineration for residual municipal wastes.

Gasification is more widely used and more developed than pyrolysis for several reasons. First, a highly efficient process produces a single gaseous product. Second, gasification does not have the heat transfer problems associated with pyrolysis. However, plants are known to have closed down due to waste variability and material handling problems. Newer processes have been developed in order to overcome these problems through extensive pre-processing of the feedstock waste.

Table 17 provides a comparison of the requirements and outputs of the different methods of thermal treatment. Of the three main technologies assessed, incineration is most widely developed and has the greatest flexibility with regard to handling and treating mixed MSW.

4.16. The Significance of Source Separation

MSW is currently collected and delivered as mixed waste to transfer stations, treatment plants and final disposal sites. All other waste, including some special and hazardous wastes (for example, clinical waste), is collected without differentiation.

Without either source separation or collection from individual sources (for example, market waste, green waste, and clinical waste), the following treatment options are not considered viable:

- In-vessel composting;
- Anaerobic digestion; and
- Clean MRF dealing with source separated dry recyclables.

The rationale for source-separation of wastes is that it makes it easier to deal with, and to recover value from, the resulting individual waste streams in the most appropriate manner. The quality of the materials recovered tends to be higher because of lower levels of cross-contamination with other components of the waste stream. Accordingly, the efficiency of the treatment processes advocated, as well as the possible adoption of alternative options, would be enhanced by segregating waste at source in order to establish clean feedstock for each of the treatment technologies.

For example, the percentage of recyclable materials could be increased if the potential for contamination was reduced by segregating at source and collecting dry recyclable materials separately. The method of processing of such wastes, in a clean MRF, would increase the recovery of materials.

Table 17: Comparison Between Different Methods of Thermal Treatment

Criteria	Incineration	Pyrolysis	Gasification
Waste acceptance	Residual waste	Most suitable for well-defined dry waste fractions from residual waste	Source separated dry waste only unless combined with better cleaning technology
Acceptance of Wet Organic Fraction (kitchen wastes)	Technically yes, but not applied to source-separated fractions (especially given low calorific value)	Technically possible but not likely to be applied to source-separated fractions	Technically possible but not likely to be applied to source-separated fractions
Acceptance of Garden and Park Waste	Technically yes, but not applied to source-separated fractions (especially given low calorific value)	Yes	Possible
Acceptance of Organic Waste from Hotels and Restaurants	Technically yes, but not applied to source-separated fractions (especially given low calorific value)	Yes	Possible, but normally no
Acceptance of Paper and Board	Technically yes, but not usually applied to source-separated fractions which are readily recyclable	Yes	Possible
Excluded waste fractions	None	Wet household waste	Wet household waste
Proven technology, track record	Yes; very common	Relatively few plants with continuous operation over long periods	Relatively few plants with continuous operation over long periods
Basic principle	Combustion	Anaerobic thermo- chemical conversion	Thermo- chemical conversion
Cost of treatment	Medium to very high	Medium to high	Medium to very high
Nutrient recovery	No	No	No
Energy recovery	Yes. Approximately 500 kWh (2MJ/ton waste) if electricity only. CHP plants may generate lower electrical output but total energy recovered increases to approximately 6-7 MJ/ton)	Yes. 0.7-1 MJ/ton waste. Also, energy containing product (char)	Yes. Approximately 2 MJ/ton waste
Total solid residuals, depending on waste (ton/ton waste)	0.17 - 0.3	0.2 - 0.4	0.17 - 0.3
Quality products for recycling	-	Char (0.2-0.4)	0.17 - 0.28

Criteria	Incineration	Pyrolysis	Gasification
(recovery, ton/ton waste)			
Other residuals possible for re-use with restrictions (ton/ton waste)	Metals (0.05) Bottom Ash(0.15 - 0.22)	Grit, Glass, Slag, Metals and Chemical bulk)	Clinker, Grit, Glass, Slag, Metals and Chemical bulk
Residuals for landfilling or other waste treatment	Fly ash etc. (0.02 -0.04)	(Char) (0.02-0.3)	Ash (0.03)

Determining the best option for specific components of the municipal waste stream implies that they are collected separately. Furthermore, the act of separation becomes an activity which serves to educate citizens as to what wastes they produce, and in what quantities.

There are two main alternatives for waste separation, and the choice between them has an important bearing on feedstock quality, particularly for biological treatment processes.

It is generally accepted that source separation provides the best quality feedstock for biological treatment with both a maximum organic content and minimum contamination with heavy metals, glass and plastics. Processing of source-separated organic waste results in high quality compost with a wide variety of applications or, in the case of AD, a quality digestate and a high volume of biogas.

4.17. Conclusion

It is understood that there are no short- to medium-term plans to introduce source segregation throughout the districts of Karachi. Accordingly, available options for treatment of MSW to divert this from landfilling are somewhat limited. **Table 18** summarizes options that appear to be viable. Whilst some options are considered technically viable, they may not be deemed acceptable necessarily from a cost-benefit perspective or from environmental considerations.

Centralised separation is the only route for obtaining a compostable/digestible fraction from residual waste. The techniques involved include mechanical processing, optical processing and hand-picking. The digestible fraction obtained inevitably is significantly more contaminated than source separated biowaste with inevitable consequences for the digestate's ultimate utilization and marketability. There is also the risk of larger non-separated components of the waste causing physical damage to treatment plants (by abrasion, blockages or tangling).

The financial sustainability of processing mixed MSW is often marginal and typically requires some form of cost recovery to the operator, either in the form of a substantial gate fee or a direct subsidy from the government. For this reason alone, where cost recovery is not a fundamental objective in the current waste management system, it would appear that the cost benefit ration of any form of treatment of mixed MSW is likely to be significantly negative.

Table 18: Potentially Viable Treatment and Disposal Options

Option	Sub-Option	Viability		Remarks
		Yes	No	
Landfill	Open dumping		■	Not viable or sustainable from environmental considerations.
	Sanitary landfill	■		Fundamental requirement for the disposal of all residual wastes.
Biological Treatment	Composting	■		Output of low quality from mixed MSW – high degree of contamination likely restricting markets for the product. Sustainability and viability influenced by degree of contamination and the quality of the compost.
	Anaerobic Digestion		■	
Material Recovery	Dirty MRF	■		Viability marginal given potential for contamination from mixed MSW. Low % recovery. Sustainability and viability influenced by degree of contamination and market prices for recovered materials.
	Clean MRF		■	Not viable without segregation at source.
	MBT	■		Viability marginal given potential for contamination from mixed MSW. Material recovery – as for dirty MRF. Grey compost of low quality. Viability improved if market exists for RDF.
Thermal Treatment	Incineration		■	Calorific value of mixed MSW may be too low without preparation of RDF. High investment and operational cost.
	Pyrolysis		■	Requires pre-sorting of mixed MSW. High investment and operational cost.
	Gasification		■	Requires pre-sorting of mixed MSW. High investment and operational cost.

5. CONCEPTUAL DESIGN OF JAM CHAKRO LANDFILL

5.1. Introduction

There are a variety of different approaches within the term 'engineered' landfill that range from simple dry encapsulation of the waste mass to minimize the ingress of water into the waste and the migration of leachate from the base of the landfill, through to active and controlled management of landfill process operations that aim to speed up the rate of waste decomposition, landfill gas evolution and stabilization of the waste mass. As the level of sophistication increases in the management of landfill process operations, so too does the complexity of site engineering.

Three main types of engineered landfill may be recognised:

- A 'standard' sanitary landfill in which containment measures are installed to minimize leachate generation, allied with the cell method of site operation, capture and treat any leachate generated and capture and treatment of evolved landfill gas produced from anaerobic decomposition of the waste, either by flaring or conversion to electricity;
- A 'bioreactor' landfill in which the same types of engineering measures are employed as for a 'standard' sanitary landfill but coupled with recirculation of leachate back to the waste mass to exert process control over the rate and degree of waste decomposition, to reduce the requirement for leachate treatment and to enhance the rate of gas evolution by anaerobic decomposition; and
- A 'semi-aerobic' landfill (Fukuoka method) in which air is allowed to enter the base of the landfill in order to achieve waste decomposition aerobically, as against anaerobic decomposition.

5.1.1. 'Standard' Engineered Landfill

Traditionally, engineered landfill development has focussed on the adoption of measures to isolate the waste mass waste using the principle of 'containment' (**Section 4.3.1**). Landfilled waste is separated from the environment by engineered barriers (liners) (**Figure 29**), and both leachate and landfill gas are collected (**Figure 30**) and treated, including for a sustained period of time after the closure of the landfill.

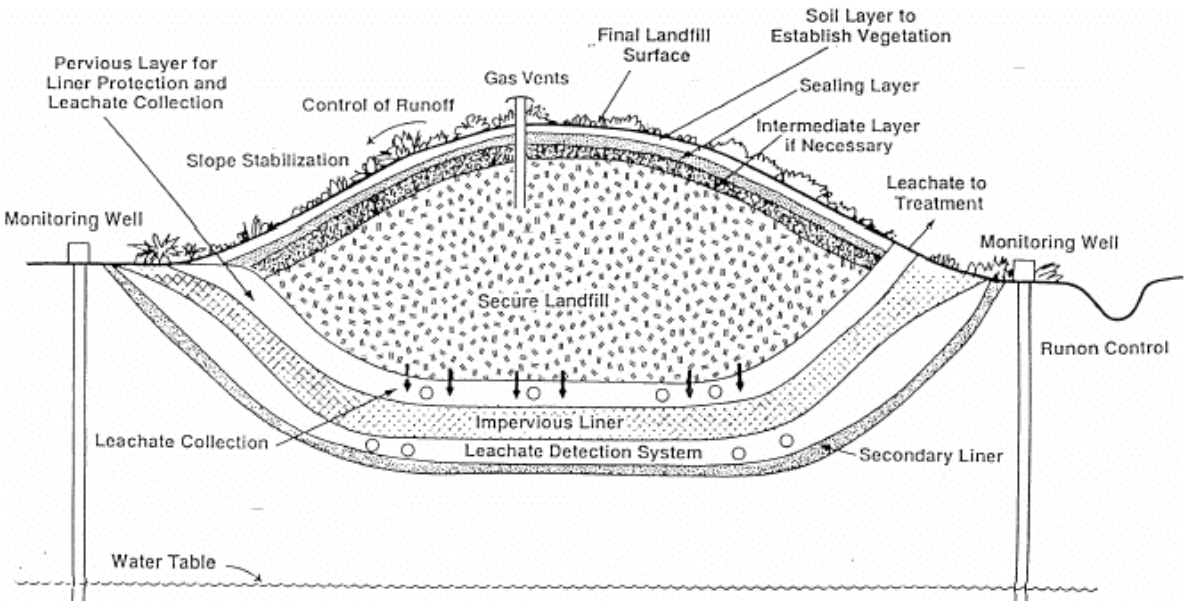


Figure 29: Typical Cross-Section Through an Engineered Landfill



Figure 30: Leachate Collection Pipework on the Base of a Lined Engineered Landfill

Decomposition of waste occurs anaerobically and, depending upon the composition of the deposited waste, the climatic regime and operational controls during waste filling, can result in strong leachate and extended periods of landfill gas generation that require management over several tens of years, even after landfill closure (post closure maintenance). There is a long-term legacy cost often associated with the development of a sanitary landfill since the stabilization of the waste mass occurs over a prolonged period of time.

5.1.2. **Bio-Reactor Landfill**

In order to speed up the stabilization process attention has turned to the operation of a sanitary landfill as a bio-reactor landfill similar in concept to an anaerobic digester but at a larger scale. The landfill is designed in a similar manner to a standard landfill. The difference between the two is the increased need for maintenance and care during the process of waste filling, especially in re-infiltration of leachate into the landfill body.

The basic principle of the bioreactor landfill concept is that by optimising the operational control and environmental conditions of the deposited waste (mainly moisture content) the degradation of the waste will happen much more rapidly and be more complete. The main aim is to stabilize the waste within a reasonable time frame and in this way to assure an acceptable risk to the environment in the event that failure of the basal liner (engineered containment) occurs.

In brief, a bioreactor landfill is a complex sanitary landfill that uses enhanced microbiological processes to transform and stabilize the readily and moderately decomposable organic waste constituents within five (5) to ten (10) years of bioreactor process implementation. The bioreactor landfill increases significantly the extent of organic waste decomposition, conversion rates and process effectiveness over what would otherwise occur within the landfill. Stabilization means that the environmental performance measurement parameters (landfill gas composition and generation rate and leachate constituent concentrations) remain at steady levels, and should not increase, in the event of any partial containment system failures beyond five (5) to ten (10) years of bioreactor process implementation.

The bioreactor landfill requires certain specific management activities and operational modifications to enhance microbial decomposition processes. The single most important and cost-effective method is liquid addition and management. Other strategies, including waste shredding, pH adjustment, nutrient addition, waste pre-disposal and post-disposal conditioning, and temperature management, may also serve to optimise the bioreactor process. Successful implementation also requires the development and implementation of focused operational and development plans. The schematic of a bioreactor landfill is show in **Figure 31**.

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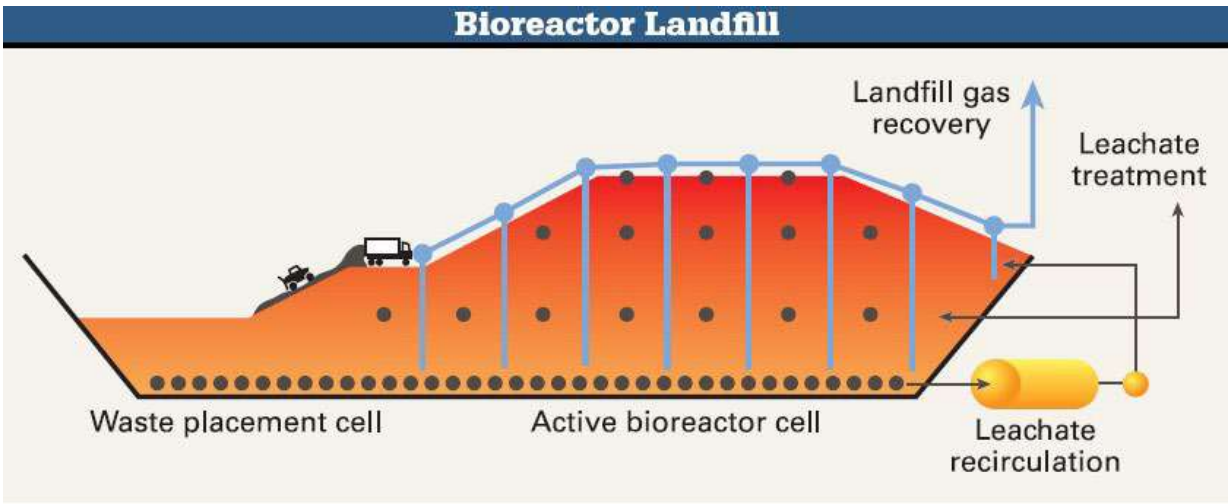


Figure 31: Typical Cross-Section Through a Bioreactor Landfill

As an alternative to conventional ("dry tomb") landfills, bioreactor landfills are designed to promote the rapid decomposition of the organic portion. This is accomplished by maintaining optimal moisture conditions at or near field capacity (approximately 34% to 65 %). At a minimum, leachate is injected into the landfill to stimulate naturally occurring micro-organisms that can be either aerobic (with oxygen) or anaerobic (without oxygen). However, bioreactor landfills often need other liquids such as storm water, wastewater, and wastewater treatment plant sludges to supplement leachate for maintenance of optimal moisture levels. Liquids are added to the landfill through vertical wells, horizontal pipes, or trenches. The primary purpose of a bioreactor landfill is to accelerate decomposition of the organic fraction to less than ten (10) years (that is, rather than thirty (30) or more years). Another aim is that through the bioreactor technology (physical, chemical and biological process control with adequate leachate management) to recover energy within the waste in the form of landfill gas and, possibly, residues as manure.

There are three basic configurations of a bioreactor landfill:

- **Aerobic** – leachate is collected from the bottom layer of the bioreactor landfill, stored in tanks and then re-circulated in the landfill body in a controlled manner (see also semi-aerobic landfill, **Section 5.1.3** below). By using vertical or horizontal wells, air is injected into the waste in order to help aerobic activity and to accelerate waste stabilization. The degradation of waste occurs under conditions similar to compost operations. The by-products of aerobic degradation are carbon dioxide (CO_2) and water (H_2O);
- **Anaerobic** – some moisture is added to the waste (either re-circulated leachate or from other sources) in order to obtain an optimal moisture level in the landfill. Waste biodegradation will take place in the absence of oxygen (anaerobic process) and will produce landfill gas (LFG). Without air, methanogenic bacteria are promoted to accelerate waste degradation. Landfill gas is a composition of methane (CH_4) and carbon dioxide (CO_2) and can be extracted from the landfill body in order to minimize greenhouse gas emissions and to transform it to energy; and
- **Hybrid (Aerobic – Anaerobic)** – this bioreactor type accelerates waste biodegradation by employing a sequential aerobic-anaerobic treatment in order to achieve a rapid degradation of

organic matter in the upper sections of the landfill and the collection of landfill gas from lower sections. Operation of a hybrid bioreactor results in an earlier production of landfill gas compared to aerobic bioreactor landfills.

Engineered bioreactor landfills have the following advantages, **if properly implemented and managed**:

- Rapid conversion/stabilization of organic waste;
- Material recovery - by encouraging microbial degradation of solid waste and removal of inert end products through periodical engineered mining, the bioreactor landfill cells could be re-used, and the end product could be used for the final closure layer of the landfill during closure works. The opportunity of re-using the bioreactor landfill cells improves significantly the economics of the bioreactor cell technology;
- Overall reduction of contamination risk over life span of the landfill - this occurs as a result of a decrease in contaminant concentrations during the operating period of the bioreactor landfills;
- Gaining additional volume – due to mining after a period of 10 years and screening of organic materials for material recovery purposes and potential production of refuse derived fuel (RDF) additional tipping volume is gained and the life span of the sanitary site can be extended by about 40-50%;
- Energy recovery – gas quantity and quality can be maximised based on maintaining optimal conditions. By turning the gas into energy the opportunity exists to achieve revenues from feeding electricity into the national grid;
- Reduction of environmental impacts, such as odours, surface seeps, landfill fires and physical instability of the material, due to increased moisture and higher densities; and
- Integrated leachate treatment as a consequence of re-infiltration. Organic and pollutant particles are filtered within the landfill body and are degraded by microbes, and the volume of leachate is reduced adhesion to the surface and evaporates.

5.1.3. Semi Aerobic Landfill - Fukuoka Method

This method, which is akin to the aerobic bioreactor landfill discussed above, is based on the introduction of air into the waste mass as waste decomposition proceeds. The primary method of achieving this is to place large diameter perforated pipes at the base of the landfill (**Figure 32**), with gravel surround, through which leachate is drained continuously, whilst allowing the passage of air into the base of the landfill.

Heat from the fermentation of microorganisms provides the driving force to generate convection current within the landfill, which is comparable to an uprising current of heated water from the bottom of bath tab to the upper part. In this way, fresh air is introduced to the bottom part of landfill from outside. A dense network of vertical pipes that connect with the pipes at the base allow air to circulate by convection within the waste mass, as well as the drainage of leachate (**Figure 33**).

Principal benefits claimed from this method of landfilling, compared to more traditional encapsulation of waste under anaerobic conditions, include the following:

- The decomposition of waste is accelerated – hence the time to achieve stabilization of the waste is reduced and results in less post-closure maintenance and aftercare;
- Concentration of contaminants in the leachate is reduced;
- Creation of an aerobic condition results in less generation of methane gas – CO_2 is produced rather than CH_4 - which reduces the potency of greenhouse gas emissions; and
- Some components of engineering can be undertaken using ‘locally-available’ materials (e.g. waste oil drums for vent pipes) which may result in lower development and operational costs.



Figure 32: Large Diameter Pipe on the Base of a Semi-Aerobic Landfill

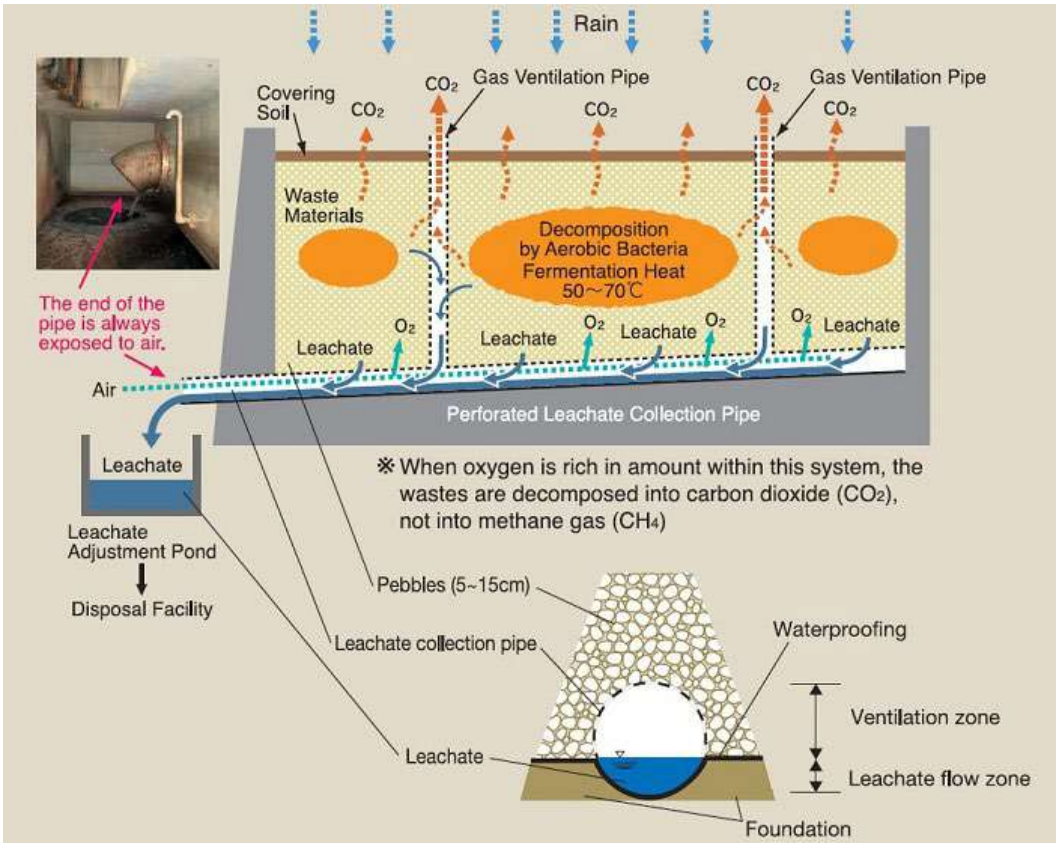


Figure 33: Schematic Section Through a Semi-Aerobic Landfill

5.1.4. Discussion

Semi-aerobic landfills have primarily been developed in the Asia-Pacific region, including small island nations, but have gradually been tried in other countries in south-east Asia (for example, Malaysia) and proposed to be adopted in Africa. Where successful, reductions in methane emissions of up to 40% have been reported.

Key considerations that influence the applicability of the process are:

- Suitable for landfills that are developed above existing natural ground (that is, land raise) since the process relies on rapid drainage of leachate by gravity from the base of the landfill and the ability to introduce air naturally into the base of the landfill;
- The ability to maintain leachate levels as a small percentage of the internal area/volume of the base pipes is critical since if the pipes are saturated then the ingress of air is prohibited;
- Climate has an impact on the rate of decomposition – arid climates reduce the rate of decomposition unless leachate is recirculated back to the waste mass to maintain moisture levels (aerobic bioreactor landfill);
- The organic content of waste in many of the countries in which semi-aerobic landfills have been developed is, on average, relatively low which could account for the reduced quantity of methane generated, the lower strength of the leachate and the earlier than anticipated stabilization of the waste mass;
- Most semi-aerobic landfills have been developed with relatively small rates of waste inputs and not for sites which receive large quantities of mixed waste daily; and
- Where gravity drainage of leachate is not feasible then a variant can adopt the use of forced aeration to introduce air; however, this increases the complexity of operation considerably as well as the cost of operation.

A comparison of the three potential approaches is provided on **Table 19**.

Table 19: Comparison of Different Landfill Types

Criteria	Standard Landfill	Bioreactor Landfill	Semi-Aerobic Landfill
Suitable for above ground filling	Yes	Yes	Yes
Suitable for below ground filling	Yes	Yes	No
Leachate Drainage by gravity	Possible only for land raise	Possible only for land raise	Yes
Leachate drainage by pumping	Yes	Yes	Not required
Waste decomposition	Anaerobic	Anaerobic	Aerobic
Leachate strength	High	Moderate	Low
Leachate recirculation	Not required	Required	Not required
Comparative leachate treatment costs	High	Moderate	Low-Moderate
Dominant evolved gas	Mainly CH_4	Mainly CH_4	Mainly CO_2
Comparative greenhouse gas potency	High	High	Low-Moderate
Gas flaring for large sites	Required	Required	Not required
Potential Energy Recovery	Yes	Yes	No
Comparative cost of site development	Moderate	Higher	Higher
Comparative cost of site operation	Moderate	Higher	Lower
Waste stabilization period	> 30 years	5-10 years	5-10 years
Applicable for high rates of waste input	Yes	Yes	Not proven
Applicable in arid climates	Yes	Not proven	Not proven
Successful application in Pakistan	None	None	None

The core of the method for a semi-aerobic landfill is microbial fermentation, together with the precondition that aerobic conditions should be maintained - the method is not readily applicable in places with poor oxygen supply, such as in landfills developed in cells excavated below natural ground level. These topographic constraints do not exist with a standard landfill or an anaerobic bioreactor landfill, although any cell with a base a few metres below natural ground level will invariably require pumping of the leachate out of the cell base.

Neither semi-aerobic landfills or bioreactor landfills have been developed in Pakistan and, therefore, there is no experience in country of how these landfills operate and perform. Similarly, however, there is extremely limited experience of an engineered landfill of any description in Pakistan and certainly no successful development in the country to date.

With regard to the topography at Jam Chakro, it would appear possible to develop the western valley (**Section 3.4**, **Figure 11**) on the basis of a semi aerobic landfill since the natural slope is to the north and the presence of bedrock close to the surface precludes significant excavation to increase void capacity. Accordingly, the base grading of the cell would follow the existing topography and would permit leachate to be drained by gravity from south to north at a slope of approximately 2%.

The benefit of this approach in the western valley is the reduction in complexity of landfill engineering and, more importantly, in the reduced strength of leachate, the production of CO_2 rather than CH_4 and the more rapid stabilization of the waste mass, with reduced aftercare/post closure costs.

For the eastern part of the site, the situation is less clearcut since drainage of leachate by gravity is not feasible because of the shallow ground slopes and extended drainage path from south to north. A standard landfill, or a variant based on recirculation of leachate (bioreactor landfill) would appear to be more appropriate for this part of the site.

5.2. Chief Design Criteria

5.2.1. Design Standards

All work shall be carried out in accordance with good engineering practice and the latest revisions of all recognised and applicable International Codes of Practice, Standards and Specifications and their addenda.

Geosynthetic Research Institute ("GRI") standards shall be the reference standards for design of the necessary liners and other related geosynthetic products. These internationally recognised standards reference ASTM and USEPA for individual test procedures and protocols.

All sampling and analysis shall meet the requirements of ISO 17025. The laboratory shall have ISO 17025 accreditation for the methods used for analysis.

Should any conflict arise, the following ranking of precedence shall apply, in descending order:

- Pakistan statutory regulations;
- Project-specific specifications; and
- International standards and codes of practice.

All equipment installed within plant rooms or equipment cabinets, whether environmentally controlled or otherwise, shall be designed to meet IP54 enclosure protection. All equipment installed within open areas shall be dustproof and waterproof to IP65 enclosure protection and, where practicable, all exposed equipment shall be provided with a sunshade. All areas with buildings and processing facilities shall be provided with suitable lighting, with a minimum illumination level of 50 lux.

5.2.2. Waste Input

The site shall be designed to cater for up to 5,000 tonnes per day of collected MSW.

The site shall be designed to cater for the largest trucks (trailers) that potentially could operate and access the site which have a net waste capacity of approximately 55 tonnes (80 tonnes gross vehicle weight).

5.2.3. Operational Availability

The hours of operation for the Jam Chakro Sanitary Landfill shall be as follows:

Monday to Sunday - 5.00 AM to 10.00 PM

Whilst the site shall be open as a minimum during daylight hours for the receipt of MSW, it is designed to operate during night-time as required given the existing pattern of waste deliveries to the current dump site.

The landfill will be open on Public Holidays.

The design shall have sufficient redundancy and back-up arrangements, in case of the failure of any critical component of the facility, to remain functional for the receipt, recording and disposal of incoming waste no less than 99.5% of the time once the facility is in operation (public holidays excluded).

5.2.4. Acceptable Wastes

It is assumed that the types of waste shall be accepted at the site:

- Municipal solid waste from households and small commercial establishments;
- Commercial and institutional waste similar to MSW from households;
- Green waste and yard waste;
- Designated special or hazardous wastes; and
- Granular construction debris that can be used for the formation of internal site roads.

Designated hazardous and special waste will not be accepted at the site unless provision is made to accommodate these materials in a separate lined cell. These types of waste shall be restricted to residues from the treatment of medical waste (incinerator ash) and electronic waste. In addition, solid (non-liquid) chemical waste may also be disposed with suitable pre-treatment or if placed in encapsulated storage containers.

No hazardous waste or special waste shall be co-disposed with normal MSW. All incoming waste will be inspected and checked, either at the weighbridge (based on a waste manifest system) detailing the source and types of waste delivered and/or at the tipping face. Waste delivered to the site that does not meet the acceptance criteria will not be permitted and will be turned away.

5.2.5. Diversion of Recyclable and Compostable Materials

At the request of the Project Proponent provision has been made to include a dedicated area on site for the potential recovery of recyclable materials. This area will be made available to waste pickers only for sorting through specific loads of waste that are deemed to have a comparatively high percentage of recyclables.

Sorting operations, however, will not be a formal part of the site operations and will not be undertaken by the landfill operator. Similarly, there is no composting facility to be constructed at the site; therefore, organic wastes will be disposed directly to the landfill.

5.2.6. Unacceptable Wastes

Any waste that is not deemed to comply with any category of Acceptable Waste shall not be accepted at the site. No liquids or sludges will be accepted at the site; the only liquids and sludges disposed at the site will be those generated from on-site activities.

5.2.7. Design Life

The design shall attempt to provide sufficient disposal capacity to accept all incoming waste for a minimum period of ten (10) years. If feasible, provision shall be made for a minimum additional operational life span of two (2) years at the prevailing and projected rates of waste collection and delivery. Accordingly, the minimum disposal capacity required will be for 12 years of waste at 5,000 tpd.

The design shall maximise the available landfill footprint within the current site boundaries, whilst making adequate provision for support infrastructure. The site will accommodate all wastes generated on-site during both the construction phase and subsequent site operations

5.2.8. Infrastructure

The design shall adopt the following design life for the facility:

- civil works – 40 years;
- roads – 20 years;
- mechanical and electrical plant – 20 years;
- electronic control equipment – 15 years;
- cabling – 15 years; and
- utility services – 15 years.

5.2.9. Leachate and Landfill Gas Management

The design shall provide all required containment measures and treatment measures for the management of leachate and landfill gas generated during site operations and post-closure after the completion of filling, until such time as the risk of pollution to the environment is reduced to an acceptable level.

5.2.10. Special Waste Cell

The majority of the site shall be designed to receive MSW. The majority of waste materials generated in Karachi are collected as mixed waste and, therefore, contain potentially hazardous materials in addition to non-recyclable residual waste and potentially recyclable wastes including organic waste. These materials shall all be co-disposed in the landfill and the landfill containment engineering measures designed accordingly.

For special wastes that are delivered to the site separate from MSW the Project Proponent requires, subject to available capacity, that a dedicated cell be allocated for the disposal of such wastes and that they not be co-disposed with MSW.

5.2.11. Phasing of Site Development

The Project Proponent requires that all construction works for site development are undertaken under a single construction contract. Accordingly, the development of the sanitary landfill will be single stage rather than phased via progressive development cell by cell.

This requires that landfill base preparation works, such as base grading works, must be constructed for the whole of the landfill. The only exception is that the basal engineered lining system and the leachate

collection system shall be installed only in those cells which will receive MSW during the active life of the construction and operations contract. In addition, leachate treatment and landfill gas collection and treatment facilities must be constructed at the outset.

For those areas not filled with MSW in the initial stages of site operation, there is a requirement to provide only base grading without basal lining. Since the whole of the landfill base will be developed from the outset, there is a need to install stormwater drainage systems in the landfill base independent of any leachate collection system.

5.2.12. **Minimum Facility and Design Requirements**

The design is required to provide the following facilities and measures as part of the site development:

- Subdivision of the site into areas for the disposal of residual waste, in a series of working cells and phases;
- Phases are to be developed in one stage at the outset, together with all associated landfill engineering works, whilst the cells will be developed sequentially during landfill operations;
- Allocation of an area on site for the informal recovery of recyclable materials;
- Provision of all necessary engineering measures (barriers, collection and treatment systems) to mitigate the uncontrolled discharge of leachate into the surrounding environment.
- Provision of all necessary engineering measures (barriers, collection and treatment systems) to minimize the uncontrolled discharge of landfill gas into the surrounding environment;
- Provision of stormwater management systems around the waste disposal area and all processing areas to separate clean water from contaminated water and to provide adequate storage capacity to meet site needs for process water and to buffer storm water flows;
- Provision of controlled and secure access to the site, including security office, gate control, fencing and closed-circuit television (CCTV) monitoring of critical infrastructure and operations;
- Provision of access road and internal haul roads to all waste disposal areas and maintenance road(s) to processing and treatment facilities;
- Traffic management system for all vehicular traffic within the facility, including appropriate signage and traffic control measures;
- Provision of wheel and vehicle washing facilities for waste collection/delivery vehicles and operational mobile plant;
- Provision of workshop and storage facilities for the first-line on-site maintenance of mobile and fixed plant and equipment;
- Provision of waste reception facilities near the entrance to the site, for the monitoring and control of incoming waste loads, including weighbridge and supporting software for accurate recording of all incoming waste loads and outgoing products;
- Provision of parking lot for site personnel and visitors;
- Provision of adequate facilities for worker amenity, including for changing, washing, restrooms and eating;
- Provision of support buildings for site administration, control room(s), for meetings and for training;
- Provision of electrical supply and potable water supply to all buildings;
- Provision of fire and loss prevention systems to ensure the integrity of site infrastructure and to meet emergency response needs; and
- Provision of all necessary mitigation measures to mitigate the impact of site construction and operation on the surrounding environment and local community.

5.3. Overview of Site Development

5.3.1. Introduction

For practical purposes, the site is subdivided into four separate areas (**Figure 34**):

1. Access road corridor from the existing entrance to the dump site to the new sanitary landfill site;
2. An administration and waste reception area ('Administration Area'), at the south-east corner of the site at the end of the access road corridor;
3. The landfill *per se*, which occupies the majority of the project site; and
4. An area for the treatment of leachate and landfill gas at the north-east corner of the site.

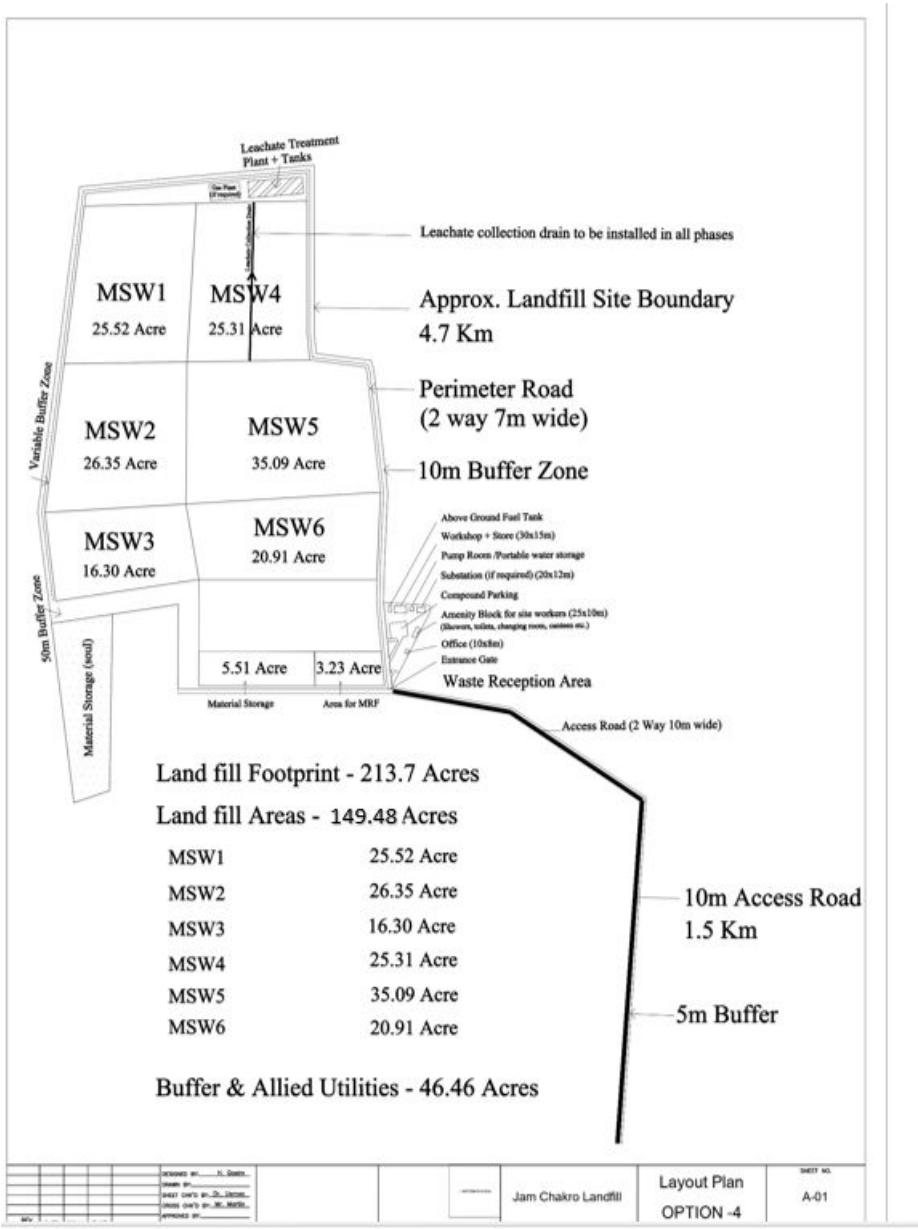


Figure 34: Overview of Potential Site Development Phasing

5.3.2. Site Access

Since there is currently no access road to the proposed sanitary landfill, a new access road shall be designed and constructed which comes off the link road close to the existing weighbridge and site office of the dump

site. It runs north for a distance of approximately 850 m before swinging westwards for a further 650 m to enter the waste reception area at the south-east corner of the site (**Figure 34**).

5.3.3. Buffer Zones and Standoffs

A buffer zone, a minimum of ten (10) metres has been adopted all around the site perimeter. This buffer zone shall be used to develop the following:

- Perimeter boundary wall for access and litter control;
- Vegetative planting for screening, litter and odour control;
- Internal roads to the waste disposal area, plant areas and for site maintenance; and
- Stormwater drainage to prevent run-on into the site and to capture run-off from any restored surface of the waste disposal area.

Along the south-western boundary of the site, adjacent to nearby residential development at Haji Ibrahim Goth, the distance to the landfill margin is wider, being a minimum of 15 m, but for the most part ranging between 20 m and 50 m or more.

In the proposed location of the treatment plants in the northern part of the site the buffer zone extends to approximately 50 m in width.

5.3.4. Administration Area

A list of proposed infrastructure to be developed and constructed/installed at the landfill, together with the approximate indicative sizing, is summarized on **Table 20** and is based upon consideration of functional requirements for landfill operation. Final sizing will be based on, *inter alia*, the available site geometry and utility requirements.

Table 20: Support Infrastructure

Component	Typical Size	Type
Weighbridge	100 ton, 18 m x 3.5 m	Surface mounted, 1 No.
Weighbridge Office	3 m x 3 m	Brick/concrete
RFID Readers/system		
Security office (site entrance)	12 m x 9 m	RCC
Entrance Gate - vehicle	12m W	Double leaf/sliding gate
Entrance Gate - pedestrian	1 m W	
Boundary wall	2.40 H	
Emergency access gate	6 m W	Double leaf
Administration Office	23 m x 10 m	RCC, 2 storey
Amenity Block	27.5 m x 9 m	RCC
Testing laboratory	20 m x 15 m	RCC
Mosque	9 m x 6 m	RCC
Parking for staff vehicles	18 m x 10 m (size varies)	Covered shelters
Workshop	20 m x 20 m	RCC
Store	10 m x 15 m	Combined with workshop
Workshop Apron	20 m x 15 m	Hardstanding
Parking yard for trailers		
Transformer		Sized based on site load list
Solar panels		Sized based on site load list + 30%
Standby generator	Mobile, diesel, 100 kVA	Emergency back-up (critical systems only)
Substation	20 m x 12 m	RCC
Water Reservoir	10,000 gallons	Potable water

Component	Typical Size	Type
Water Reservoir	25,000 gallons	Raw water – wash water
Vehicle cleaning		High pressure wash system for trailer bodies and wheels, hose bibs
Wash water collection system		Sump and sedimentation tank
Leachate collection system and chambers		
Water Borehole		Raw water
Sewerage system		Septic tank and soakage pit
Fire Water Tank	50,000 gallons	
Foam Tank		
Fire alarm & detection system		Buildings
Fire Fighting System		Hydrants/hose reels as per NFPA
Radio tower		
Light posts	6 m high	Floodlights
Stormwater collection system		Sump and drains/rainwater harvesting
CCTV system		Security and treatment plant areas
Landscaping and buffer zones	5 m W (varies)	Grass, shrubs, trees
Irrigation system		Manual
Signage		As required

One potential arrangement of the Administration Area is illustrated on **Figure 35**.

5.3.5. Landfill Footprint

The landfill footprint has been optimized to maximise the available space for the disposal of MSW and, hence, extend the lifespan of the landfill to the maximum extent possible. The footprint occupied by the landfill is approximately 150 acres (approximately 62.5 ha.) and comprises just under 70% of the total site area.

The landfill footprint has been subdivided into six areas (MSW1-MSW6), nominally termed Cells', as indicated on **Figure 34**. Smaller tipping cells will be developed within each Cell during site operations. The subdivision of Cells is indicative and will be adjusted and optimized during detailed design to provide an approximate equal lifespan for planning purposes.

Each Cell is separated by inter-Phase embankment designed to separate the Cells both for leachate and stormwater management and control and for counter-bearing to provide lateral restraint to the waste mound during disposal operations.

In the eastern part of the site (Cell MSW4-MSW6) leachate collection systems and landfill gas management systems would be independent in each Cell; in the west the natural topography and gradient to the north dictates that Cells MSW1 to MSW3 are linked and have a common drainage system. Provision has been made for the recirculation and re-infiltration of leachate back to the landfill area to enhance the rate of waste decomposition and waste stabilization.

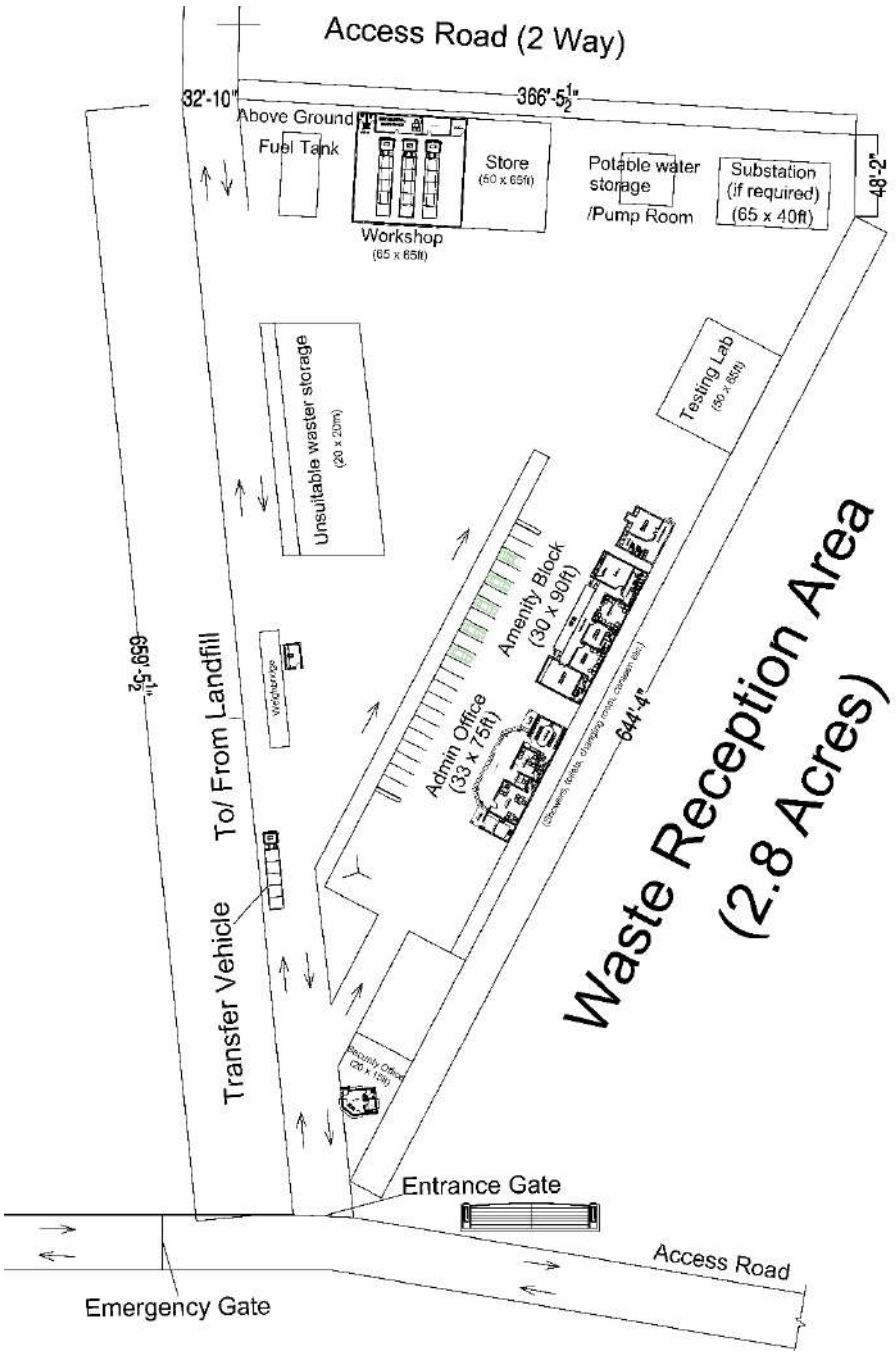


Figure 35: Overview of Potential Arrangement of Waste Reception Area

5.3.6. Treatment Plants

The north-east corner of the site has been allocated for the treatment plants for the management of leachate and landfill gas. The plants are located at the lowest elevation of the site to facilitate leachate drainage by gravity and to minimize pumping requirements.

The leachate treatment area will comprise a series of leachate tanks served by leachate transfer pipes from the leachate collection sumps in each Cell. A leachate recirculation system (re-infiltration system) will be developed at the leachate holding tanks to permit the transfer of leachate back to the waste mass; re-pumping of leachate into the landfill body shall provide for increased compaction and for maintaining the moisture content at an optimum level for maximum gas generation and yield.

A solar plant shall be designed to meet initial site power requirements, for all support infrastructure.

A gas treatment plant is proposed to be located adjacent to the leachate treatment area. This will comprise a series of flares to burn off accumulated and captured landfill gas. As the volume of gas generated at the site increases, it is proposed to install gas engines to convert the captured gas to electricity, to supplement site power requirements. Excess electricity generated above the site power demand can be exported back to the grid. An alternative location for the gas plant would be adjacent to the Waste Reception Area.

5.3.7. **Roads**

The majority of the landfill will be surrounded by a perimeter road for both waste delivery vehicles and to facilitate maintenance. Different types of roads are proposed depending upon the assessed traffic load and function.

For waste delivery vehicles access roads shall be two lanes, a minimum of 6.5 m wide and provided with double surface dressing. Maintenance roads shall be one lane, minimum of 4 m wide and surfaced with gravel.

The Administration Area will be paved to the same standard as that of the primary roads used by waste delivery traffic.

Within the landfill temporary haul roads, 6 m wide and surfaced with free-draining granular material, shall provide access to the tipping area.

5.3.8. **Stormwater Drainage**

Stormwater drainage channels shall be installed on the landfill side of the perimeter road to prevent runoff from the road entering the waste disposal area and to intercept runoff from the landfill surface once restored. Stormwater will be directed towards a series of retention ponds which will trap any entrained sediment.

All stormwater run-off from buildings and from paved surfaces in the Administration Area will be intercepted and directed to a retention pond in the Administration Area (rainwater harvesting).

Rainwater collected in the stormwater ponds may be used as a source of raw water, when available, for:

- Flushing of sanitary fixtures in site buildings;
- Cleaning of external hard surfaces in the Administration Area;
- Wash water for use in the Wash Bays;
- Dampening of dust on site roads;
- Irrigation water for landscaped areas in the Administration Area; and
- Fire water for fighting in the Administration Area and the landfill.

5.3.9. **Site Security**

Security of the site will be achieved by the following measures:

- Boundary wall around the whole of the facility;
- Lockable entrance gates on each entry road to, and exit road from, the site;
- Gate House (security office) at the site entrance, manned by security personnel;
- Internal fencing to the recyclable storage area;
- CCTV system covering critical areas of the facility - at the site entrances, at the treatment plant area and at the Administration Area; and
- Internal fencing to the leachate plant and landfill gas plant areas.

5.4. Preliminary Landfill Engineering Design

5.4.1. Introduction

The recommended approach for disposal of MSW delivered to the site is conventional landfilling supplemented by the recirculation of leachate to the waste mass to assist with compaction of the waste. Addition of water is required because of the prevailing climatic regime which demonstrates a significant soil moisture deficit on an annual basis.

Recirculation of leachate has the added benefit of providing treatment of the leachate by the binding of contaminants within the waste mass as the waste decomposes, whilst also providing optimal conditions for the generation of landfill gas under anaerobic conditions which can be captured and, subsequently, converted to electrical energy.

Notwithstanding this, the option exists to trial a semi-aerobic landfill in the western valley to gauge the efficacy of this approach and to attempt to reduce the requirements for leachate treatment and to limit greenhouse gas emissions at least in the initial stages of landfill development. It is recommended that this approach should be adopted for the western valley.

Should a semi-aerobic landfill not prove to be beneficial, then the landfill in the western valley can be converted to a traditional contained landfill by modifying the outlet of the leachate collection system at the northern end of the valley.

5.4.2. Perimeter Embankments

Perimeter embankments shall be constructed at both ends of the western valley in order to increase the volumetric capacity of the landfill. Provisionally, mall embankment dams, up to 8 m high, will be constructed across the southern end of the vally as well as the northern end of the valley. Dam slopes shall be 1V:3H and be formed of suitable granular fill obtained from site-won material. Outer dam facing shall be of low permeability and suitable to maintain a vegetative cover to inhibit erosion.

For the eastern par tof the site, small perimeter embankments up to approximately 3 m high shall again serve to increase the volumetric capacity of the site. These embankments, constructed along the northern, eastern and southern margin of the landfill will provide some lateral restraint to the waste mound.

5.4.3. Interphase Embankments

Geometry

Small embankments, between 2 and 4 m high, will be constructed between each Cell. The inter-Phase embankments serve to compartmentalize each phase of the landfill with respect to containment engineering, leachate collection and management and stormwater management.

Material of Construction

The embankments will be formed from site-won excavated soils compacted to >95% of the Maximum Dry Density (MDD) and at 0% to +2% above the Optimum Moisture Content (OMC).

Stability of Embankments

Geotechnical results (refer to **Annexure C**) indicate that site-won materials have high frictional strength with an adequate Factor of Safety (FoS) to be constructed at slopes of 1V:3H under both operational (FoS > 1.6) and seismic loads (FoS > 1.15).

5.4.4. Site Preparation

Site Clearing

The site will be cleared on existing vegetation in stages in advance of the commencement of construction activities across the site. Cleared vegetation shall be shredded and stockpiled for use in site greening and landscaping works. Large trees may be cut for timber and removed from site.

Groundwater Control

Temporary groundwater control in advance of construction activities will be required in any area where groundwater is encountered. Groundwater control may be achieved by the construction of shallow trenches excavated to rockhead and by the use of temporary sumps and dewatering pumps. All groundwater shall be clarified in sedimentation ponds before it is permitted to be discharged off-site. Groundwater shall meet national water quality standards before it is discharged off-site.

Excavation of Superficial Material

Excavation of superficial materials at the site is required to achieve the design grades and elevations on the landfill base, the levels on the perimeter of the landfill and for other site construction activities (foundations for structures, road construction).

In the western valley, the upper slopes are covered with a very thin veneer of gravelly soil which can be readily removed. In the eastern part of the site, the thickness of superficial soils is greater and is underlain by extremely weak to weak sandstone which will require to be excavated to achieve the design grades. Conventional construction equipment (excavators, dozers with rippers, wheel loaders, dump trucks, etc.) are suitable for this purpose.

Blasting of Rock

It is possible but not likely that some blasting of rock will be required on the western slope of the western valley to remove a re-entrant and achieve the design grades and elevations on the base of the landfill. Based on field observations, the majority of the limestone bedrock is suitable for being ripped.

Recovered rock may be crushed on-site and re-used in the permanent works if it meets the required properties for dam fill materials and road works.

Temporary Storage of Site-Won Materials

Screening and stockpiling of site-won materials will be required where such materials are re-used in the permanent works. Excess material and materials unsuitable for use in the construction works will be stored in temporary stockpiles located within the southern parts of the site close to the waste reception area.site (**Figure 34**).

Stormwater Management

Construction works, including excavation and grading works, should be programmed for the dry season in order to reduce the requirement for stormwater management. Temporary berms, bunds and ponds shall be constructed to control stormwater flows in the event of inclement weather and to avoid the transportation of silt and sediment off-site from areas that have been cleared of vegetation and are undergoing construction and development. Permanent surface drains shall be constructed to collect run-off from the restored landfill surface.

5.4.5. Base Grading

Base Preparation and Compaction

The base of the landfill will be prepared and shaped prior to the installation of containment measures designed to inhibit the migration of leachate into the surrounding environment.

Shaping, to the lines and elevations shown on the drawings, will involve one or more of the following:

- Excavation of superficial soils;
- Ripping or blasting of competent rock; and/or
- Filling of depressions.

Upon achieving design grades and elevations the base of the site will be cleared of any large obstructions and will be proof-rolled.

Bearing Capacity

The project site is underlain by competent bedrock at very shallow depth, with an average thickness of soil above rock lying typically in the range 0.1 m to 4 m. Building foundations shall be developed at rockhead level, for which there is more than adequate bearing capacity (refer to **Annexure C**).

Base Grading Profiles

Minimum slopes on the landfill base shall be no flatter than 1V:100H. Maximum slopes shall be no steeper than 1V:3H, including any embankments constructed at the landfill margin to generate additional void space and for lateral restraint and the side slopes of inter-Phase embankments.

In the western valley it is proposed to utilize the existing valley slopes which range between 1V:3H to 1V:5H without any significant alteration except locally as required to achieve a smooth sidewall for the landfill. In the valley floor the existing slope is adequate for leachate drainage by gravity (2%) (**Figure 36**). It is proposed to undertake minor excavation of superficial soils in the valley floor to achieve a uniform drainage profile.

The western slope of the eastern part of the landfill is also at approximately 1V:3H; therefore, little preparation work is required other than to smooth any protuberances and infill minor hollows. For the central and eastern part of the eastern area it will be necessary to re-shape the base to achieve satisfactory design grades for leachate drainage. This will require excavation of superficial soils and bedrock on the eastern side of the landfill site, within the alignment of the perimeter road. It is anticipated that excavation of up to 10 m may be required to achieve the necessary falls to drain leachate by gravity to the outer margin of the Cells (MSW4, MSW5 and MSW6) (**Figure 36**).

Stability of Cut Slopes

Geotechnical results (refer to Annexure C) indicate that site-won materials have high frictional strength with an adequate Factor of Safety to be constructed at slopes of 1V:3H under both operational (FoS > 1.6) and seismic loads (FoS > 1.1).

Slope Stability assessments have been conducted using a 2D Limit Equilibrium FEM Slope Stability Analysis Software (Plaxis). The analysis method selected was based on the available parameters which indicated that Bishop's Method was appropriate.

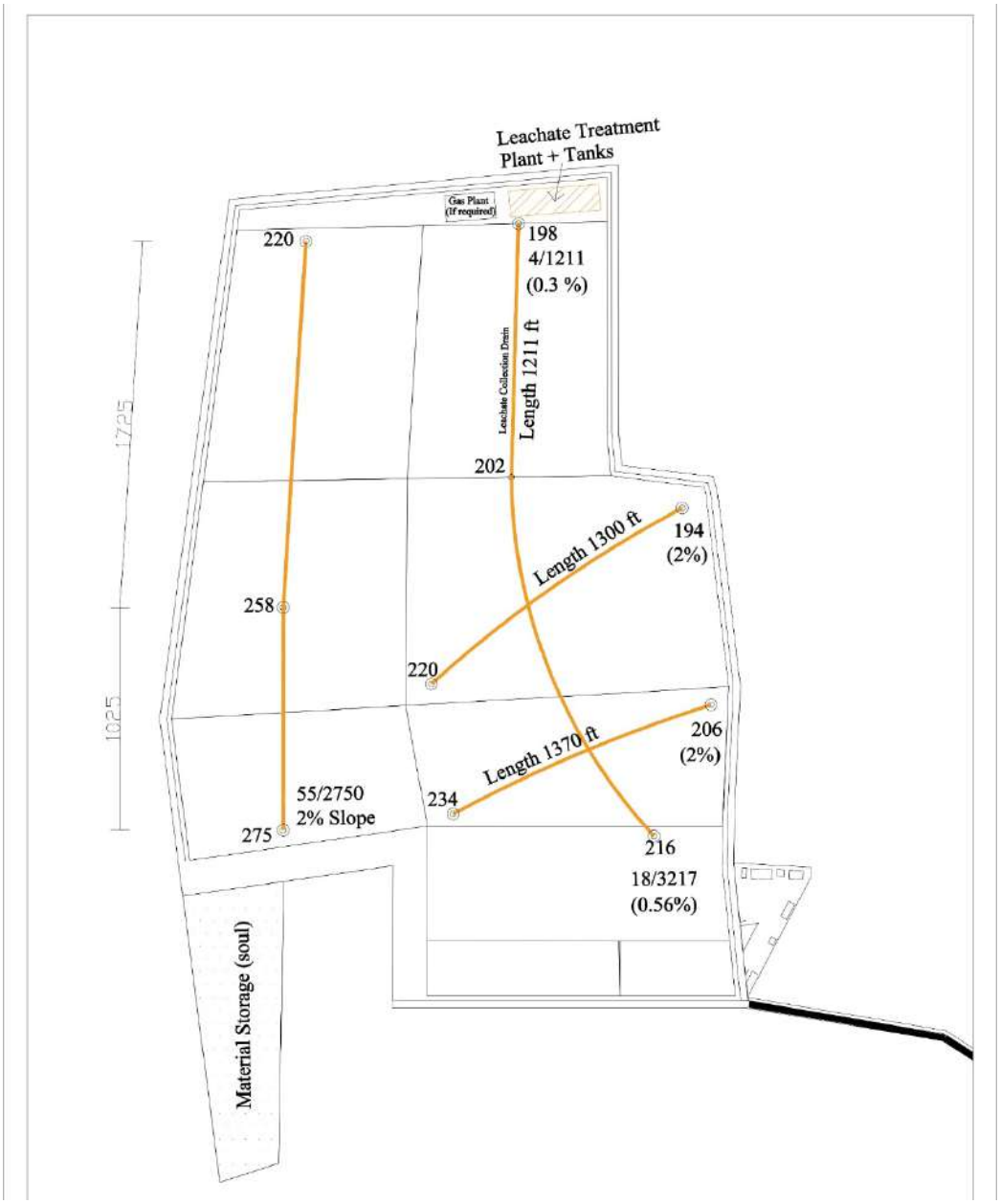


Figure 36: Leachate Drainage Constraints in the Base of the Landfill

5.4.6. **Basal Lining System**

Leachate contains highly polluting substances which, if not contained, could seep into any underlying groundwater or adjacent surface water and render such water unfit for consumption or unsafe and toxic for aquatic life. Landfill gases, such as methane (CH_4), carbon dioxide (CO_2), carbon monoxide (CO) and hydrogen sulphide (H_2S), contribute to global warming and climate change or may occur in elevated concentrations that are toxic to human, animal and plant life or potentially explosive in confined spaces.

The primary method of containing uncontrolled migration of leachate and of landfill gases is to install engineered barriers of low permeability on the base, sides and top of the landfill.

The system of basal containment proposed on the base and sides of the landfill comprises a composite lining system particularly where the base slope is flatter than 1.0V:30.0H (1.9°, grade 3.33%). The basal lining system could be reduced to a single barrier where slopes are steeper than 1V:30H, subject to not exceeding

a proposed maximum stipulated seepage rate of no more than twenty-five (25) litres/day/hectare of lined cell. A composite barrier is better at reducing leachate migration into the subsoil than either a clay liner or a single geomembrane layer. However, on steep slopes where drainage is rapid then a single High Density Polyethylene (HDPE) liner would likely be sufficient.

The proposed lining system is consistent with the requirements for engineered barriers in municipal solid waste landfills adopted internationally (for example, Subtitle D of the Resource Conservation and Recovery Act, US Environmental Protection Agency).

Geocomposite Clay Liner (GCL)

The GCL proposed is a 4 – 6 mm thick reinforced GCL consisting of a layer of sodium activated bentonite sandwiched between two nonwoven, needle punched geotextiles, the intrinsic permeability of which is <1 x 10^{-9} ms^{-1} and produced in conformity with National Standard Material Specification 595 (US EPA).

Rolls of GCL shall be overlapped to ensure adequate sealing. The GCL panels shall also be stitched together in order to ensure that the panels remain in place under all loading conditions. The GCL shall be constrained after placement in order to inhibit uncontrolled swelling of the bentonite clay.

The bentonite clay layer of the GCL will swell and become self-sealing in the unlikely event that it becomes damp from any seepage of leachate through the primary HDPE membrane installed above the GCL.

The soils underlying the existing waste have been observed to comprise predominantly silty or clayey gravelly fine to medium sands, the residual weathering products of the underlying bedrock. Soils of unsuitable permeability will be improved by the addition of bentonite or be replaced by clean soils of lower permeability.

To ensure the GCL will function adequately the estimated confinement pressures imposed on the GCL should be consistent with waste fill thickness and density. The confinement is required where the GCL hydrates.

High Density Polyethylene (HDPE) Membrane

The primary liner comprises a 2 mm thick HDPE flexible geomembrane, with an intrinsic permeability of approximately 1 x 10^{-13} ms^{-1}. The HDPE geomembrane will be textured on the underside in order to increase interface stability between the GCL and the HDPE geomembrane and/or the side slopes of the landfill where laid over bedrock surfaces.

It is not proposed to provide a leak detection layer between the HDPE and GCL since this negates the benefit of placing the |GCL in intimate contact with the geomembrane liner. In addition, providing a leak detection layer (granular substrate) does not, in itself, serve to identify where the primary liner may be breached, thus hindering the ability to repair any such breach.

The geomembrane will be welded in panels *in situ* by specialist and experienced installers following strict CQA/CQC protocols. All welds and panels shall be tested and approved prior to placement of any overlying materials.

Geotextile

A geotextile, with a proposed weight of 1,200 grams/m^2, will be placed immediately above the geomembrane for liner protection prior to the placement of the overlying leachate collection gravel and pipework. This geotextile is heavy duty but deemed necessary given the proposed thickness of waste to be placed in the landfill.

Anchor Trench Design and Construction

The lining system will be installed throughout the base of each Cell and will be brought up to the margin of each Cell. The GCL and the HDPE liner will be tied into the ground surface in an anchor trench constructed along the upper margin of each Cell. If the GCL is omitted on the steeper side slopes of the western valley, approximately 10 m above the base of the slope/cell basey, then an anchor trench will be constructed at a lower level

5.4.7. Leachate Collection and Management System

Leachate Generation

Leachate generation depends on a variety of factors, including:

- Incident precipitation (average 175 mm/year for the period 2001-2020);
- Evaporation (average > 2,500 mm/year);
- The extent of the waste surface that is open and exposed;
- The rate at which the site is covered and capped; and
- The permeability and water holding capacity of the waste material.

Karachi has an arid climate with low but highly variable rainfall. Heavy monsoonal rains occur mostly in July and August; rainfall events can be torrential but are often highly localized. Recent monthly rainfall data for Karachi is summarized on **Table 21**.

Table 21: Monthly Rainfall Totals in Karachi, 2001-2020

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	0.0	0.0	0.0	0.0	0.0	10.6	73.6	16.2	N/A	0.0	0.0	0.0	100.4
2002	0.0	2.4	0.0	0.0	0.0	N/A	N/A	52.2	N/A	0.0	0.5	0.4	55.5
2003	6.4	21.8	0.0	0.0	0.0	16.3	270.4	9.8	N/A	0.0	0.2	0.0	324.9
2004	13.7	0.0	0.0	0.0	0.0	N/A	3.0	5.6	N/A	39.3	0.0	4.3	65.9
2005	6.6	12.8	N/A	0.0	0.0	N/A	N/A	0.3	54.9	0.0	0.0	17.1	91.7
2006	N/A	0.0	N/A	0.0	0.0	0.0	66.2	148.6	21.9	0.0	3.1	61.3	301.1
2007	0.0	13.2	33.4	0.0	0.0	110.2	N/A	N/A	N/A	N/A	N/A	N/A	156.8
2008	8.0	Trace	1.1	0.0	0.0	0.0	54.0	37.5	Trace	0.0	0.0	21.0	121.6
2009	3.0	Trace	0.0	Trace	0.0	2.6	159.9	44.0	68.9	0.0	0.0	1.5	279.9
2012	0.2	0.0	0.0	0.0	0.0	Trace	Trace	8.1	121.0	0.0	0.0	22.8	152.1
2013	Trace	20.0	2.8	30.0	0.0	Trace	5.5	105.4	4.0	1.2	0.0	0.0	168.9
2014	Trace	0.0	12.4	0.0	1.3	Trace	1.1	9.9	1.4	0.0	4.6	0.0	30.7
2015	0.3	2.1	2.8	0.0	0.0	Trace	46.6	1.4	Trace	0.0	0.0	0.0	53.2
2016	3.1	0.0	Trace	0.0	0.0	65.8	1.9	96.9	Trace	0.0	0.0	0.0	167.7
2017	41.5	Trace	0.0	0.0	0.0	58.8	33.3	65.6	26.4	0.0	0.0	6.6	232.2
2018	Trace	Trace	0.0	0.0	0.0	Trace	Trace	0.8	Trace	0.0	0.0	Trace	0.8
2019	39.4	Trace	2.2	0.0	0.0	1.6	66.3	204	51.7	1.2	Trace	Trace	366.4
2020	Trace	2.6	0.5	0.0	0.0	Trace	101.2	366.8	Trace	0.0	3.1	0.0	474.2
Source: Pakistan Meteorological Department													

Annual rainfall totals have varied between a minimum of 0.8 mm in 2018 to 474.2 mm in 2020; approximately 30% of the 20 years had annual rainfall totals less than 100 mm, whilst approximately 16% had annual rainfall totals that exceeded 300 mm.

Reference has been made to the hydrology and hydraulic study conducted for the Malir Expressway by Zeeruk International (Pvt.) Ltd. (Annex 4 of the Environmental Impact Assessment, Malir Expressway Project, October 2021). The Derived rainfall-frequency curve from this study is reproduced as **Figure 37**.

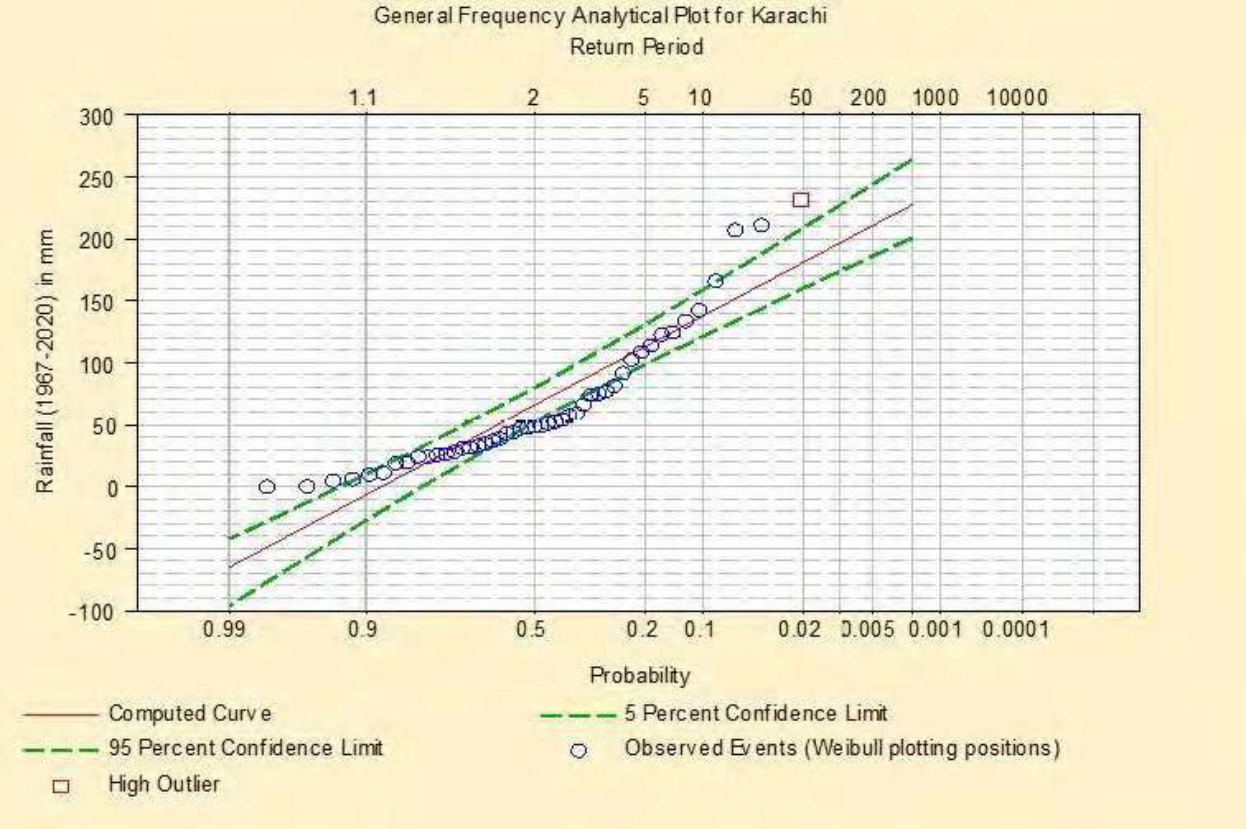


Figure 37: Rainfall Frequency Curve for the Study Area (Gumbel Distribution)

The derived rainfall totals for a specified return period from **Figure 37** are as follows:

- 1 in 2 years: 65 mm
- 1 in 5 years: 109 mm
- 1 in 10 years: 138 mm
- 1 in 50 years: 181 mm
- 1 in 100 years: 198 mm

Partly degraded material has a 30% increased water holding capacity, allowing to use the landfill as storage (buffer) and to reduce the required volumetric capacity of the leachate holding / storage tanks / ponds.

Preliminary leachate generation has been calculated based on the average precipitation (175 mm, mean over last 20 years), the average evaporation and potential minimum and maximum rainfall events. For the latter, a 1 in 100 year storm event has been assumed with a total accumulated rainfall total of 200 mm.

Assuming an exposed waste surface of 2.5 acres (1 ha.) the maximum leachate generation, excluding potential reductions through absorption by waste and evaporation, is estimated to be 650 m^3 for a 1 in 2 year storm. This can readily be stored within the base of any of the Cells on a temporary basis (for example, in Cell MSW 5, the equivalent depth of leachate is approximately 4.6 mm. For a 1 in 200 year storm event, the equivalent depth of leachate is less than 13 mm.

Leachate tanks will be provided at the northern end of the site for the collection and temporary storage of leachate. These will be sized based an assumed infiltration rate of 85% (-15% run-off and evaporation) and a 40% release rate due to water holding and capillary effects over time.

Detailed leachate generation projections will be provided at detailed design stage once the cell areas have been confirmed and the sequencing of filling, capping and closure determined.

Leachate Collection Gravel

A gravel layer, 30 cm thick will be placed above the basal lining system in order to facilitate the drainage of leachate towards the leachate collection pipes. The gravel shall be formed from crushed rock, with a grain-size of 16/32 and be free of carbonate (< 5%). The upper surface of the gravel will be covered with a geotextile of 800g/m². Given the waste thickness it is necessary to have robust thickness for filtration.

Leachate Collection Pipes

There are two main-types of pipes:

- Perforated (2/3 slotted); and
- Non-perforated (solid).

Pipes of different dimensions and ratings shall be provided, subject to confirmation of required capacity and strength. These are likely to be DN250 PN10 and DN350 PN16.

Perforated pipes shall be 2/3rd slotted and placed on the prepared, profiled and sealed basal lining system. Perforated collection pipes shall be laid in a herringbone pattern, have a dimension of DN250 PN10 and will lead into a main collection pipe of DN350 PN16. Perforated pipes shall be wrapped by a geotextile filter cloth to prevent the ingress of fines into the pipe. Solid pipes in the dimension of DN350/PN16 penetrate the landfill embankment and basal sealing system in order to drain the leachate to the Leachate Sumps and further to the leachate collection tanks.

The minimum gradient of any collection pipe will be 2%.

Non-contaminated surface water from the Cells that are not in operation will be kept separate from, and discharged separately from, the leachate.

Leachate Manholes

Leachate Manholes (LMH) shall connect pipes from various Cells and allow the manipulation of leachate flows (valves) into different leachate tank sectors. A typical leachate manhole is illustrated on **Figure 38**.

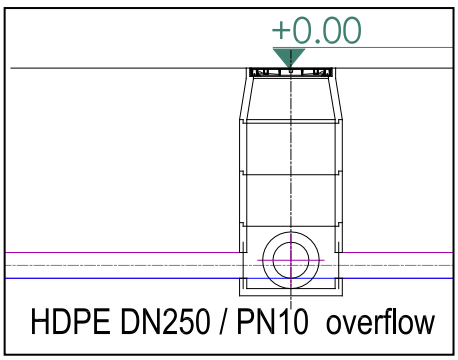


Figure 38: Leachate Manhole

Leachate Collection Sumps/Chambers

Leachate collection sumps will be constructed at the margins of each Cell. The incoming leachate pipes are assumed to be of dimension DN350 and will be reduced (by connector) to a dimension of DN200 surface water pipe. Due to the basal lining system the landfill can be used temporarily for leachate storage as the need arises. Leachate pipe DN350, as well storm/surface water pipe DN200, shall be installed with non-corrosive butterfly valves.

A typical leachate collection sump is illustrated on **Figure 39**.

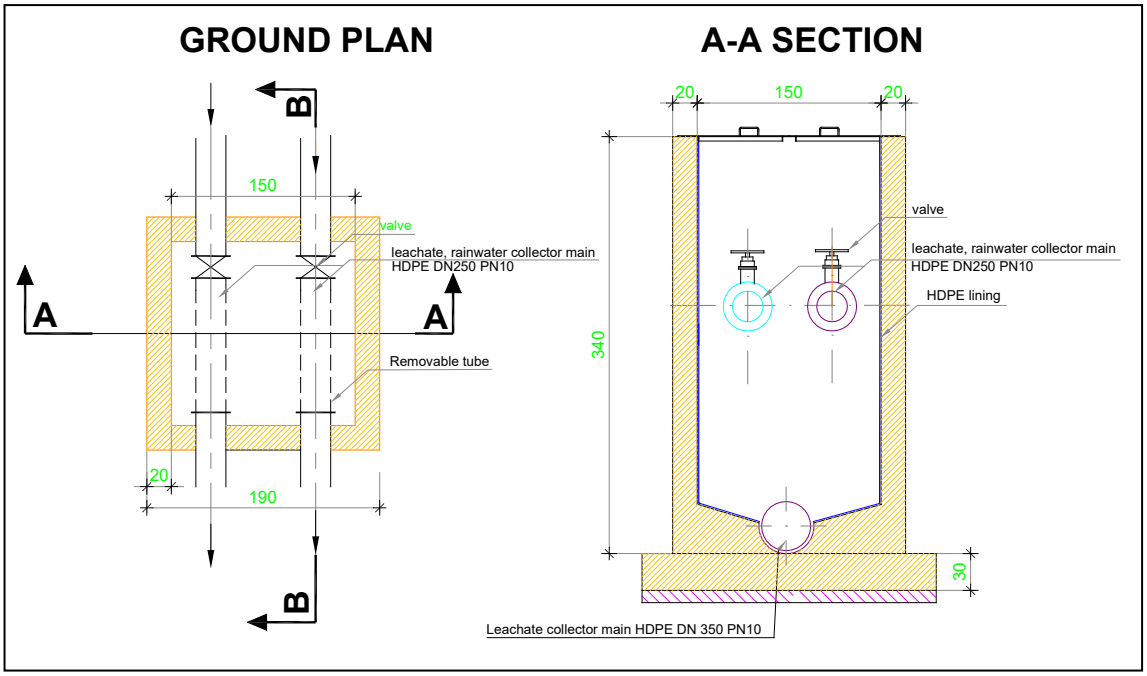


Figure 39: Typical Leachate Collection Sump

Pipe Clean Outs

Leachate collection pipes will be required be flushed on a regular basis to reduce clogging and maintain the flow capacity of the collection system. Clean out access will be provided at the edge of each Cell where the leachate collection pipe is brought to the surface. The pipe end will be provided with a concrete surround to protect the pipe and flanges from damage. Cleaning will be carried out with high pressure jets.

Leachate Tanks

The tanks will consist of several sedimentation sections. This design allows to reduce the operational and treatment costs. The last sector (purification sector) stores those semi-purified leachates which will be pumped back towards the landfill body for wetting the incoming waste to achieve an increased compaction rate, reduction of wind-blown litter and an increased generation of methane due to the provision of necessary conditions for the biological process (>55° moisture). Leachate storage tanks shall have a sufficient volume to collect and store leachate for a period of 15 days under maximum precipitation conditions.

For health and safety reason the storage of leachate to be carried out in tank made from sulphate resistant concrete.

The potential layout of the leachate tanks is illustrated on **Figure 40**, together with sections through the tanks (**Figure 41**).

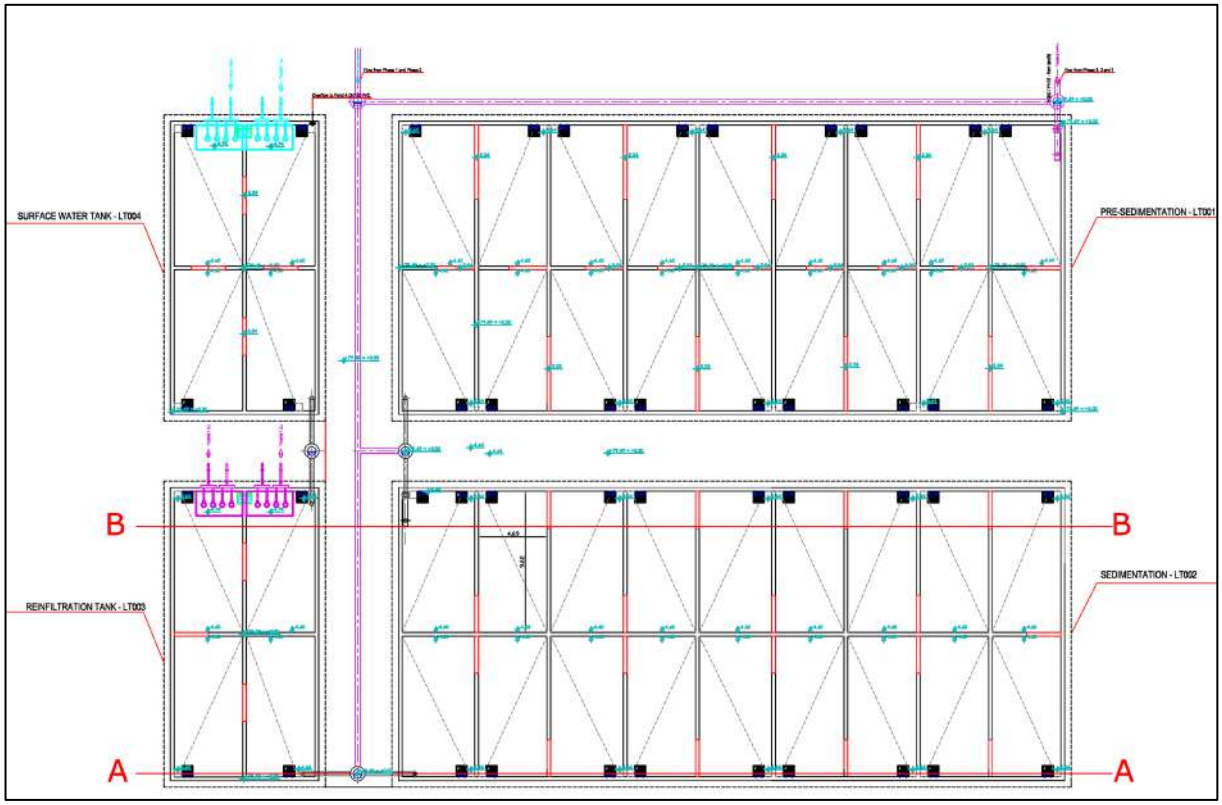


Figure 40: Plan View of Leachate Tanks

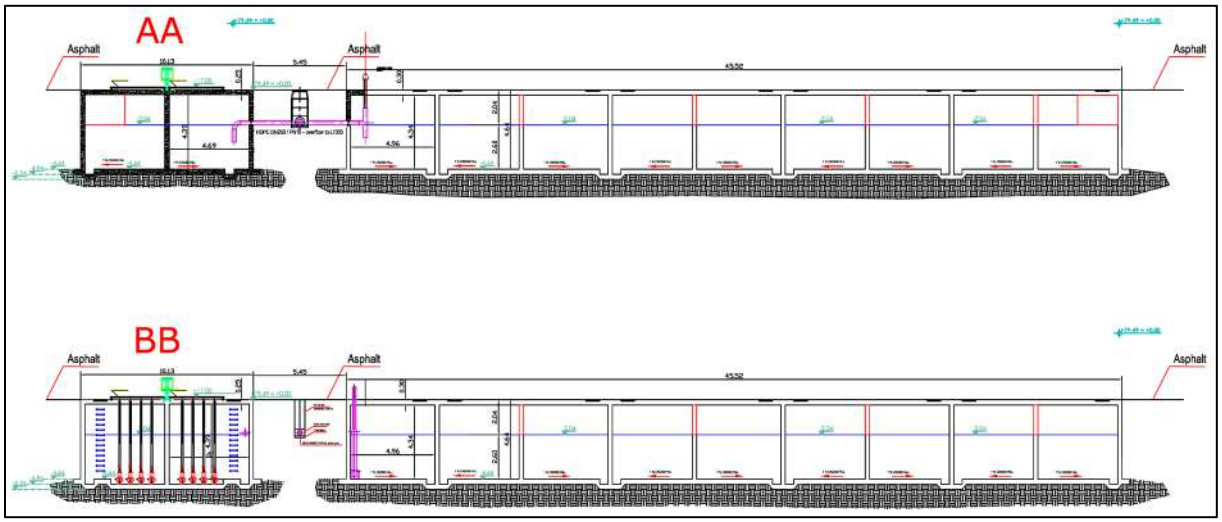


Figure 41: Sections Through the Leachate Tanks

5.4.8. Leachate Treatment

The primary method of leachate treatment shall be by leachate recirculation to the waste mass,given the prevailing climatic conditions. Re-infiltration shall be achieved by a combination of mobile tanker and spray bar in the active waste deposition area and by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level. A ring main will be developed around the landfill Cells comprising HDPE DN100 which will supply re-infiltration connections installed at 50 meters intervals. The re-infiltration pumps shall be located at the leachate tanks in the re-infiltration pumping chamber. There shall be a minimum of two submersible water pumps. A local PLC station will supply the pumps with electricity. Pumps in leachate tank shall be rated for protection class EX2.

Re-infiltration units will supply the connection/distribution points where tube connection (Storz-B) will allow a controlled distribution of leachate during operation. The distribution at the surface will be carried out via fire-fighting hoses and perforated HDPE pipes (DN65).

Should leachate re-circulation not prove to be completely effective as a leachate management process, then it will be necessary to consider other forms of treatment that might be more appropriate, particularly if treated leachate is required to be discharged off-site. One option is an anaerobic digestion leachate treatment plant which is completely enclosed and produces electricity to offset the operations costs and the water quality is usable for landscaping. The sludge produces are an excellent quality compost with commercial value. A typical plant is illustrated on **Figure 42**.



Figure 42: Anaerobic Leachate Treatment Plant

5.4.9. Instrumentation and Control of the Leachate Management System

A SCADA system will record and illustrate the flow of each pump (flowmeter ex-protected), as well the amperage and pump operational hours, in order to understand the volume of leachate managed as well as pump service and maintenance needs. Leachate levels in the tanks will also be monitored via level sensors which will activate/deactivate pump operation based upon leachate levels.

Local Control Panels (LCPs) at each tank permit the manual control and operation of the pumps. A central control panel for all leachate pumps is located in the PLC Container at the landfill gas. The signals from this centralized panel will be transferred to the central SCADA unit located in the Operations Room of the Administration Building.

5.4.10. Landfill Gas Management

Preliminary Gas Generation Estimates

A preliminary assessment of potential gas generation has been made over an assumed ten (10) year operating lifespan under a design capacity input 5,000 tons per day from 2026 to 2035 with a total amount of 18,250,000 tons (**Table 22**).

Table 22: Provisional Gas Generation Estimates

Year	Waste amount [m]	TC-content	Collection rate	Gas Production (Qt)	Gas collection (Qa)	Energy (Qeff)	Plant dimension	Accum. Energy	Potential emission
a	Mg/a	kg/Mg Mf	%	Nm³/h	Nm³/h	kWh	kW	MWh	l/m²/hour
Year 1	1,825,000	250	0.5	0.0	0	0	0	0	0
Year 2	1,825,000	250	0.5	2,800	1,400	49,062	5,600	13	58
Year 3	1,825,000	250	0.5	5,411	2,706	94,807	10,825	39	111
Year 4	1,825,000	250	0.5	7,845	3,923	137,460	15,694	76	162
Year 5	1,825,000	250	0.5	10,116	5,058	177,229	20,231	124	208
Year 6	1,825,000	250	0.5	12,233	6,116	214,309	24,463	182	252
Year 7	1,825,000	250	0.5	14,206	7,103	248,882	28,413	249	293
Year 8	1,825,000	250	0.5	16,046	8,023	281,118	32,094	325	329
Year 9	1,825,000	250	0.5	17,761	8,881	311,175	35,525	409	366
Year 10	1,825,000	250	0.5	19,360	9,681	339,200	38,719	500	399

The gas generation increasing factor is assumed to be 5% due to thermophilic conditions (about 60°C). The methane concentration within the landfill gas is assumed to be 50%. Since MSW is currently received mixed, without separation of the organics, then the Total Organic Content (TOC) has been assumed to be 250 kg/ton of input. Gas capturing efficiency was predicted at 50% during the operating life of active waste deposition.

Treatment by flaring would start in the 1st year to capture low-quality gas with a gas flare capacity of 3,000 Nm³/h and a ratio of 1:5. Thereafter, as gas quality improved flares with a capacity of 10,000 Nm³/h and a ratio of 1:6 (from 1,600 Nm³/h to 10,000 Nm³/h) will be installed.

As required, gen-sets, each of up to 10 MW capacity (Innio Jenbacher type or equivalent) can be installed to produce electricity.

Gas Collection Wells

The landfill gas collection system is design from bottom up to avoid emission during landfill operation and to avoid drilling through the garbage when the cell is filled with waste. When two meters of waste layer is deposited in the first cell a 30m x 30m grid of perforated gas recovery pipes are installed (**Figure 43 and Figure 44**) and are brought up as waste filling progresses.

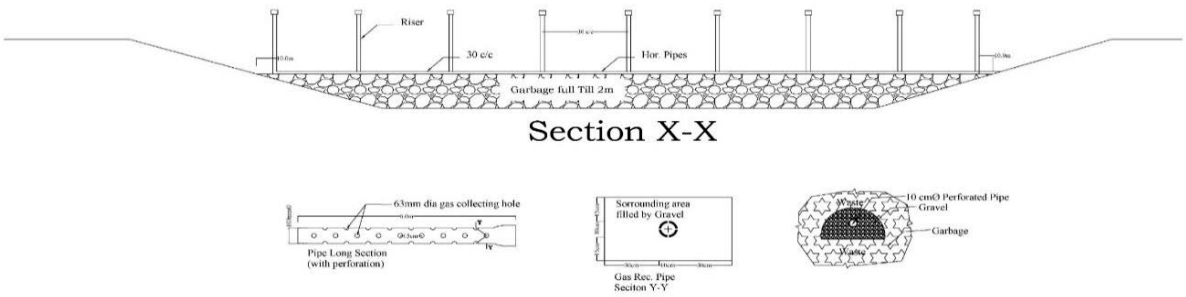


Figure 43: Vertical Gas Wells

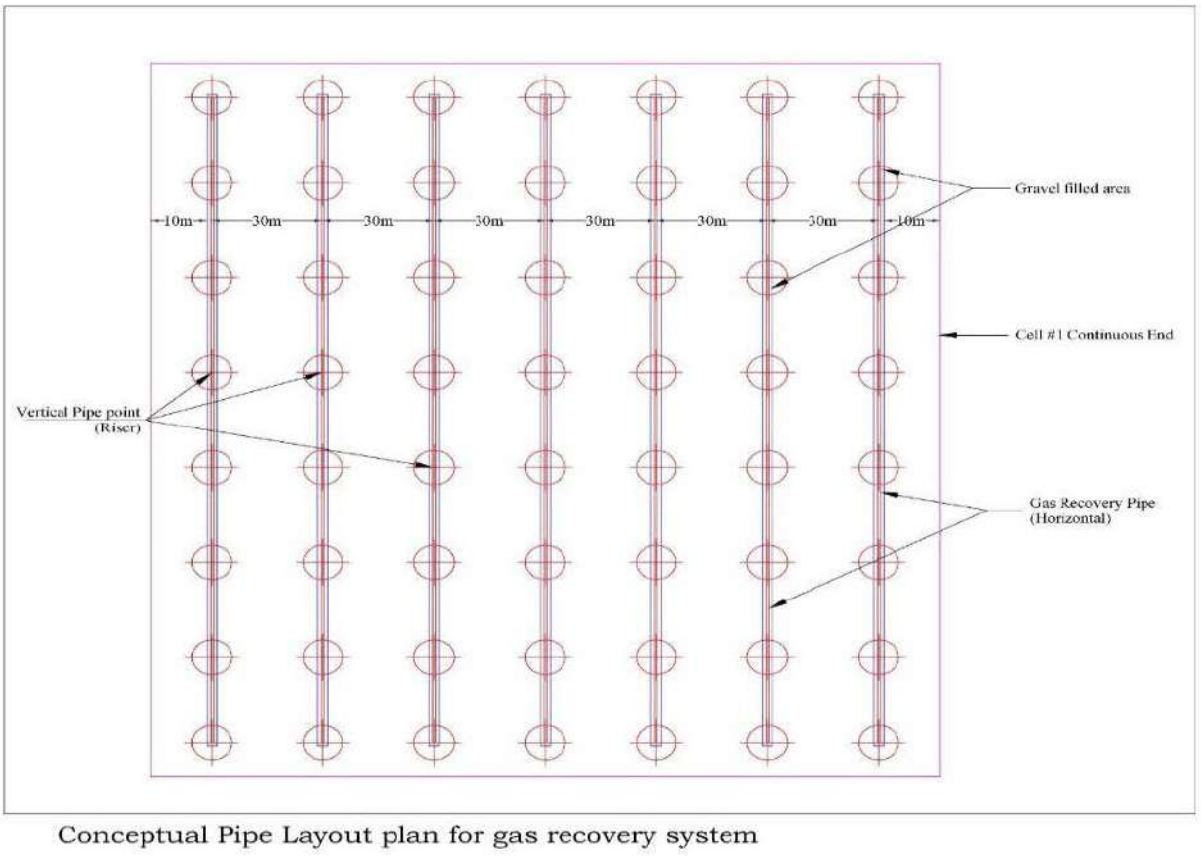


Figure 44: Landfill Gas Recovery System

An overlap of 15% in the radius of influence of each well is normally designed between adjacent gas wells, such that the final radius between wells is reduced to 20m. The vertical and horizontal pipework typically comprises HDPE DN65 PN16, perforated and surrounded by a gravel pack. The gas well is extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome is installed at the top of the well (**Figure 45**)

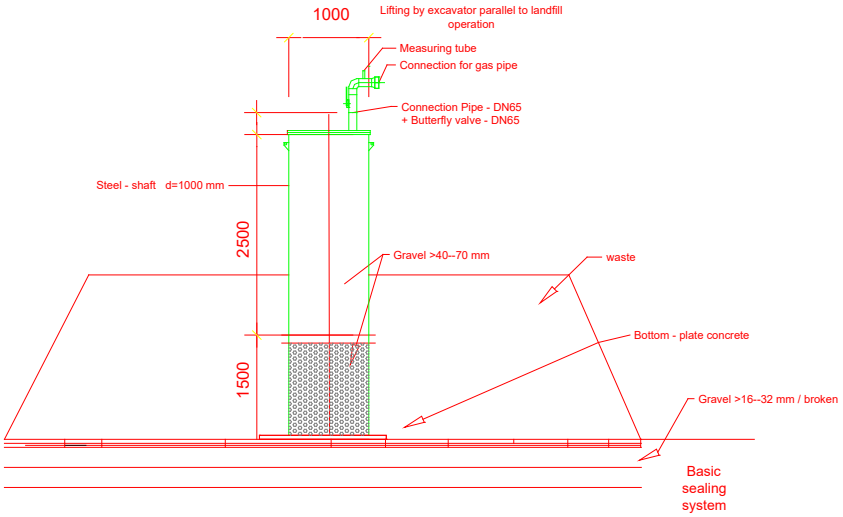


Figure 45: Gas Dome/Gas Well Section

The gas collection wells/domes are connected via HDPE DN65 perforated pipes to collection strings. Each string is lead to a main collection pipe at the manifold and can be regulated with a separate valve based on the quality of gas.

Condensate Traps

Condensates will be limited due to the inclination of piping; condensates will be collected mainly in the gas-cleaning/distributing unit (container). A condensate discharge pipe will drain to the leachate tank for re-infiltration. Condensate pipe is made from Poly Vinyl Chloride (PVC) (Sewer pipe).

Manifolds

At the gas plant the strings will be connected to a manifold. The manifolds serve to connect the gas collection pipes DN65 into a main collection pipe HDPE DN200, separated by valves. One reserve string for each manifold is foreseen. A typical arrangement is shown on **Figure 46**.

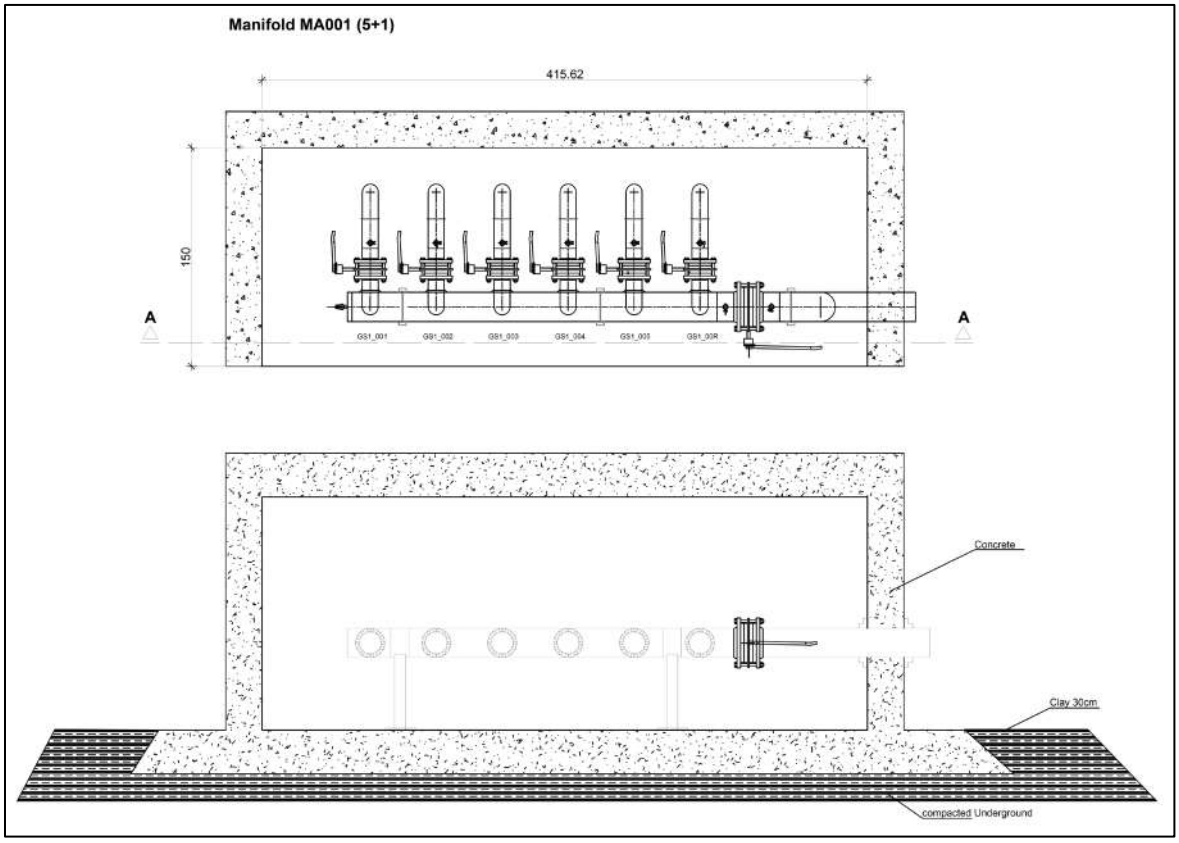


Figure 46: Typical Gas Manifold Arrangement

The walls are made from sulphate-resistant concrete. All main pipes can be shut down by a flanged valve (DN200).

5.4.11. Gas Treatment Plant

The gas treatment plant shall consists of:

- Series of manifolds connecting all gas wells in each Cell;
- Low Calorific Flare 3,000 Nm³ per hour, v=1:5;
- High Temperature Flares 10,000 Nm³ per hour; v=1:6, number to be determined based on gas yield;
- Gas engines (each up to 10 MW capacity);
- Gas cleaning and distribution container (filters and condensate separator);
- PLC container;
- SCADA container;

- Cooling units (chiller) linked with stormwater pond 4 (fed by stormwater tank and related pumps) and heat-exchanger.

Condensates from the purification filters shall be discharged into the leachate tank and the condensates re-infiltrated into the landfill body.

Gas blowers (**Figure 47**) supply gas to the flares and operate independently from each other. All blowers, necessary P&ID as well gas-analyser and control units are integrated in the PLC container. Electricity supply will be provided via the PLC container. Operational and controlling signals are transmitted into the control container and further towards the SCADA system in the Administration Building.

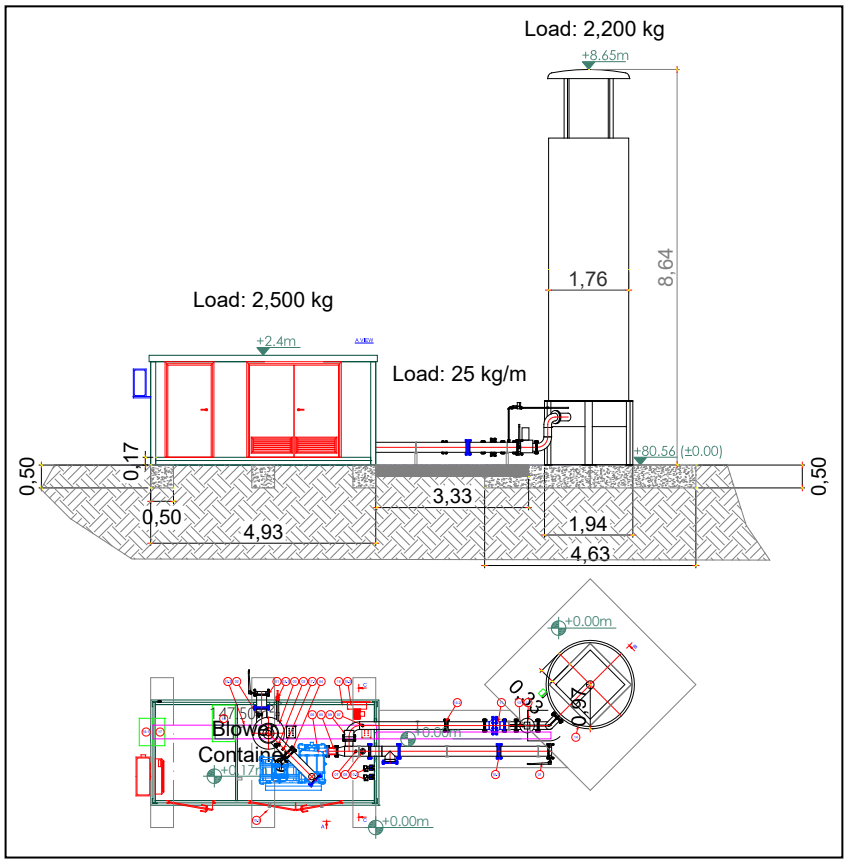


Figure 47: Gas Blower and Flare

Energy recovery units shall consist of a gas-driven turbine with a power rating of up to 1) MW each. Provision shall be made for heat-exchange in case of energy recovery. Exhaust heat shall be reduced by the installation of chillers (3+1 standby) which will be fed by raw water from a tube well.

5.4.12. Instrumentation and Control of the Landfill Gas Management System

The LCPs of each unit are integrated within the installation containers such as:

- Gas analyser:
  - o $C0_2$
  - o CH_4
  - o O_2
  - o Gas temperature before blower
- Atmospheric pressure
- Difference pressure after blower

- RPM of blower (via frequency converter)
- Bearing vibration
- Temperature within blower container
- Gas temperature after blower
- Volume to flare in m³ per hour as well accumulated m³
- Flare temperature
- Daily recording data logger

Signals are transferred to the PLC Control Container at the gas plant allowing the operator an active interruption into the process. Data signals shall be provided to the SCADA system located in the Administration Building for recording and monitoring purposes; however, there is no active control from the Administration Building, only from the PLC Container. Electricity supply is provided from the PLC container (see **Figure 48**).

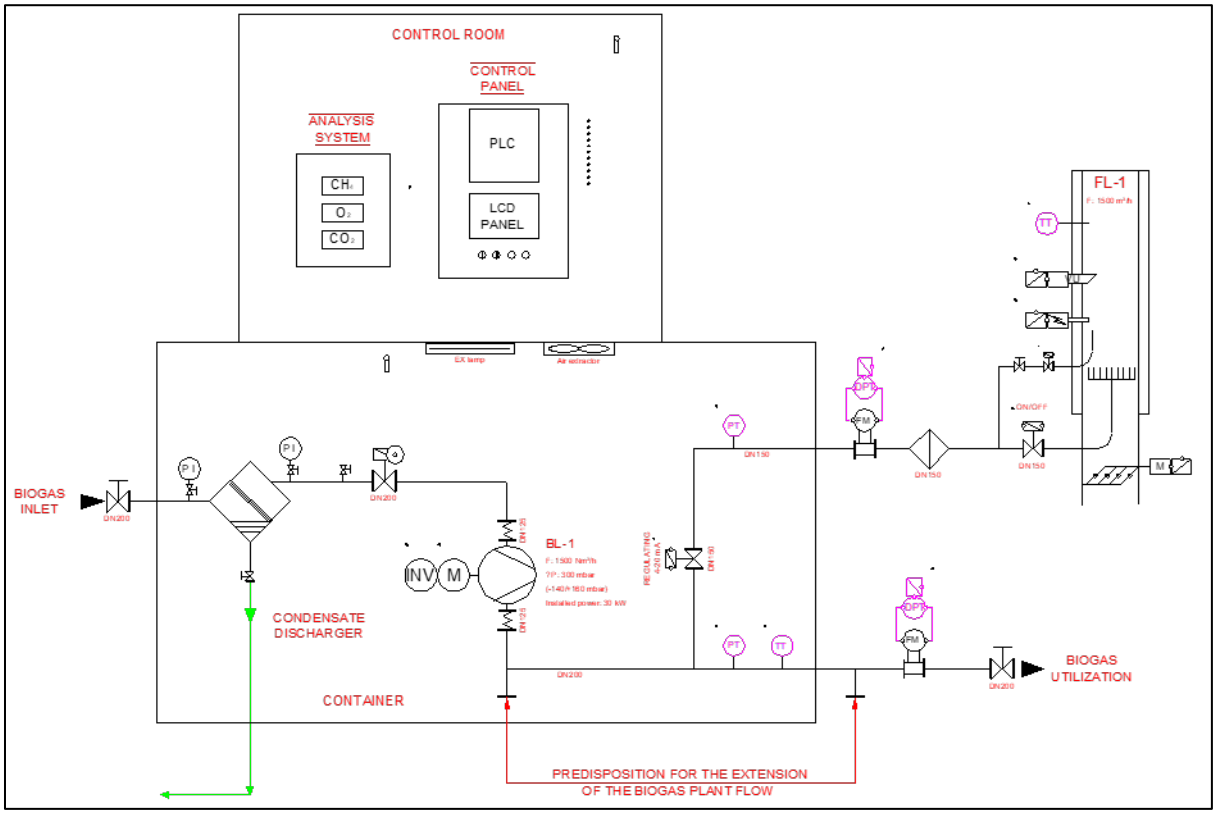


Figure 48: P&ID of Gas Blower and Flare

The smaller low calorific flare has only service/maintenance and emergency functions and becomes operational due to:

- a dropout of the main flares;
- in a situation of low-calorific gas content (methane value below 25%); or
- in case of manual operation during service and maintenance works.

5.4.13. Stormwater Drainage

The proposed minimum criteria and geometries to which the stormwater drainage system will be designed are below and on **Table 23.**

Table 23: Culvert Capacities

Culvert	Drainage System Frequency of Occurrence (years)
Side Culvert	15
Closed/Open Drainage System	15
Cross culvert	25

Sections of Drains:

U-Shaped lined drain - Minimum U-Shaped drain width: 600mm

Open trapezoidal - Minimum bottom width: 600mm
Side slope unlined : 1:5, 1: 2.0
Side slope lined: 1:0.5, 1:1, 1:1.5, and 1:2

Circular culverts / Closed System Drains
Minimum diameter for all culverts: 900mm
Maximum diameter for cross culvert: 1800mm

Rectangular Culverts Minimum internal height: 1000mm

Cover over Culvert The minimum cover for all pipes shall be 0.3m.

Manning's Roughness:

Concrete lined channel	0.013 – 0.015
Sandcrete block	0.015 – 0.020
Masonry	0.017 – 0.030
Earth (new)	0.018 – 0.030
Earth (existing)	0.022 – 0.060

Flow Velocities in Drains

Maximum Velocities: Open earth drains (no lining) 1.7 m/s
Block/masonry lined 2.5 m/s
Concrete 6.0 m/s

Minimum Velocities: Minimum flow velocities in all drains should be 0.80 m/s.

Stormwater drains will be constructed around the perimeter of the landfill in order to intercept surface run-off from the restored surface. For the majority of the site the drainage will be directed northwards, as is the present drainage pattern for the site. Special attention will be paid, however, to two parts of the site where drainage to the north is either not feasible or is difficult. These are:

- The southern part of the western valley where, once the embankment dam and waste mass are in place, surface run-off will not be able to drain northwards. Run-off from the southern facing waste slopes will drain southwards and either have to be directed through the settlement of Haji Ibrahim Goth or channelled eastwards through the end of the ridge adjacent to the settlement; and
- The southern part of the eastern part of the landfill where the drainage path length will be increased around the eastern margin of the landfill. In this area the simplest solution would be to provide stormwater retention ponds and which can serve as a source of process water for site operations.

5.4.14. Surface Restoration and Capping

Capping System Components

Capping is an ongoing process to mitigate and minimize:

- Odour;
- Wind-blown litter;
- Precipitation infiltration;
- Reduced biogas migration into the atmosphere; and
- Birds and vermin.

Capping will be undertaken once deposited and compacted waste achieves final height in any part of the landfill. Capping will proceed in parallel with waste deposition in the active tipping area.

After waste has achieved final height infill material will be placed onto the landfill slopes and profiled to a first shape. The infill material will be formed from low quality site-won overburden, recovered from the materials used for daily cover. Thereafter, two layers shall be installed, each 25 cm thick, of clay, profiled and compacted to 98% of the MDD at a moisture content in the range of OMC 0% to OMC +3%.

The specification of this material as follows:

- Clay/bentonite content (<0.002 mm): > 35%
- Fine fraction content (<0.063 mm): > 60%
- Lime content: < 30%
- Organic matter content: < 5%
- Carbons content: < 15%
- Permeability of $<10^{-7}$ cms^{-1}
- Linear shrinkage: 0 – 10%
- Plasticity index: 15 < PI < 35
- Yielding point: 0 - 45
- Moisture content after laying: between OMC and OMC +3%
- Proctor: >98% MDD

Topsoil consists of organic activated soil (humus). Due to low availability of humus on site, overburden can be enriched by the addition of compost from a composting facility at a minimum addition of 15 %.

- Laying and compacting of available soil-structured layer of 2 x 25cm;
- Compacting;
- Seeding 40kg per ha;
- Rolling; and
- Watering.

Seeding, at an application rate of 40 kg /ha, requires a total of 2, 800 kg of seeds over an area of approximately 70 ha (landfill and buffer area).

Potential Restoration Profile

A final capping gradient of 1V:3H is normally proposed to maximise the available volumetric capacity (**Figure 49**). As waste decomposes and degrades the surface of the landfill will settle, often by 20% or more, with a consequent reduction in surface gradient to 1V:3.6H.

Given the site geometry and the possibility of seismic activity it is anticipated that the initial restoration profile may need to be flatter, for example 1V:4H, in order to maintain the stability of the final slopes in the waste mass. Slope stability calculations will be undertaken to confirm the final slope profile under both static and dynamic (seismic) loading. It may also be necessary to provide benches on the slopes, both to improve stability and also for control of surface water run-off.

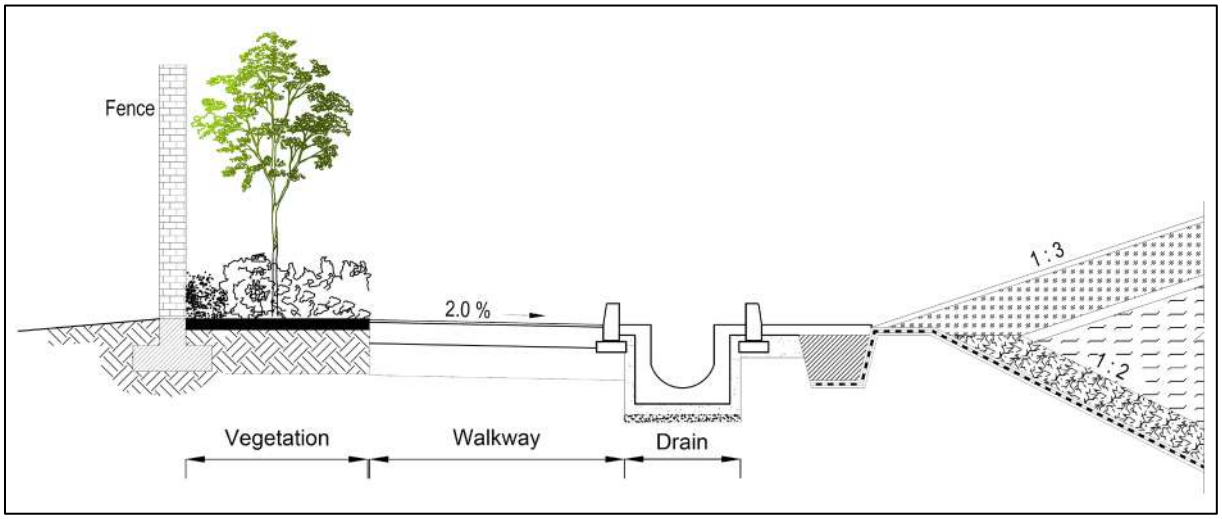


Figure 49: Schematic Section Through a Restored Landfill Profile

5.4.15. Landfill Roads

As noted in **Section 5.3.7** above, there will be three (3) main types of road at the project site:

- A primary access road to the Waste Reception Area from the entrance to the Jam Chakro site;
- A perimeter road around the majority of the landfill, for both waste delivery vehicles and to facilitate maintenance; and
- Temporary haul roads within the waste disposal area to provide access for waste delivery vehicles to the active tipping area.

A preliminary design of the access road and perimeter road is reproduced as **Annexure E**. This preliminary design is subject to refinement to co-ordinate both with the development of the landfill footprint and to optimise the geometry and alignment, both vertical and horizontal.

Within the landfill temporary haul roads, up to 6 m wide and surfaced with free-draining granular material, shall provide access to the tipping area. These roads are temporary and will be relocated as the locus of waste deposition changes as filling proceeds. The roads will be graded periodically and sloped to shed surface water to maintain trafficability.

Potential traffic volumes have been derived based on a net waste input of 5,000 tonnes per day, with site operations continuing seven (7) days per week. The assumed site life is 10 years. The largest potential vehicles that might access the site comprise compactor trailers with slave unit with a gross weight of 80 tonnes and a net waste load of 55 tonnes.

Overall traffic volumes for the site are low and comprise:

- Waste delivery vehicles (daily);
- Other deliveries (fuel, potable water, materials);
- Internal service vehicles around the site (4 x 4, water tanker/mobile bowser); and

- Staff and visitor vehicles - assume 30 vehicles per day visiting the site.

5.4.16. Landfill Operating Plant

Mobile Plant and Equipment

The types of mobile plant and equipment required to support landfill operations is set out on **Table 24**. These items shall either be procured under the construction contract or provided by the contractor appointed to operate the site.

Table 24: Operation Phase Mobile Equipment/Machinery

Equipment	Minimum Number	Function
Compactor (min. 40 tons)	4	Spreading, chopping and compaction of deposited waste
Track type bulldozer (min. 160 kW)	4	Spreading of waste in thin layers, laying of soil and cover material, support capping activities
Wheel type loader (min. 100 kW)	1	Loading of supply material onto the dumper truck such as drainage material, cover and capping material
Dumper truck (15 m^3)	3	Transfer of materials around the site; Supply of cover and capping material; transportation of residues from recycling yard to landfill; support trench cleaning and remediation works;
Shredder (30 Mg - 150m^3/h)	1	Waste shredding, assisting compaction. Shredding of bulky items (e.g. green waste)
Tractor (100 kW)	1	Transport of small amount of material; towing and operating the water browser; loading activities for small amounts (recycling yard); Material transport in case of service and maintenance and repairs
Trailer with tank of 5000 l (water bowser)	1	Wetting down road and landfill during hot/dry season to avoid of fugitive dust impacts;
Trailer 5m^3 net load	1	Material transport in case of service and maintenance and repairs; fuel supply for site equipment (Compactor, dozer, etc.)
Mobile pump set - dewatering (1.5 kW)	2	Support of dewatering and water holding activities; cleaning and irrigation works
Mobile pump set - leachate (1.5 kW) - EXII2ga	2	Support leachate tank area in water circulation, cleaning and re-infiltration activities; cleaning of leachate pipes;
Mobile diesel generator (2.5 kW)	2	Support external electricity provision for service and maintenance activities; supply of equipment in case of energy failures; driving of aggregates at site;
Mobile pump set - watering (1.5 kW)	2	Support of dewatering and water holding activities; cleaning and irrigation works
Environmental monitoring equipment	1	See – lab equipment / sampling and rapid testing of environmental conditions and/or health and safety conditions
Suction truck (134 kW, 8m^3)	1	Surface water control, leachate extraction, desludging of ponds
Backhoe loader (34 kW, 1m^3)	1	Digging of ditches and temporary diversions, Clearing of drains and ponds
Forklift (3 ton)	1	Transfer of materials within the store and onto utility vehicles

Fixed Plant and Equipment

The types of fixed plant and equipment required to support landfill operations is set out on **Table 25**. These items shall be procured under the construction contract.

Table 25: Operation Phase Fixed Equipment/Machinery

Equipment	Minimum Number	Function
Weighbridge, 100 tons, 18 m long	1	Measuring of waste inputs and other deliveries. Documenting recovered materials removed from site
Weight recording system	1	Documenting and storing records of waste inputs
Diesel generator	1	Back-up power supply in the event of loss of mains supply
Leachate pumps	4	Transfer of leachate to/from the leachate tanks
Landfill gas plant	1	Treatment of captured landfill gas; flaring of gas and potential conversion to electricity
Potable water pumps	2	Transfer of potable water to site buildings
Raw water pumps	2	Transfer of captured run-off for sanitary uses in buildings
Wash Bay pumps	2	Supply to pressure washing units at the Wash Bays
Irrigation pumps	2	Supply of raw water to irrigation zones
Fire pumps	3	Supply to fire water to ring main for fire fighting
Diesel fuel tank & fuel dispensing system	1	Storage of diesel fuel for use of site operating plant

Workshop Equipment

The types of workshop plant and equipment required to support landfill operations is set out on **Table 26**. These items shall either be procured under the construction contract or provided by the contractor appointed to operate the site.

Table 26: Workshop Equipment/Machinery

Equipment	Minimum Number
Air Compressor (1.5 kW)	1
High pressure washer (1.6 kW / 100 bar)	2
Welding machine (CO_2 - 2.5 kW - 120 A)	1
Hydraulic bearing press (high pressure / 50 ton / hand-driven)	1
Hand-held electrical side-cutter (2.4 kW)	2
Hand-held tools (screwdriver, hammer, oil-greasing pump, etc.)	2 sets
Drill (stationary) (550 W)	1
Handheld drill (550 W)	2

Laboratory Equipment

The types of laboratory equipment required to support landfill operations is set out on **Table 27**. These items shall either be procured under the construction contract or provided by the contractor appointed to operate the site.

Table 27: Laboratory Equipment

Equipment	Minimum Number
Assorted glass ware	1 set
Desiccator	1
Multimeter equipment WTW (oxygen/conduct./pH/Redox) (500 W for charging)	2
Photometric analyser (800 W)	1
Heavy metal fusion unit (250 W)	1
Drying oven (1.2 kW)	1
Muffle furnace 2.5 kW, 3 phases	1

Equipment	Minimum Number
Special glass ware (Soxhlet, Kjeldahl,...)	1
Water treatment (Ion-exchanger unit)	1
Titration (oximetric/gravimetric)	3
Freezer (-30°) - (300 W)	1
Cooler (-10°) - (300 W)	1
Centrifuge (60 W)	1
Gravimetric balances	2
BSB5-barometric unit (6pcs) (25 W)	1
Climate cabinet (300 W)	1
Handheld gas monitors	4
Water testing kits	2

Personal Protective Equipment

The types of personal protective equipment (PPE) required to support landfill operations is set out on **Table 28**. These items shall either be procured under the construction contract or provided by the contractor appointed to operate the site.

Table 28: Personal Protective Equipment

Equipment	Minimum Number
Working Uniforms (trousers/jacket)	80
Safety Working Boots	80
High visibility vests (yellow/orange)	90
Leather gloves (2 pairs per worker)	80
Dust Masks (FP1) for waste worker	2000
Dust Masks (FP3) for streetsweeper	500
Hard hat	50
First Aid Kit for each vehicle + landfill gas plant	14
Eye wash bottles in landfill gas plant	1
Fire Extinguisher (ABC) on each operating equipment, 6 kg	14
Fire Extinguisher (ABC) for gas and leachate plants,12 kg	4
Fire Blanket (for each operating equipment and in landfill gas plant)	14
Gas detector + reserve	3

Miscellaneous Equipment

Miscellaneous equipment required to support landfill operations and utility services includes:

- Fire extinguishers in all buildings;
- Fire blankets in kitchens and pantries;
- Office furniture and equipment for all buildings;
- Oil spill kits, for the workshop and fuel station; and
- Portable litter fences, to be deployed adjacent to the active tipping area.

These items shall either be procured under the construction contract and/or be provided by the contractor appointed to operate the site.

Spares and Storage

Critical spare parts for landfill operating equipment will be maintained in the Store Room in the Workshop Building. Critical spare parts will be established on the basis of the manufacturer's recommendations for replacement parts over a rolling two year period. In addition, items required to be replaced during routine maintenance will be stored covering a period of one year going forward.

A Maintenance Management System (MMS) will be established to:

- Record all spare parts and service items held in storage;
- Monitor the usage of spare parts and service items; and
- Identify the requirement to order replacement spare parts and service items in advance once stocks held reduce below specified levels.

5.4.17. Estimated Void Space

Preliminary base grading plans have been developed for both the western valley (MSW1 to MSW3) and the eastern part of the landfill (MSW4 to MSW6). After assessing various potential configurations, the base grading plans have been developed on the basis of the following:

- For the western valley, utilizing the existing valley side slopes as is (1V:3H to 1V:5H) and maintaining the gradient on the valley floor at 2% fall to the north with minimal excavation of 1 to 2 m. Both ends of the valley are closed off with small embankment dams up to 8 m high; and
- For the eastern part of the site, maintaining the western slope as is (1V:3H), whilst regrading the floor of each of the cells to fall generally to the north-east at approximately 2%. This requires that the eastern part of the site is excavated to an average depth of 5 m, ranging from 0 m in the west to approximately 10 m at the eastern margin. Excavated sides slopes are graded at 1V:3H.

An extract of the base grading is illustrated on **Figure 50** for MSW1. This plan illustrates:

- Small embankment dams at the northern end of the cell;
- Contours at two (2) feet intervals;
- Two valleys – the main valley and a subsidiary valley to the west of the main valley;
- Side slopes on the valley sides, ranging from 1V:3H to 1V:5H;
- Shallower contours on the valley floors;
- Leachate collection drain on the floor of each valley (straight green line), draining from south to north;
- Three access routes/roads, each approximately 7 m wide, one each on the upper west and east sides of the cell which are required for the installation of the basal lining system and the construction of the anchor trench;
- The third access route/road provides access for waste delivery vehicles during filling and for the installation of the basal lining system at lower elevations.

Figure 51 shows a similar extract for MSW1 but for the potential surface restoration contours. In this plan the restoration contours have been developed at 1V:4H as a uniform slope with no intermediate benching. This plan shows that the final surface will have three slope facets in this location, facing north, west and east respectively. **Figure 52** and **Figure 53** show cross-sections through Cell MSW1 looking west to east and north to south respectively.

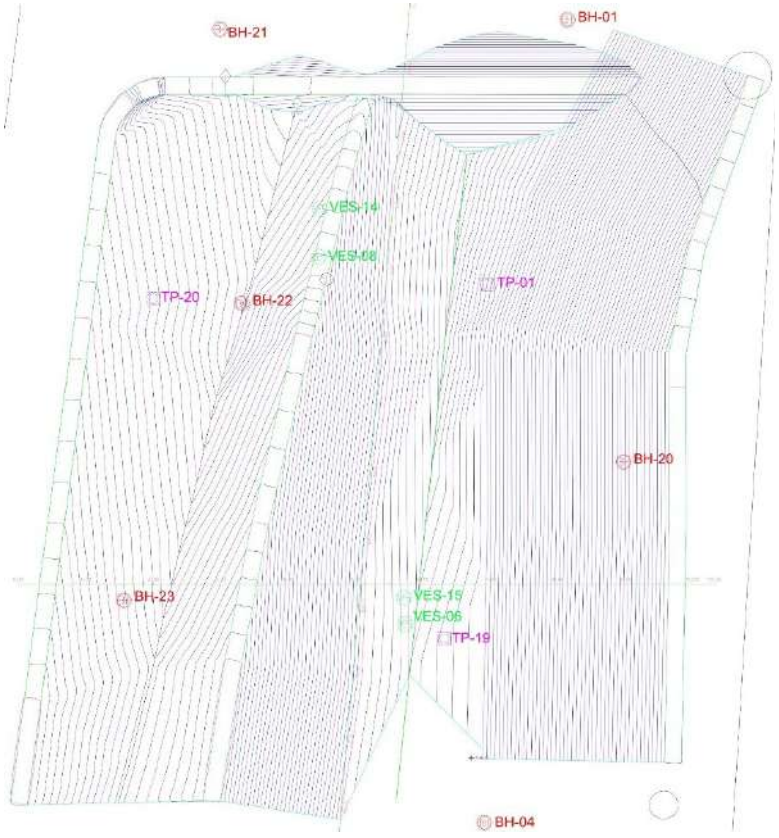


Figure 50: Illustrative Base Grading for Cell MSW1

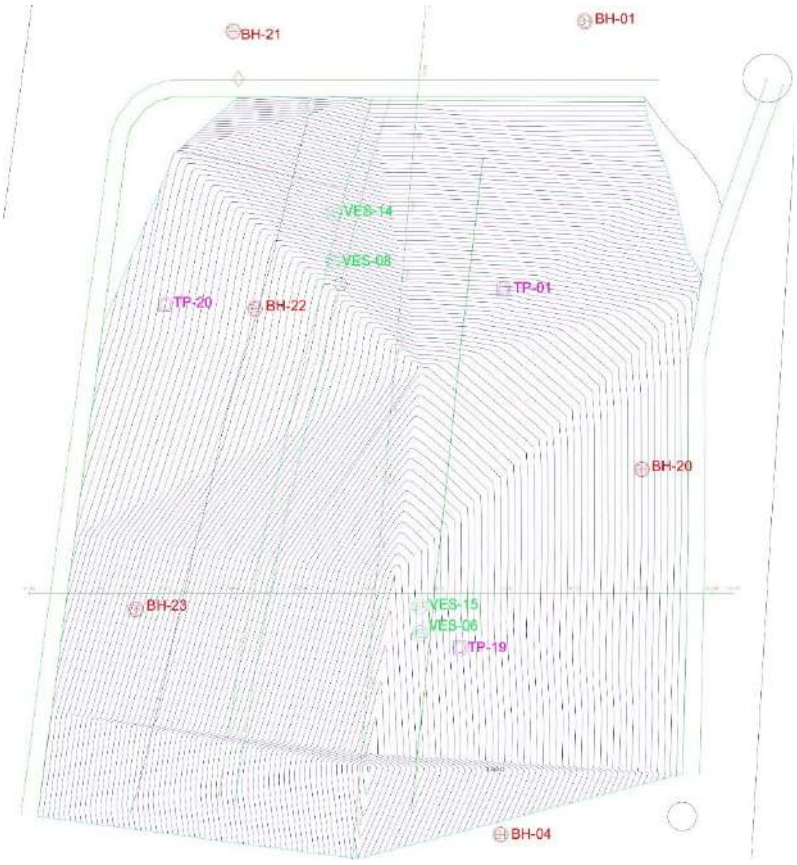


Figure 51: Illustrative Restoration Contours for Cell MSW1

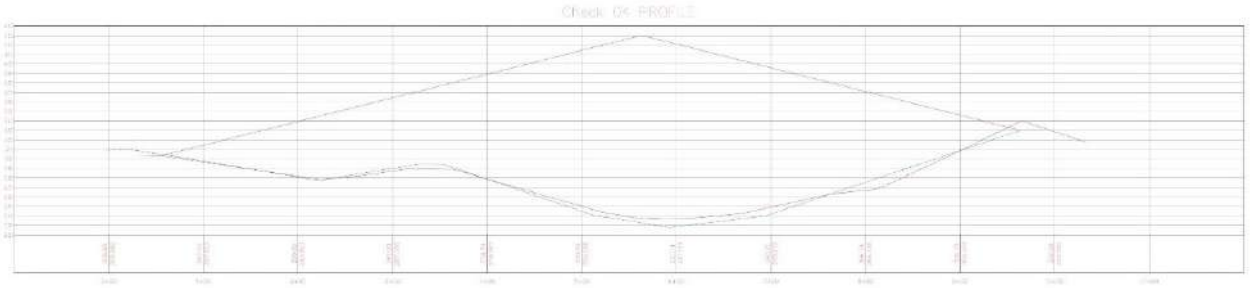


Figure 52: West to East Section Through Cell MSW1

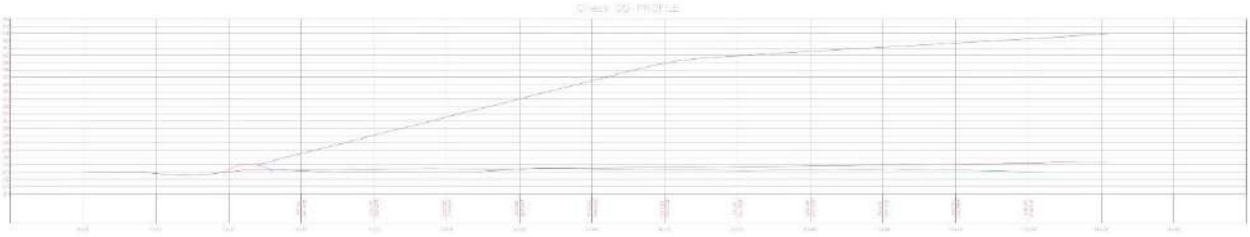


Figure 53: North to South Section Through Cell MSW1

The estimated capacities for the whole landfill site, based on the approach and assumptions outlined above are summarized on **Table 29**.

Table 29: Computed Cell Capacities

Cell No.	Area (m^2)	Volumetric Capacity (m^3)	Average Fill Depth (m)
MSW 1	85,452	2,095,425	24.50
MSW 2	103,420	3,159,494	30.55
MSW 3	57,229	1,128,633	19.72
MSW 4	98,614	2,263,162	23.00
MSW 5	142,022	3,699,673	26.05
MSW 6	156,500	3,716,875	23.75
Sub-Total	**643,237**	**16,063,262**	**24.97**

5.4.18. Estimated Lifespan

The estimated lifespan has been computed for a variety of scenarios assuming different compacted densities for the landfilled waste and assuming that the quantity of waste delivered to the landfill remains at an average of 5,000 tons per day waste input for the duration of the active life of the landfill.

The projected lifespan for three different rates of compaction are set out on **Table 30**. The projected lifespan ranges from a minimum of 7.04 years at a compacted density of 0.8 t/m^3 to 10.56 years at a compacted density of 1.2 t/m^3.

The actual lifespan of the landfill is subject to a number of variables, including waste input rate and the degree of compaction achieved. **Figure 54** illustrates how the lifespan varies according to changes in these two parameters.

Table 30: Projected Lifespan at 5,000 Tons per Day Waste Input

Cell No.	Volumetric Capacity (m^3)	Lifespan (Days) Density @ 0.8 t/m^3	Lifespan (Days) Density @ 1.0 t/m^3	Lifespan (Days) Density @ 1.2 t/m^3
MSW 1	2,095,425	335	419	503
MSW 2	3,159,494	505	632	758
MSW 3	1,128,633	180	226	271
MSW 4	2,263,162	362	453	543
MSW 5	3,699,673	592	740	888
MSW 6	3,716,875	595	743	892
Sub-Total	**16,063,262**	**2,569 days = 7.04 years**	**3,213 days = 8.80 years**	**3,855 days = 10.56 years**

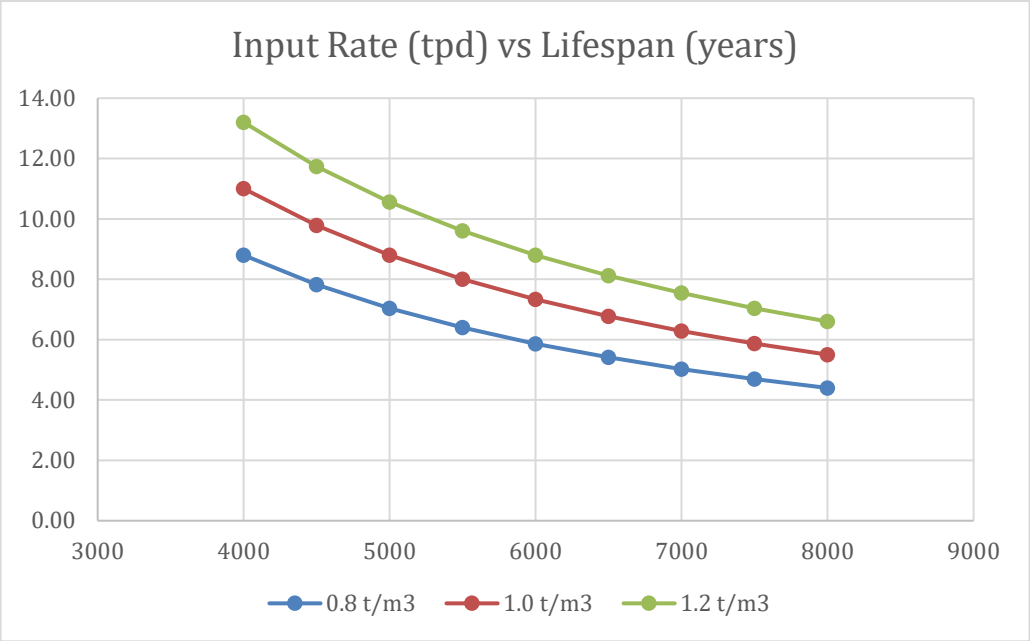


Figure 54: Variation in Projected Lifespan

5.5. Design and Operational Philosophies

5.5.1. Criticality, Availability and Reliability

The management of MSW generated in Karachi has been identified as posing a critical risk to human and ecological health. The proposed facility at Jam Chakro shall be capable of managing all of the different components of the mixed MSW delivered to the facility. The associated methodology for the receipt, screening, processing and disposal of residual wastes shall be detailed in the operations manual. Construction and operation of the project facility also presents a potential health risk to humans due to the hazardous nature of some of the components of the mixed MS during disposal operations.

The facility shall be designed to ensure bioremediation of organic components of the waste stream to levels acceptable for the final use, at least commensurate with use as final cover material and as mulch on the restored surface of the landfill.

The project facility shall operate seven (7) days per week, all year round, and be available to receive, treat and dispose of MSW during daylight hours, ostensibly between 5.00 am and 10.00 pm.

The facility shall be designed, constructed and operated to a high level of availability and reliability based on proven technology currently used in the landfill and waste treatment industry. In other words, the design shall ensure that the availability and reliability of the facility conforms to internationally accepted industry norms and standards.

5.5.2. Operating, Control and Safeguarding Philosophy

The facility shall be operated such that all MSW delivered to the site is stored and processed in a manner that minimises adverse impacts on human and ecological health, with all emissions or discharges meeting Environmental Protection Agency environmental standards.

In brief, and depending upon the final option selected, operation of the facility shall consist of:

- Receipt of MSW at the site and its recording and documentation via the weighbridge;
- Application of decision-tree to direct waste delivery vehicles to the relevant processing area, depending upon the nature and source of the MSW;
- Unsuitable wastes not in conformity with wastes licensed to be accepted at the site shall be separated and stored temporarily at an Unacceptable Waste Store and/or transferred to a Special Waste holding cell;
- All contaminated water released during processing shall be collected and directed to the leachate treatment facility. Where suitable, this water will be used as a source of process water during composting and/or landfill operations. In the alternative, where this water is not required for site operations, it shall be evaporated or treated for possible discharge off-site once it complies with national effluent standards;
- Stormwater shall be kept separate from any contaminated water and will be used as a source of process water, as required;
- Landfill gas released during waste composition shall be collected and either flared or used to generate electricity;
- Site operations shall be managed from the office complex, which shall be serviced by necessary utilities; and
- Minor vehicle and plant maintenance will be undertaken in the workshop.

Key parameters that shall be monitored and controlled with respect to biological treatment include:

- Soil temperature, pH, electrical conductivity (EC), moisture content and nutrient concentration to ensure optimal conditions for biodegradation. The first three shall be monitored *in situ* using portable probes on a bi-weekly basis, the latter from samples collected monthly;
- Oxygen/carbon dioxide relationship to assist in determination of degradation. A portable gas monitor shall be used to measure levels on a bi-weekly basis; and
- Quantity of organic waste received, as measured at the weighbridge and based upon the quantum of rejects from screening;

Key parameters that shall be monitored and controlled with respect to the landfilling of MSW shall include:

- Water balance of deposited wastes;
- Leachate quantities, flows and quality;
- Landfill gas volumes, flows and gas quality;
- Groundwater and surface water quality;
- Air quality;
- Litter;

- Vermin and pests;
- Fires and smoke; and
- Presence of unacceptable and/or hazardous, special or hot wastes.

Monitoring and control points in the areas which are adjacent to the processing areas ancillary areas shall consist of:

- Wind sock;
- Fire, smoke and gas detectors and alarms in tall buildings and confined processing areas;
- Leachate sump level switch;
- Leachate flow meters;
- Process water flow meters;
- Gas flow meters;
- Storage tank level indicators (all tanks);
- Fuel dispensing meter;
- Necessary control, indicator and relief valves in water distribution systems;
- Emergency stop and override controls; and
- Closed-circuit television (CCTV) monitoring of the site entrance, weighbridge and processing areas.

5.5.3. Safety and Loss Prevention Philosophy

The fire, safety, and loss prevention philosophy applied throughout site operations shall be based on international standards and good practice.

As the fire hazard risk and likelihood of occurrence is low in the landfill cells, the fire and smoke detection and fire-fighting system will be designed and installed only for buildings and confined processing areas. The system will include the location of firefighting equipment in the office, workshop, laboratory and other site buildings, a fire water tank located on site, manual fire call points, and a dedicated line to send alarms directly to the Pakistan National Fire Service.

5.5.4. Equipment Sparing Philosophy

The basic premise of the equipment sparing philosophy shall be to avoid delay to any of the site operations. All items shall be reviewed for criticality, frequency of use, and lead time to replacement, in order to determine if replication/back-up (standby) is required.

A preliminary review of major aspects has indicated:

- The key pieces of mobile plant and equipment with regard to the landfill operation are the landfill compactor, the tracked dozer, excavator and dump truck. Should any of these machines breakdown, however, replacement equipment may be brought in or hired in, with the possible exception of the landfill compactor;
- If composting is undertaken by windrows, the most critical item of mobile plant will be the windrow turner. Should this machine breakdown there are alternative, although less efficient means of turning windrows using screener crusher buckets, for example, attached to an excavator;
- For material recovery equipment, it is recommended that dual lines are established so that in the event of any breakdown, or during required servicing, at least one line should remain operational;
- Provision of a standby generator to service essential loads in the event of a power outage, and the provision for connection of a large temporary generator in the event of a long-term power outage;
- Manual over-rides shall be incorporated on all electrically operated equipment;
- Standby pumps will be incorporated into the site water distribution networks (potable water, process and contaminated water), as required;

- Leachate collection lines shall be duplicated for the main collection header in the event of blockage or damage; and
- Mobile gas flares shall be maintained on-site to regulate gas discharges should there be a breakdown of the gas plant or during routine servicing and maintenance.

5.5.5. Units of Measurement

Units of measurement shall be in accordance with SI requirements, as per BS ISO 1000 and BS 350.

All sampling and analysis shall meet the requirements of ISO 17025. The laboratory shall have ISO 17025 accreditation for the methods used for analysis.

5.5.6. Environmental Conditions

The climate is considered arid and tropical, and the atmosphere can be salt-laden. The key weather conditions likely to impact on design of the facility include:

- High temperatures, humidity and ultra violet (UV) radiation;
- Low rainfall;
- High potential evaporation, resulting in a net moisture deficit; and
- Low to moderate winds, with a prevailing wind direction from north-west to south-west.

The high potential for moisture loss throughout the year will, therefore, be considered during the design of the facility. In addition:

- All equipment and materials shall be specified to withstand the corrosive (salt, dust) environment;
- All Glass Re-inforced Plastic (GRP) and other plastics subject to direct sunlight shall contain an UV barrier; and
- The design wind speeds shall be assumed to act from any direction.

5.5.7. Management of Site Generated Waste

The waste strategy for the facility shall be to implement procedures that avoid waste generation where possible, and otherwise, reduce, re-use and recycle wastes. Wastes generated by the facility are likely to include:

- Office waste – paper, plastics, food scraps;
- Workshop waste – waste oil, grease, spent parts, batteries, contaminated clothing; and
- Laboratory waste – sample residues, spent calibration fluids, plastic packaging.

Wastes shall be deposited into appropriate storage containers on site and transferred to the appropriate treatment or disposal area on site. For wastes not able to be managed on-site (for example, waste oils, and sewage) these shall be collected by licensed operators, and transferred to the appropriate treatment facility.

Tracking and documentation of waste generation, transportation, and final disposal shall occur using a manifest system. In a manifest system the generator, transporter, receiver, and environmental authority produce a signed record at each stage of the transfer of waste.

5.5.8. Services

Power Supply

Electricity is required to power the following:

- Office facilities, including lights, air conditioning, computers, communications equipment, and basic kitchen facilities;
- Workshop facilities, including lights, tools, hoists and air conditioning;
- Laboratory facilities, including testing apparatuses, exhausts and air conditioning;
- Air conditioning and lighting in the gatehouse and other buildings;
- Safety lighting within and around the perimeter of the facility;
- Weighbridge;
- Fuel dispensing (if installed);
- Potable water distribution system;
- Process and fire water pumps and wash down area, including metering;
- Leachate pumping/transfer system, operated on an intermittent basis; and
- Landfill gas plant.

A preliminary load assessment has been prepared on the basis of simultaneous maximum demand and the minimum facility requirements; the estimated load is approximately 263kW. Incorporating a 50% contingency to allow for refinement of the above calculations during detailed engineering the estimated design load is approximately 394kW. The estimated electrical load shall be reviewed and updated as the design phase progresses.

One duty pump and one standby pump shall be provided for all operations, including fire water distribution. Jockey pumps shall also be provided. The duty pumps shall be electric and the standby pumps shall be diesel powered.

There is no existing power to the site. Accordingly consideration shall be given to providing on-site power requirements through a solar plant.

The design of the installation and distribution of power shall be carried out in accordance with national regulations. In addition, the sizing, selection, installation and operation of any electrical equipment shall be assessed with specific consideration of the hazards identified for the facilities installed near to the operational areas of the landfill and other processing areas.

Telecommunications

Telecommunication infrastructure required for the project site includes:

- Local Area Network (LAN) for telephone sets and Ethernet connectivity;
- Field telephone booths; and
- Linking of the fire alarm system to the Pakistan National Fire Service.

Sewage

It is proposed that sewage be collected on site in a below ground sump with submerged pump and transported in tankers to the nearest sewage treatment plant (STP) for treatment as required.

The holding tanks will be designed on the basis of a site population of up to fifty (50) people and situated to facilitate access to tankers.

Process Water

Process water is required for:

- Moisture conditioning of the disposed residual waste to assist in maximizing compaction;
- Composting operations;

- Irrigation of any landscaped areas or restored areas;
- Road cleansing;
- Wash down water for fixed and mobile plant, drums and waste delivery vehicles; and
- Emergency firefighting.

Process water will be obtained from surface water draining through and within the site, as required, supplemented by water obtained from tube wells. Storage ponds will be provided on-site and sized to meet the projected demand. Sedimentation structures will be designed for all inlets to the storage ponds. Pumps are to be located at the storage tank(s) to ensure the water can be distributed across the site to the required processing areas.

Potable Water Supply

Potable water is required on-site for the following activities:

- Human consumption;
- Wash room facilities; and
- Firefighting.

A preliminary, conservative, estimate of the on-going potable water requirement is approximately 15-20 m^3 per day.

Water will be obtained from groundwater sources at and adjacent to the site and, as required, supplemented by water tankered to the site.

6. INSTITUTIONAL ANALYSIS AND CAPACITY STRENGTHENING

6.1. Overview of Existing Institutional and Implementation Arrangements

The Sindh Solid Waste Management Board (SSWMB) is the primary implementing agency for SWEEP and established a project implementation unit (PIU) with full-time dedicated staff with technical expertise in engineering, environmental and social safeguards, procurement, financial management and other key functions. The SSWMB has the mandate to: transport and transfer waste (the middle end), including of transfer facility operations; conduct disposal of solid waste and oversee the O&M of disposal facilities; and manage waste collection services in three districts in Karachi (provided by private contractors). The SWEEP PIU has been notified and a Project Director appointed by the GoS, with further resources to be recruited after effectiveness.

SWEEP's implementation arrangements are based on the institutional mandates of relevant agencies. The Local Government Department (LGD) represents the umbrella institution for all implementing agencies as the parent body for all local governments and with SSWMB established as an attached entity. A Steering Committee, headed by the Chairman, Planning and Development (P&D) Board, with representatives from relevant GoS agencies, will provide overall strategic oversight, review progress, resolve inter-agency disputes, and provide approvals for project-related matters as needed.

SWEEP PIU is responsible for implementation of all activities. The SSWMB also procure equipment for District Municipal Corporations (DMCs), as needed, to carry out waste collection, routine cleanup and maintenance tasks. Further, SSWMB will develop and adopt an Operations Manual for implementation of the Project.

SSWMB is to be transformed into a fully functional body under the CLICK project. Apart from the other aspects, CLICK project also focuses SWMBB. CLICK project is being carried out by Sindh Government with the financial assistance of World Bank.

The project seeks to provide broad-based strategic sectoral supports to provincial government for solid waste management for the city through technical assistance. It also supports the preparation of comprehensive planning documents for the sector, the working paper of the project stated.

The objective of technical assistance is to improve the overall performance of solid waste management through a set of targeted activities addressing critical sector challenges and help contribute to the formulation of a comprehensive investment strategy.

The SWM component of the project consists of activities along four thematic areas which include improving efficiency and effectiveness of solid waste management, developing upstream sector policies through an overall sector review, community level activities and job creation in waste sector, capacity strengthening of SSWMB, data management and improved monitoring & evaluation in solid waste management.

The major functions of Local Govt Department (LGD) are given below:

- Administration and fiscal support to the various tiers of Local Councils
- Human Resource Management for the offices of Local Councils
- Secretariat of Local Government Commission
- Coordination in the matters related to audit and accounts of various tiers of Local Councils
- Coordination, Supervision and Monitoring of Provincial, Foreign-aided and Mega Projects of Local Government / Councils
- Capacity building for Local Councils employees and elected representatives

The PIU established under LGD for CLICK support project preparation and immediate emergency activities under Component 1 of SWEEP, as a shared services unit. The PIU will continue to be responsible for implementation of CLICK components aimed at:

(a) Providing Performance Grants and technical assistance to local councils; and,
(b) Institutional strengthening and TA to SSWMB. Under the latter component, CLICK PIU will resources to the SSWMB, including, Technical Specialist for Waste Collection Services, Performance Management Specialist, and Legal Specialist.

The PIU hire staff (or consultants) to provide monitoring and evaluation (M&E) services, including data collection and analysis for reporting on project results (e.g., indicators, outputs and outcomes) and specialized agencies will be considered for provision of training and equipment to sanitary workers. Infrastructure delivered under SWEEP will be integrated with the performance management system being designed for the SSWMB under CLICK. The generation of timely and accurate data will allow a performance assessment of facilities to evaluate. The organization set up of SSWMB with its strength and capacity is given in **Figure 55**.

6.2. Existing Organizational Structure, Capacity and Capabilities at Jam Chakro Landfill

6.2.1. Existing Organizational Structure

The hierarchy of SSWMB (**Figure 55**) shows that the Karachi Division, Operation of solid waste, is headed by Executive Director (ops) Karachi Division (EDKD). The 03 Directors; Director Front End Collection, Director GTS and Director Waste to Energy (DWE) reports to EDKD. The Jam Chakro Landfill (CLF) affairs headed by the same Director Waste to Energy. He is looking affairs of Composting Biogas, Landfill Site, Waste to Energy. 03 Deputy Directors of each above-mentioned affairs report to DWE. It is revealed that according to hierarchy, the head of land fill site is the Deputy Director Landfill Site (DDLS) but in existing setup of CLF, Director waste to energy is directly looking after of CLF operation as shown **Figure 56**. This post is looking after the all operation and management affairs of landfill sites. The assistant director landfill report to DWE and under this post there are significant operation and management staff report to this post. Most of the non-executive operational staff from outsourced / provided by private contractor.

6.2.2. Existing Capacity and Capabilities

Currently, the institutional arrangements to manage solid waste at the Jam Chakro site rests with SWEEP/SSWMB. The Assistant Director Landfill Site is responsible for daily activities, with oversight by the operations team's higher tier. However, it is pertinent to mention that after SWEEP, the Schedule of Establishment has been revised to some extent but still needs additional staffing and funding provision. At present, the waste is transferred from the GTS to CLF by private contractor via larger-capacity vehicles

Existing Organizational set up at CLF comprises overall 41 employees at landfill site to operate and maintain the landfill operations headed by DWE. All of them are in the field working at the landfills or performing support activities to landfill operations. The major three functions have been carried out at CLF are administration/management, engineering/operations, and environmental. The further major details of stated functions are given below.

6.2.3. Existing Major Functions at Jam Chakro

Administrative/ Management

The Function provides support services for the daily push, pack, and cover operations of the landfill. This includes:

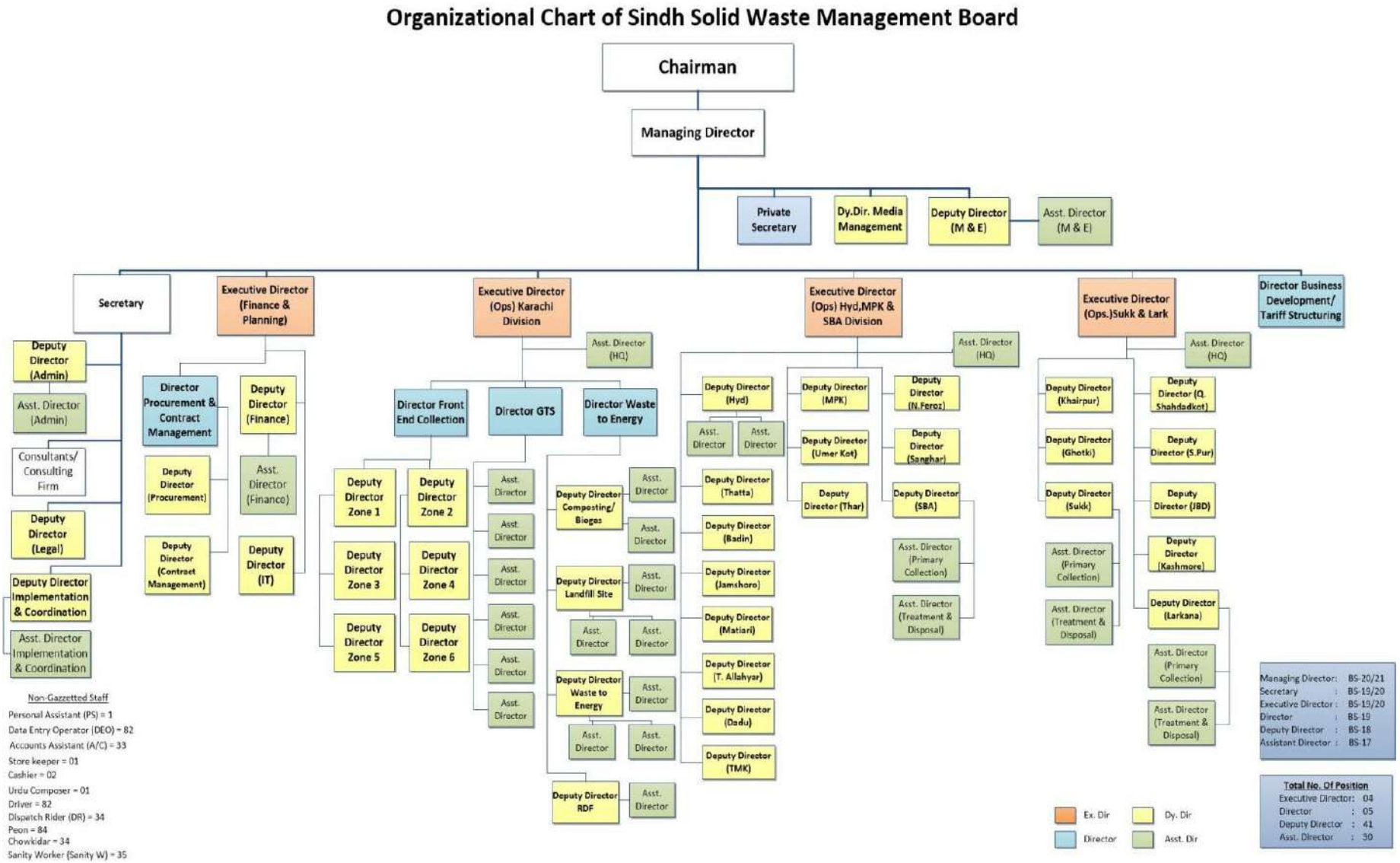


Figure 55: Organisation Chart SSWMB

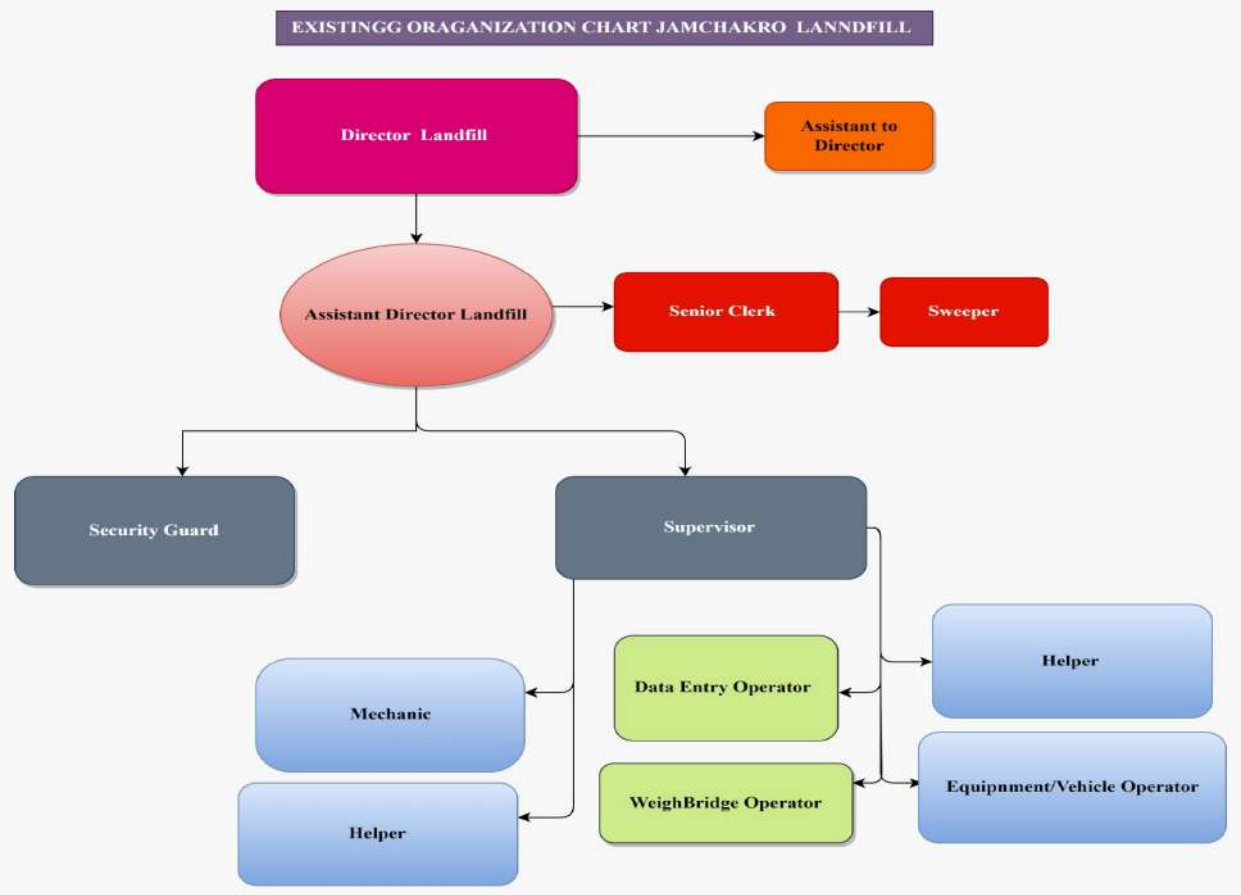


Figure 56: Existing Organisation Chart for Jam Chakro Landfill

- Administrative Services & Support
- Fleet (Fleet Administration, Equipment Procurement, Parts Warehouse, Equipment and Vehicle Maintenance)
- Gate administration
- Fiscal (General Accounting, Recording & Reporting,
- Human Capital Management

Engineering/Operations

The function is to oversees both active and inactive works related to engineering/operations. Activities include:

- Planning;
- Operations (overseeing the daily "push, pack, and cover" operation of burying refuse); and
- Maintenance,

Environmental Management

The Environmental related activities to oversees a variety of support activities to the daily push, pack, and cover operations at the site keeping in view the environment standards including safety and health. This function mostly includes environmental monitoring.

6.2.4. Strength of Staff, Capability and Assessment

The existing staff strength for three shifts of operation and their qualification as well experiences are given in **Table 31**.

Table 31: Existing Staff at Jam Chakro Landfill

Designation	Number of Positions	Qualification	Experience
Director	1	B. A	20
Assistant Director	1	B.E, MBA	14
Assistant to Director	1	Intermediate	4
Senior Clerk	1	Intermediate	4
Supervisor	3	Metric/Intermediate	5
Data Entry & Weighing Bridge Operator	6	Diploma in IT	3
Sweepers	1	Middle	2
Helper/ Equipment Operator	18	Metric/Intermediate	2 to 5
Security Guard	9	Metric/Intermediate	2 to 5
Total Positions	**41**	-	-

The above table reveals that the existing CLF is simply working as a dumping site, not as a scientific landfill. All the non-executive staff at CLF are from outsourced, provided by contractor as per the work requirement. The entire Garbage transfer & dumping and vehicle movement are managed & controlled by IT system besides the data of vehicle movement, weighing, dumping etc are entered into Centralize Management System (CMS) which based on software system and links are provided to all relevant organisations. All the executive staff deputed there are well experienced & handling entire activities professionally well at site. The Skill of contractor's staff are as per the activities/work and their job descriptions.

6.3. Views on Administrative Institutional Arrangement for SWM

6.3.1. Historical Administrative Institutional Arrangement

The institutional evolution of municipal solid waste management (MSWM) in Karachi can be broadly categorized into four phases over the last 25 years; from 1995 till 2001; from 2001 till 2009, from 2009 till 2013; and from 2013 onwards. We found that the institutional infrastructure has been directly connected with changes in national level politics, which in turn have been largely influenced by regional politics. Thus, discussion includes the evolution of national and regional aspects to better explain their impact on local service provision.

The over view the period 2013-2022 evident that after a gap of six years, party-based local government elections took place in Karachi as per Sindh Local Government Act (SLGA) Government of Sindh (GoS), 2013. SLGA 2013, abolished the powerful centralized three-tiered urban city district government with its mayor at the top of the administration and established instead, a six-district based decentralized three-tiered system of local government, called the Karachi Municipal Corporation (KMC) headed by a mayor coming under the Sindh Local Government Department.

KMC functions are distributed at the district level under the six District Municipal Councils (DMCs). They are autonomous in terms of finances and are responsible for the sweeping in the city, which in turn is managed at the Union Committee (UC) level in urban areas. While a District Council exists for the rural Union Councils (UCs), in the city it works similarly to the DMCs. As a result, solid Waste Management was no longer the responsibility of the KMC under the SLGA 2013.Sindh Solid Waste Management Board (SSWMB) was established in 2014 through an act of the provincial assembly Sindh (GoS, 2014). It was tasked with taking care of the municipal function of solid waste management within the provincial territory

of Sindh, having three regional offices including a head office in Karachi.

Table 32: The Administration of Karachi

Divisions	Administration	Local government
Karachi division (urban + rural)	Commissioner Karachi. + Metropolitan commissioner (appointed chief executive of the council, looks after the municipal functions of the city) Officer in charge of the Corporation administration.	Karachi Municipal Corporation (KMC) headed by an elected Mayor and deputy mayor. Heads the Municipal council comprising of chairpersons of all the Union Committees) in the city. UC chairpersons in the council elect the Mayor and the Deputy Mayor. In council, reserved seats to the extent of 22% for women members, 5% for non-Muslim members and 5% for labourer or peasant members, to be indirectly elected by the members elected by the chairmen of UCs. Although, mayor is given more powers over the chief executive (metro commissioner) but the responsibilities and functions given to the mayor and the chief executives are vague (Murtaza and Rid, 2017).
Six districts	6 Deputy Commissioners responsible for the admin. Of the districts.	6 District municipal corporations (DMC), headed by elected Chairperson and vice chairperson DMC. Chairperson is elected by the Vice Chairpersons of the DMCs. District Council – comprising of representatives of the union councils (rural UCs). One District Council in Karachi.
Union committees (urban) Union councils (rural)	A government officer of grade-16 is appointed in the UCs to represent the administration as the secretary of the council.	Each district comprises of Union Committees (UC) by elected UC Chairperson and vice Chairperson. The Local government elections directly elect the UC chairmen/vice chairmen panel and the 4 ward members of each UC. Otherseats are reserved for women, non-Muslimminorities, youth members and labours in a Union Committee all of which are indirectly elected by the direct election of chairman/vice chairman panel. In Rural areas, UC is termed as Union council.

Provincial finance commission (to provide finances to the KMC). Local Government Commission (to monitor the working, to guide and to do planning). Historical SWM responsibilities in Karachi during past 25 years are summarised in **Table 33** below.

Table 33: Historical SWM Responsibilities in Karachi

Year	SWM roles and responsibilities
1995	- Benazir Bhutto announced Karachi package and Garbage Train Project. - KMC has four districts called Zonal Municipal Corporation (ZMCs). Waste collection and transportation is the responsibly of ZMCs. 226 councilors of Karachi are part of ZMCs. KMC has a small emerging SWM department mainly for international projects and procurement, planning of landfills and transfer stations.
1996	- Zonal Municipal Committees (ZMCs) were delegated the responsibilities of waste collection and transportation until 1996, the tasks were taken over by the five District Municipal Corporations (DMC) in 1996 (Ahmed, 2010). While the final disposal sites and planning of Garbage Transfer Stations (GTS) remained the responsibility of KMC. - A new administrator was appointed (Mr. Faheem Uz Zaman Siddiqui, 1994-1996 and then Anzar Hussain Zaidi April – September 1996, and then Sibghat Mansoor September 5 to November 11, 1996) - Water and Sewage management functions were taken away from KMC and Karachi water and sewerage board was formed. This took away a number of employees from the KMC. - No formal permanent hiring of solid management staff since 1996.
1998	- New administrator KMC appointed (Syed Arshad Ali August 28, 1998, to August 11, 1999.) - Military takeover of the country.
1999	- New administrator KMC appointed (Mushahidullah Khan August 11, 1999, to October 12, 1999, and then Iqbal Ahmed Zubaidi October 13 to October 29, 1999)
2001	- Implementation of Sindh Local Government Ordinance 2001. - The pre-2001 KMC was made part of the CDGK, while the Zonal Municipal Councils (ZMCs) were rearranged under the eighteen-town administration. The CDGK would perform SWM related functions at various levels ranging from UC till the City Level under SLGO-2001 (Alam and Wajidi, 2013). CDGK transferred waste vehicles and staff at the level of towns. - Local government elections took place and J.I lead govt. led the CDGK headed by the City Nazim (Mayor) Naimat ullah Khan Advocate (Aug 2001-June 2005).
2005	- Second term elections for the CDGK. Mustafa Kamal of MQM took over.
2010	- Local government system, as per SLGO 2001 was abolished. New elections did not take place. - Federal level 18th amendment took place, provinces were empowered, and local governments establishment was provinces responsibility. - Administrative system returned to the city, while de-facto town administrations kept working as a legacy of CDGK. - UCs became non-functional. - Appointed Town administrator was responsible for the town functions under the KMC administrator.
2012	- In 2012 'The Sindh Peoples Local Government Act 2012' (GoS, 2012) was approved which lived short and was taken back within six months. The act had support of both MQM and PPP.
2013	- Sindh Local Government Act 2013 (SLGA 2013) was approved that described the future form of local government in the city and the province. - 6 Districts were restored; 18 towns were abolished. - KMC would be the local government. - District Municipal Corporations (DMCs) were the second tier of KMC. - Union Committees (UCs) were the lowest tier, having the councillors, UC Chairmen and Deputy Chairmen and other elected responsible individuals at the UC level.
2014	- Formation of SSWM Board through the Provincial assembly legislation. - SWM functions taken away from the KMC.
2015	- Local government elections took place according to the SLGA 2013.

- For six months after the elections, no mayor was appointed, and local government remained stalled. SWMB looked after the SWM.

2016 - District South Municipal Corporation signed contract with Chinese first to hand over responsibility of waste collection in the district. District east also followed the policy.

2017 - District Malir (District Municipal Corporations) and District West, signed contract with Chinese first to handover responsibility of waste collection in these districts.

2020 - SSWM Board has majority of planning and implementation responsibilities. 2 Chinese Contractor working. Districts also outsource collection and transportation. KMC has a small budget for small waste related projects.

- Sindh Government announced 7th district by dividing the district west, making "Keamari District"

6.3.2. Current Administrative Structure

Pakistan is a federal republic, having three tiers of government, i.e., federal, provincial and local governments (**Figure 57**). There are five provinces and federally administered tribal areas. Sindh province lies in the south, abutting the Arabian sea, while Karachi is the provincial capital of Sindh and, as per the Sindh Local Government Act 2013, it is a division subdivided into seven districts.

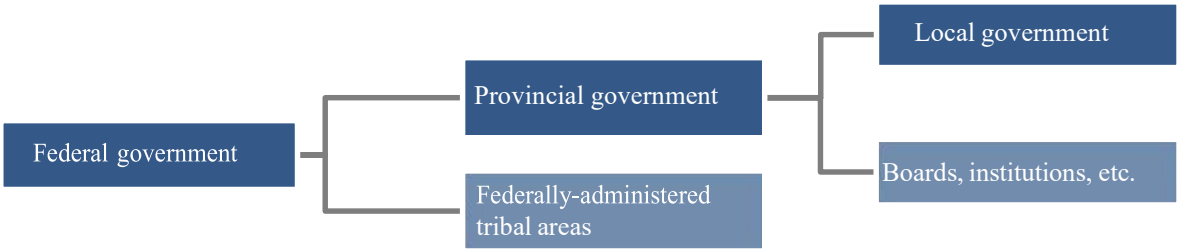


Figure 57: Three-Tiered Governance System

https://www.lgdsindh.gov.pk

Each province is headed by a politically elected Chief Minister, who is the chief executive of the province, and has a secretariat having Departments (equivalent to ministries in the federal government) headed by provincial ministers (Provincial cabinet). Each Department works under the supervision of provincial ministers and the appointed secretaries. The Local Government Department is one of the major departments that looks after the affairs of the major institutions including local governments in Sindh (**Figure 58**).

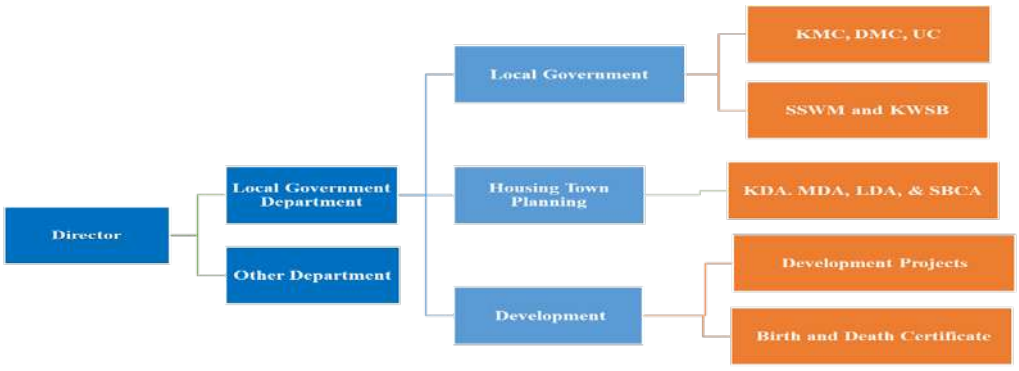


Figure 58: Provincial Government Hierarchies

The Local Government Department has three wings, i.e., a) Local Government, b) Housing, Town Planning and c) Development (**Figure 58**). Local government heads the Karachi water and Sewerage Board (KWSB), Sindh Solid Waste Management Board (SSWMB) and other institutions, apart from that, the major task is to manage the affairs of the local government system, approve budgets, appointment municipal

commissioners and other strategic decisions, which are the prerogative of the Local Government Department. The Local Government or the KMC has various line departments responsible for discharging various services such as the fire brigade service, Department of Katchi Abadis Up- gradation (DKAU) etc. The other two wings of local government look after other organizations, especially the three land owning agencies i.e., the KDA, MDA and LDA, that work for the city's management and service provisions.

The local government of Karachi follows a metropolitan governance system and is a three-tiered system according to the Sindh Local Governments Act 2013 (GoS 2013). The top tier, i.e., the metropolitan entity called Karachi Metropolitan Corporation (KMC), is a city-wide entity headed by an elected mayor and a deputy mayor. District Municipal Corporations (DMC) forms the second tier and are headed by elected chairmen and vice- chairmen. While the third tier is the Union Committee (UC) headed by the chairmen and vice- chairmen in urban areas. The KMC and the DMC share various responsibilities and are supposed to function independently in discharging their municipal functions. For the KMC these are, for example, major roads and city-level infrastructure, large public amenities, parks and public spaces, and major health care facilities. Numerous municipal functions are the mandate of DMCs, such as solid waste management, street lighting, and community services (Shehri 2018).

Specific to solid waste management, Sindh government created the Sindh Solid Waste Management Board in 2014 with a mandate to manage municipal solid waste in the province generally and in Karachi specifically. The board has contracted out collection of waste from street level and its transfer-to-transfer stations located at the district level. From here solid waste is transferred to the city level land fill sites in Jam Chakro located in the northern part of the city, and Govind Pass located in the west.

6.3.3. Relationships and Roles of Stakeholders

In Pakistan, land is a provincial responsibility and the Board of Revenue (BoR) of the province is the custodian of lands. There are thirteen land-owning agencies in Karachi, from federal to provincial government (Raza 2012) (**Figure 59**). Out of these thirteen, three development authorities are public sector entities, namely KDA, MDA and LDA.

A number of corporate organizations are also important stakeholders in terms of the land holding share of the city as shown below:

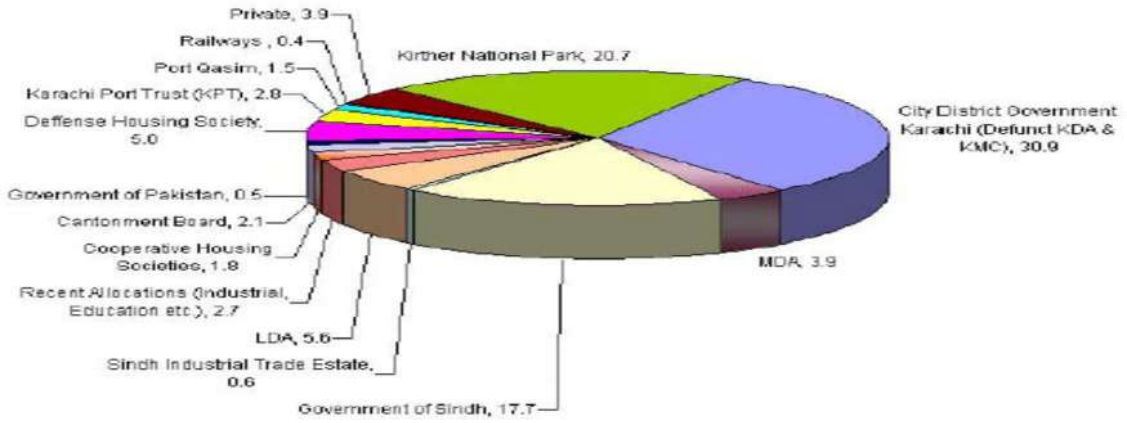


Figure 59: Land Owning Agencies in Karachi

Source: KSDP 2020

The Metropolitan, Municipal and District councils are responsible for the collection and final disposal of solid waste. These councils and municipalities have a number of functional departments and one of the departments is the Waste Management Department (WMD), which is responsible solid waste collection and disposal, cleansing of streets and drains, and supervision and monitoring of the activities of private contractors engaged by the SSWMB. **Figure 58** shows the relationships and roles of the stakeholders (and

institutions) in the institutional arrangements for solid waste collection. The Local Government Department, (LGD) formulates solid waste and sanitation policies and also provides oversight role to the councils/ municipalities and also gives subsidies for provision of SWC services.

Relationships and roles of stakeholders in the Institutional arrangements for solid waste collection. The Major role of different stake holders are in the institutional arrangement for solid waste collection is describe below:

- Sanitation and solid waste policies formulated for the UCs/ Municipalities to implement
- Provision of funds for solid waste collection activities
- Submission of reports on activities of private companies and access to data
- Payment of charges to private companies.
- Supervision and monitoring of activities of service providers
- Rendering of services to service beneficiaries by the UCs/ Municipalities or private companies
- Release of funds to private companies for services rendered
- Payment of user charges to private companies by service beneficiaries
- Complaints about service quality by beneficiaries.

6.3.4. Policy, Institutional, Financial, and Human Resource Bottlenecks

An Overview on Karachi and SWM

Karachi, located on the south coast of Pakistan, is a metropolitan city that houses more than 20 million people (Statistics, 2017). This city is also considered the business hub of Pakistan with an ever-growing rate of commercial activities. Although it is considered a megacity, Karachi has its fair share of problems — including the discrepancies in the solid waste management system (Mahmood and Khan, 2019).

In fact, 'Karachi has seen an upward trajectory in its solid waste, from 2,000 tonnes per day before 1974 to 6,000 tonnes in 2001. By 2005, it had leapfrogged to 9,000 tonnes per day, and, now, it stands at a staggering 12,000 tonnes per day' (Mahmood and Khan, 2019, p.78). The rate of generation of solid waste has also changed in Karachi in recent years due to the booming population, coupled with increased urbanization, lifestyle changes, a rise in fast-food chains, and commercial activities (Mahmood and Khan, 2020).

The large rural influx into Karachi, mass migrations, and overpopulation mean that there is also a decline in the basic urban resources such as housing, clean water, and sewerage systems. This has also resulted in the rise in Katchi Abadis (squatter settlements), which account for more than 30% of Karachi's population (Guideline for Solid Waste Management, 2005).

Moreover, people living in Katchi Abadis are deprived of solid waste disposal facilities, hence they dump solid waste in natural drains, streets, parks, or even in varying open areas. The municipal institutions, on the other hand, do not have sufficient resources to manage the needs of the growing population — plus the lack of planning, financial, and technological constraints add to the problem of solid waste management in Karachi.

Karachi only has had four master plans for the city since 1947, and all of them have failed to reach the development, planning, and solid waste management targets — including the latest plan, that is, the Karachi Development plan 2020. The new plan is now also on the verge of failing (Mahmood and Khan, 2019).

There has also been an increase in fast-food restaurants in the 21st century, which has exacerbated the solid waste generation and disposal problems. Many 'smaller restaurants and businesses mostly do not adhere to the relevant policies towards hygiene and health — and dispose of solid waste out in the open.

Problems for Disposal of SWM

Illegal dumping also leads to the open burning of waste at various points around the city, which is extremely harmful to the health and well-being of the citizens — and for the environment (Mahmood and Khan, 2019). Some even started burning their waste, which is now increasing the levels of carbon dioxide and nitrogen oxide in the atmosphere.

The air quality has deteriorated in Karachi due to the open burning of waste, and the same has led to health problems 'such as respiratory diseases, chest infections, and coughing. Improper waste management has also added to waterborne diseases such as gastric problems and hepatitis' (Mahmood and Khan, 2019, p.81). Solid waste negatively impacts water quality and leads to soil pollution, climate change, and adverse effects on flora and fauna.

Keeping in mind the same, there is an urgent need to halt illegal dumping and outdoor burning of waste, which causes smoke, environmental degradation — and also results in diseases (Sabir, Waheed, and et.al. 2016). Solid waste effects are most evident in Katchi Abadis and the trash problems there have deadly consequences. Al Jazeera (2017) reports that three children in one of these squatter settlements died when a garbage pile caught fire in an alley next to their home.

People living in Katchi Abadis also have to bear the consequences of the poor waste management system more than anyone else as heaps of garbage are piled up near their homes. This results in vector-borne diseases, that is, diseases caused by insects and rodents (like malaria and chikungunya) which affect the health and well-being of the people residing there (Nathanson, 2020).

The environmentalist critic rightfully calls the link between the impact of pollution and health problems as slow violence (Rob Nixon, 2011) — which is often inflicted upon the marginalized and poor people, like the plight of improper solid waste management on the Katchi Abadi residents in Karachi

Current System of Waste Management

In Karachi, the responsibility of waste collection and transportation falls under Town Administrators, and treatment and disposal of refuse are handled by the City District Government (CDGK) (Mahmood and Khan, 2020). Under the CDGK fall two cantonment boards, the Karachi Metropolitan Corporation (KMC), and the District Municipal Corporation (DMC).

These two controlled the solid waste management system in Karachi up until 2014, and then 'under the Sindh Act No. 4 of 2014, the Sindh Solid Waste Management Board (SSWM) was formed — which became responsible for the solid waste management of areas that fell under KMC' (p.81). Furthermore under the City district Government (CDGK), 'Karachi is split into six districts with further divisions into 18 sub-districts or tehsils, and every tehsil is administratively separated into 178 union councils which manage the solid waste of their areas'(Sabir, Waheed, and et. al., 2016).

Also, the disposal system in Karachi is divided into three main phases:

- FEC (Front-end collection): The collection of waste from muhalla kachra kundis, union council kachra kundis, and street bins.
- GTS (Garbage-transfer station): These are big grounds that are used to dump garbage collection from FECs, and serve as a facility to sort recyclables ideally.
- LFS (Landfill sites): Where waste is dumped under the land. Karachi has only two functional landfill sites: five hundred acres of land each on the Northern Bypass side, namely Deh Pass Gondal and Deh Jam Chakro (Baseline Study for Solid Waste Management-Karachi, n.d.).

However, 'out of the 9,000 tonnes of municipal waste generated every day in Karachi, only sixty percent is discarded in the landfills, and the other forty percent remains on the streets around us' (Sabir, Waheed, and et.al., 2016, p.152).

Constraints Between Citizens and Municipalities

In the formal solid waste management system, there are two major stakeholders: the citizens and municipalities. However, both the parties blame each other for the discrepancies in the solid waste management system as 'according to the Secretary of SSWMB, 80% of garbage is lifted from the grounds to be dumped into garbage-transfer stations, and later on, it is transferred to landfill sites.

According to the survey on solid waste management conducted, 74.8% of the population is not satisfied with the government's efforts in countering the disposal problem, 23.7% is unsure, while a mere 1.5% approve' (Mahmood and Khan, 2019, p.81). Citizens are dissatisfied with the strategies of the municipal authorities regarding solid waste management; many citizens do not trust the authorities and believe that they do not have enough resources, funds, or equipment to tackle the growing sewerage and waste problems.

Citizens also believe that municipal authorities only perform their duties in rich neighbourhoods and not the poor ones — where the people are not able to afford their services and cannot pay 200 hundred rupees every month for the garbage collection. It is, however, a right of every citizen, rich or poor, to live in a clean environment (Sabir, Waheed, and et.al. 2016).

Municipal authorities, on the other hand, believe that they alone cannot handle the waste problems of a whole city — and believe that citizens should play their part. Authorities complain that citizens throw garbage at any nearby convenient point. Authorities also believe that citizens do not take responsibility for waste management beyond their homes — and constantly litter the roads and other public areas.

However, they forget that many people live below the poverty line in Karachi and cannot afford the expense of waste collectors. This is mainly why they engage in illegal dumping of waste (Sabir, Waheed, and et.al., 2016).

Current Policies and the Role of Stakeholders

The Sindh government has formulated policies to halt littering and illegal dumping in Karachi. However, these policies have not affected the problem of littering and illegal dumping; since there is little to no implementation. Also, the fines are set too low to deter the citizens and the sweepers from dumping their waste openly.

Since the informal system of waste management includes the scavenging and informal recycling industry as well, not taking them into account in policymaking disrupts the whole system of waste management. The general public and opposition parties are in favour of changing the existing policies. The civil society and certain NGOs, like Fixit, are working to improve the conditions of waste management on their own.

The international environmental protection agencies like The United Nations Environmental Protection (UNEP) agency are towards the same in Karachi as well. Some private-sector firms are looking for the right opportunities to invest in the waste management system but are not supported by the government. Chinese firms have started their operations (Khan and Mahmood, 2019).

Policy Measures for Stakeholders

Tackling solid waste problem in a megacity like Karachi, having a population of around 22.5 million and generating a daily waste of almost 0.28 to 0.61 kg/per-capita with 2.5% growth annually, requires an effective policy framework and its efficient implementation. A holistic understanding of the institutional capacities (technical, financial, human and physical resources), actors involved in managing solid waste, household socio-economic condition, and political issues along with how they are linked to the stakeholders under various phases of the SWM system given the ground realities is crucial for such policy framework. Identification of the stakeholders and their interests is important in coordinating their participation and involvement in various waste management activities. Therefore, it is essential to access the role, interest,

and power structure of various stakeholders in process of waste management. This section provides an in-depth policy measure for all the stakeholders involved in solid waste management – from generation to disposal. Conclusions and recommend policy measures are described below with brief assessment:

- The assessment highlighted that issues have been exacerbated by unclear duties, overlapping functions, and inadequate coordination among the numerous institutions responsible for solid waste management. The functions are largely divided between KMC and SSWAMB, resulting in a lack of coordinated planning and integration. There is a need to resolve the issue by clearly assigning the responsibilities – there should be only one authority responsible for the SWM
- In addition, public awareness, financial needs, institutional capacity and regulations enforcement and establishment of a proper GTS and sanitary landfill are principal measures needed to ensure a sustainable solid waste management system.
- The assessment predicts high profitability from recovering recyclable material, mainly enjoyed by the private contractors and informal workers. Given the profitability, it is recommended that the problem of solid waste management (SWM) can be dealt with by adopting policies for improved municipal solid waste services characterized by regular collection, timely transportation, careful disposal (especially hazardous medical waste) and proper separation of recyclable waste in achieving sustainable development.
- Households are concerned with the improved solid waste system and are ready to make efforts for it but for those who are reluctant to adopt sustainable waste management strategies motivational aspects are needed.
- Finally, elected local governments have ineffective processes and capacities, and they lack the authority to carry out numerous municipal responsibilities. A variety of services and functions that the city perform includes, master planning, building control, water and sewerage services and solid waste management are all under the control of the provincial government. DMCs are in dire economic straits, relying almost completely on provincial government payments to satisfy their budgetary demands, the bulk of which is consumed by salaries and pensions, leaving relatively little for much-needed infrastructure management and development.

Suggestions

Suggestions for improving the generation, composition, and storage of refuse and Treatment and Disposal are discussed below:

Improving the generation, composition, and storage of refuse

- Sorting of recyclables like paper, glass, and metal should be done at source (domestic and commercial) (Nathanson, 2020).
- Garbage composting should be done in households to grow organic fruits and vegetables.
- The garbage from sabzi mandis should be transferred to farming areas as fertilizer for organic farming. Moreover, the installation of biogas plants at sabzi mandis can be done by private companies to produce gas efficiently.
- Increasing awareness of composting methods and recycling in public should be done through mass media and social media, alongside collaborations with notable religious scholars to increase awareness about waste management, and the importance of cleanliness.
- Compulsory sessions and classes in educational institutions should be conducted to increase awareness around waste management.
- There should be a ban on plastic in Karachi in terms of both production and consumption.
- Subsidies for companies like TrashIt should be announced to encourage composting on a large scale and also for small-scale producers to develop alternatives to plastic and shopping bags.
- Contracts should be entered into with private companies, e.g. like in Lahore, which can provide separate bins in each community for recyclables and non-recyclables. This would help sort the waste at the source rather than at the garbage transfer stations.

- Investments should be made (through public-private partnerships) to purchase adequate transport vehicles and also to automate the manual waste collection system
- Accountability of municipal staff should be increased, along with fines on illegal dumping and the budget of waste management in Karachi.
- There should be a moderate increase in garbage collection charges from the richer parts of the city – and the same money can be used to fund the garbage collection in the squatter settlements.

Treatment and Disposal

- There is a dire need to integrate the informal waste workers and recycling industries in the formal waste management system. 'If scavenging and recycling can be shifted to the landfill/GTS site then there will no problems with the waste reaching the landfill' (Ali and Hasan, 2001, p.4)
- There is a need to provide the scavengers infrastructure, housing, water, and other facilities (even subsidized food) to live near the landfill/GTS sites This would serve as an incentive to relocate from the city to landfills sites.
- Subsidies can be given to private entrepreneurs as 'they have expressed an interest in developing and managing landfill sites — provided that they are easily accessible and not too far away from their areas of operation'(Ali and Hasan, 2001,p.4)
- The informal recycling industry has also shown interest to move away from the city. However, it requires land, road access, electricity, water, and preferably living space for its workers (Ali and Hasan, 2001.p.4). The same should be considered at the government level – and adequate facilities should be provided for the same.
- 'There should be four landfill sites in Karachi – each handling about 1,500 tonnes of solid waste per day. They should be relocated so that refuse trucks do not have to travel more than 15 kilometers to them'(p.4)
- 'Jam Chakro and all GTS sites should be developed as a model and landfill handle 1,500 tonnes of solid waste per day. It should contain 30 sorting yards and 18 recycling factories along with 600 60 square Meter plots for scavengers'(p.4)
- Prevention of scavenging at the katchra kundis can be stopped if the waste is not exposed and is collected and transported in transferable sealed containers (Ali and Hasan, 2001).

Conclusion

Solid waste management problems require the immediate attention of policymakers to improve the deteriorating situation in Karachi. The recommendation in this section can help to improve their solid waste collection and disposal policy measure by improving their policy measures for institutional, financial, and human resource and by removing bottlenecks among them that constrain effective waste management.

6.4. Proposed Organization Structure of Jam Chakro Landfill and Staff

6.4.1. Proposed Organisation Structure

The proposed organisation set up. for three shifts of operation, after development of the sanitary landfill is given in **Figure 60**.

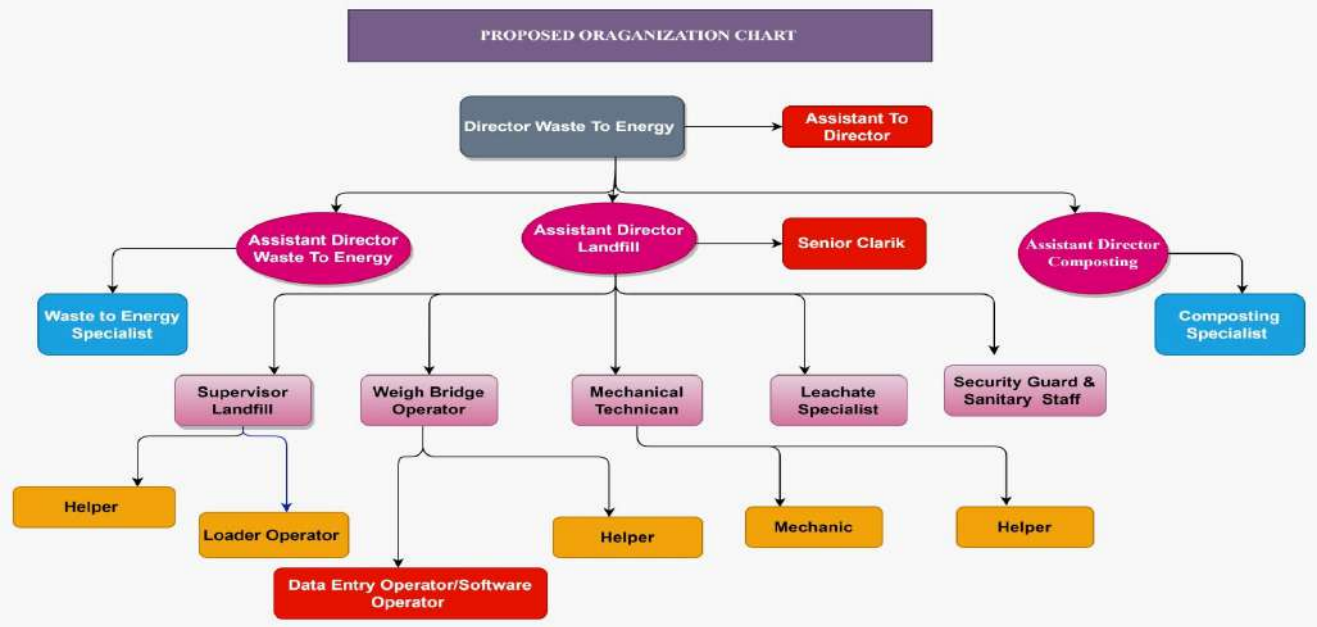


Figure 60: Potential Organogram for Jam Chakro Sanitary Landfill

The above organisation chart depicted that the Director Waste to Energy (DWE) will the overall responsible for the O&M of landfill. The Assistant directors waste to energy, landfill and compositing report to DWE. The specialists waste to energy and composting report to their respective assistant director. The Leachate specialist, landfill supervisor, weighing bridge operator and mechanical technician report to assistant director landfill. The supervisor of landfill responsible to waste to be unloaded at the landfill.

6.4.2. Proposed Staff Capacity and Capability

An adequate staff capacity for three shifts of operation is required for running the CLF, as shown in **Table 34**, whilst the required capacities and skill set of the proposed staff are set out on **Table 35**.

Table 34: Staffing Requirement for Self-Operating Scenario at Jam Chakro Landfill

Designation	Number of Positions
Director CLF	1
Assistant Director Waste Energy & Compost	2
Assistant Director Operation	1
Assistant to Director	1
Senior Clerk	1
Specialist Energy to Waste	1
Specialist Composting	1
Specialist Leachate	1
Supervisor landfill	3
Weighing Bridge Operator	3
Mechanical Technician	3
Data Entry/ Software Operator	6
Sweepers	1
Helper/Vehicle/Equipment Operator	18
Security Guard	6
Sanitation Staff	1
Total Positions	**50**

Table 35: Skill Set of the Proposed Human Resources at Jam Chakro Landfill

Institutional Arrangements	Qualification	Requirements
CLF Director/ Manager	BS-Environmental Sciences or Engineering	For fresh Graduates, basic training in SWM shall be provided
Supervisors	SWM Operations Diploma	All the supervisors shall attain a minimum of SWM operations diploma course from Local Government Department
Watchman	Basic	Basic Guard Training is necessary-Ex Military Personnel
Gate Keeper	Matriculate	Should be able to write and speak English/Urdu/Sindhi.
Weigh Scale Operator	Matriculate	Basic course in IT needed
Software / Data Entry Operator	Diploma IT	Have experience in IT
Waste Loaders / Sweepers	Middle	Have experience in Loading waste and droppings from waste compactors
Technician	Mechanical Apprenticeship	Have performed similar functions related to the vehicles fleet maintenance
Helping Staff	Middle	Basic training shall be provided

6.5. Options for Project Implementation and O & M

It is recognized that developing institutional arrangements goes beyond operations and maintenance. However, the final decisions on two modes of institutional arrangements will clearly impact all aspects of operations and maintenance, and, therefore, these aspects are discussed in this section.

There is a myriad of permutations of public/private ownership arrangements and a huge variety of approaches within each arrangement (e.g., contracts; concessions; franchises; open competition). However, it is important to note that private sector involvement is an opportunity, not a complete solution. In situations in which existing service delivery is either too costly or inadequate, private sector participation can be examined as a means of enhancing efficiency (thereby lowering costs) and mobilizing private investment (thus expanding the resources available for urban infrastructure and equipment). The aims of the government and private sector in providing these public services are divergent. For the private sector, the fundamental concern is whether service delivery will make money. For the government, one of many considerations is whether it will save money through private sector participation.

Any partnership approaches should be based on fairness and transparency, with mutual understanding of the need to ensure the success of the waste management system as a whole and the connectivity of different parts of the value chain (i.e., collection and transfer of waste, sorting and pre-processing of recyclables; collection and processing of organic wastes; collection and incineration of hazardous and special wastes). Taking a systems approach is critical in achieving financial sustainability to provide waste management services.

Having a highly motivated and committed workforce is essential in providing effective waste management services, particularly noting that much work in this sector results in workers being exposed to unpleasant working conditions. As such, workers must be well-trained, given clear procedures and working approaches, receive open two-way communications, and be recognised and rewarded for their work.

6.5.1. Options for O & M

The possible scenarios for operating the sanitary landfill at Jam Chakro are discussed below:

Self-Operation Mode

In this Option, Self-Operation mode, the overall operations of the sanitary landfill will be managed by the Government and must undergo recruitment, resource planning, staff development, monitoring and reporting protocols and financial management of the CLF.

Outsourcing Mode

The key area of work is examining various business models that may apply to CLF. To decide whether to have private sector participation, many factors need to be analysed, such as levels of service, cost recovery, efficiency, public accountability, management, finance, economies of scale, legislation, institutions, and cost. Different options around business models must then be presented to the Board to discuss potential, which will cumulate in developing a final business plan. In any of the business models, there is still a need to oversee the operations of the CLF, which will require some scheduled positions. There are many models to out sourcing O&M of CLF, as discussed below:

Management Staff from Govt & Operation Staff form Private Contractor
This model in practice in existing Jam Chakro Landfill/ Dumping site

Public Private Partner Ship
In this model Govt may provide land / developed landfill site to private sector which will be sole responsible for its O&M and further invest for revenue generation at the CLF site.

NGO / Welfare Association
In this model Govt may provide land / developed landfill site to NGO or City Welfare Association which will be sole responsible for its O&M and further invest for revenue generation at the CLF site

All the above discussed options need detailed study for the sustainability and viability of stated options for O&M of proposed CLF.

6.6. Institutional Strengthening Arrangements

An institutional framework necessary for efficient landfill development and management. Sustainability will an important and critical factor for the O&M of SWM sector.

At present, the project design integrates institutional strengthening and TA interventions under CLICK to provide a sustainable solution for improving the SWM sector in Karachi. Several dimensions of sustainability are needed to be incorporated, as discussed below:

6.6.1. Staff Development

In order for SWM to be successful at the CLF, it is essential that staff are skilled and motivated. In the first instance, this involves having the right skills in the right places, which links to staff recruitment and clear job descriptions and training. Maintaining staff morale, motivation and retention is a critical task for the management, and this can be achieved by ensuring that staff have adequate remuneration, recognition, and reward. This may involve introducing performance management and staff development systems, clear and transparent internal communications, and the creation of safe and positive work environments. This work will include the development of job descriptions, wider staff processes, and comprehensive staff inductions and ongoing training programmes.

6.6.2. Monitoring & Reporting

The global waste sector is notorious for having limited data, including data on waste generated, volumes collected, and number of materials that are recycled and composted etc. It is important that an overall

approach is developed for key data requirements, including methods for obtaining, recording, analysing, reporting, and using the data to make operational decisions. Data is critical in terms of how the overall CLF functions on a day-to-day basis and can adapt to changing waste volumes and types of waste. Systems for collecting, storing, and analysing data are identified, along with wider processes for monitoring and reporting.

6.6.3. Financial Management

For a system to be fully sustainable, it is essential that all long-term financial costs, as well as short-term operating costs, are considered. Procedures must be in place for obtaining regular finance to meet these costs. One of the challenges of waste management is achieving sustainable financial operations to maintain assets and operations since operations and maintenance can be extremely costly. Financial management must also consider future changes in solid waste management, including population growth and changes in volume and composition of wastes. Sources of revenue and cost-recovery are to be determined on time-to-time basis.

6.6.4. Recruitment

It is essential that recruitment is undertaken at the earliest opportunity, subject to budget availability, to fill all scheduled positions. If required, this can be undertaken temporarily until permanent institutional arrangements are agreed upon.

6.6.5. Management of Informal Sector / Waste Picker

“Recycling without recyclers is garbage”. This phrase, which echoes throughout waste picker or “informal recycler” organizations worldwide, the informal sector is the key element/base to any type of recycling market. There are examples of waste picker inclusion in municipal management programs which is the result of decades of struggle, organizing, dialogue and conflict.

All the waste pickers responded in the survey at SLF and GTS, the proposed sorters/waste loaders, will be divided in at least two shifts to absorb all waste pickers working on each GTS & landfill site. Hiring of waste sorters/waste loaders would be subject to the MRF running time of machines/belt for both manual and semi-manual sorting. Remaining waste pickers will/may be adjusted to have free access to the GTS & SLF and sorting lines to carry out their operations in better environment and occupational conditions. Complete access will be provided to waste pickers at all GTS & SLF sites during operations - so that they can sort the waste with better working conditions. Hence, there will be no loss of livelihood or economic displacement or restriction of land use for waste pickers visiting stated sites.

Since, the waste pickers currently working in a highly hazardous environment and sorting waste to salvage recyclables and shifting to the same mode of picking will again pose health and safety risks. Therefore, visiting waste pickers at sites will be registered and provided with PPE by Contractor / Operator during operations to minimize health hazards and provide safe working conditions. PPE includes cut resistant gloves, dust masks and jackets.

Although women waste pickers have not been observed at any GTS & SLF site but if women approach to work as waste pickers/sorters, they will be provided access along with required PPEs; however, in case of MRF timing could be mentioned for women waste pickers. They will be dedicated separate sorting line and separate washing/sanitary facilities.

This section presents possible inclusion of informal waste pickers into the waste management system based on different options discussed above. The main focus for inclusion into the waste management system will need the following roadmap:

1. **Organization of the Sector:** As mentioned in the last paragraph, the level of inclusion that waste pickers have today is to a large extent the result of the level of organization that the sector has reached, which has allowed higher negotiating and management capacity/ability. This can only be possible if at SLF, the client's management should firmly negotiate with the waste pickers at individual or by forming a small cooperative union. This will make the sector workers organized and can be properly managed.
2. **Registration of Waste Pickers**: Once the sector HR is organized, they should be registered in the current vicinity where they are working. This process will allow planning operational hours for the MRF to cater maximum HR of informal waste pickers.
3. **Work Modality:** Working modality with the workers shall be decided through the cooperative's union so that the payments mode and others can be formalized.
4. **Legal framework:** To formalize the Informal sector, certain changes are required in the existing law. One of the options can be to introduce a Zero Waste Law, establish the guarantee and priority for the sector in the collection and processing of recyclable materials, and enabled credits and subsidies for the acquisition of capital assets. These actions within the framework of a major objective: to progressively reduce waste disposal in landfills, without incineration, through source segregation and implementing a set of measures aimed at reducing waste generation and maximizing its use through reuse, recycling, composting and bio digestion.
5. **Incentives Program:** The program can yield more fruit if the Government develops a two-way approach between the cooperative union and the Government. The program shall not restrict/limit the jurisdiction to the GTS & SLF but shall be developed/included in the waste collection system at each single step. In such scenario, both the parties have to finalize their obligations set, agreed upon to achieve the targeted results of waste diversion from the landfills.

6.7. Contracting Arrangement

In this section, discussions are being carried out on different project delivery model such as Construction only, operate only and Design Built and Operate (DBO), etc. for understanding of client to may adopt any one contract delivery mechanism according to their merit and suitability.

6.7.1. Cost-Plus Contract

Under a cost-plus contract, contractors are paid for all of their construction-related expenses. That's the cost part of the name. The costs can include direct costs such as labor, materials, supplies, etc. They also include overhead costs such as insurance, mileage, a portion of office rent. Additionally, they also receive an agreed-upon amount for the profit. That's the "plus."

Benefits

This type of construction contract is usually looked upon pretty favorably by contractors. There's seemingly no risk of losing money on materials plus incur a profit. These types of contracts are especially useful when client do not have enough information to provide a thorough estimate of work or the scope is not well-defined. They also prioritize quality.

Drawbacks

However, there are a few details about these types of contracts to be aware of. First, client need to keep track of all of their expenses and be prepared to present them. That can require additional resources and labour costs on client side. client may also be limited on how much he can spend. Some cost-plus contracts include clauses with "not to exceed" amounts for costs.

6.7.2. Design-Build Contract

Traditionally, owners receive completed designs before taking in construction bids. That leads to two separate contracts and a longer process. But the design-build contract does things differently. As the name suggests, a design-build contract addresses design and construction costs simultaneously. Under this type of contract, the construction process actually begins before the final design is completed. This process saves the owner time and money by combining the design and construction project delivery into one contract. It also helps to streamline communications and create repeatable processes.

Benefits

The design-build contract helps to speed up the process and avoid disputes between the designer and builder. It's popular with organizations that want to accelerate project delivery, lean into the benefits of collaboration, and streamline processes. Designers also have more input in the construction drawing process, reducing the need for changes.

Drawbacks

Some of the pros of design-build contracts can also lead to cons. Because there's no competitive bidding phase, the final costs may be higher for the owner. It's also more difficult to estimate costs due to the necessary collaboration between designer and builder.

6.7.3. O&M Contract

The short-term benefits of an O&M agreement are pretty clear. Client is starting their operations with a readymade team of experts, who are driven to prove their value and – if O&M contractor is also equipment provider.

Benefits

- Readymade employees

Training an employee up to standard can take months if not years. The benefits of kicking off a project with employees that are "good to go" cannot be overstated. The successful operation of a plant/project depends on the experience of the people running it.

- No expenditure on staff training

An associated benefit of readymade employees is that owner don't have to spend either money or time training them, either now or in the future.

- The workforce is focused

Sure, all employees have targets to meet. But the expectations for employees in an O&M agreement are doubled – once from the plant/project owner and once from the O&M contractor. Workers have to maximise output if they're to hold on to the contract.

- Expert resources for the wider group

The plant/project owner will benefit from the expertise of the O&M workforce, whose knowledge can be shared across the owner's group. In addition, the O&M workforce has the backup of the contractor company, whose expertise can be called upon should extra assistance be needed at the plant/project.

Drawbacks

- Lack of in-house expertise

Trusting the running of the plant/project to outside contractors and not investing in a workforce of owner own means owner will be beholden to the O&M contractor to run the facility and, at least in part, owner business. Should things go well and owner decide to expand the business, owner's be looking at another O&M agreement, rather than transferring some of owner own skilled employees. Knowledge within the group for making business decisions would also be limited, so owner'd be relying on the contractor for their input, which might be biased.

- Limited exposure to other equipment suppliers

If O&M contractor is an equipment supplier, in most cases owner have to buy all equipment from or through the O&M supplier. There will be no option to explore other suppliers, even if they are offering a more suitable technology or a better deal. O&M supplier is maximising their spare parts sales or encouraging unnecessary spending to up their orders.

- Inability to break the contract

Whilst in theory it might be possible to break the contract, the practical aspects of removing the whole workforce and starting again make it almost impossible. The business disruption would be enormous, unless the majority of the people working for the O&M contractor were re-employed by the owner.

6.7.4. Design-Build-Operate (DBO)

A design build operate (DBO) contract is a project delivery model in which a single contractor is appointed to design and build a project and then to operate it for a period of time. The common form of such a contract is a public private partnership (PPP), in which a public client (e.g. government or public agency) enters into a contract with a private contractor to design, build and then operate the project, while the client finances the project and retains ownership.

This differs from a design build finance and operate (DBFO) contract in which the contractor also finances the project and leases it to the client for an agreed period (perhaps 30 years) after which the development reverts to the client. It also differs from the traditional design and build contract in that it includes operation and maintenance of the completed works, which means that the contractor's duties and responsibilities to the client do not end at final acceptance but continue through a defined operational term.

In theory, this encourages the contractor to develop a project with its long-term performance in mind from the outset, rather than just considering the efficiency of its construction, as the contractor will be responsible for any high operating, maintenance or repairs bills. However, it ties both the client and the contractor into a very long-term relationship that can be difficult to price. As a result, contractors may price considerable risk into their tenders, and so the client may not always achieve a best value outcome.

This is not only intended for the 'traditional' DBO approach, but is also available for situations in which a client wants to have an existing facility or asset operated by the contractor while it is being upgraded or extended.

Design, Build and Operate Contract (DBO), released in 2017. It has been added to the suite of contracts in response to the increasing demand for contracts extending into the operational phase.

The demand is coming both from UK clients and from international funding agencies, such as the World Bank and the Asian Development Bank (ADB). In 2015, ADB commissioned NEC to draft a consultative DBO contract, the feedback from which has helped to shape the NEC4 version.

It also aligns with the UK government's commitment to 'soft landings', in which designers and constructors are involved with projects at least three years after construction completion to ensure a smoother handover to the operator.

The new DBO contract is not only intended for the 'traditional' DBO approach, where the client requires a new facility or asset to be designed, constructed and then operated by a contractor. It is also available for situations where a client wants to have an existing facility or asset operated by the contractor while it is being upgraded or extended.

In such situations, the timing of the design and construction phase would normally be stated by the client, but may be determined by the contractor – which will undertake the work at a point to suit the performance requirements of the overall service.

The new DBO contract provides for option A (priced contract with price list), option B (target contract with price list) and option C (reimbursable contract).

Focus on operational needs

The contract starts with the operational and service requirements of the client and then integrates the new or replacement asset to reflect the way that the operation has been specified.

Perhaps even more than other contracts, the development of the client's requirements and specification in the scope will be crucial to the understanding, use and success of the contract.

Greater role for contractor

All the standard New Engineering Contract (NEC) provisions for communications, early warning and compensation are retained along with some other features added in the NEC4 suite.

The management of the work through plans and programmes for the construction and operation phases are still important. Recognising the greater involvement and responsibility of the DBO contractor in the operational phase, the contract has a lighter touch than some standard NEC design and build options.

Incentives and productivity

A key issue for the client is identifying and incentivising performance and productivity of the total asset. This may be through any or all of the traditional NEC approaches, including the reduction of payments for poor performance.

The new DBO contract brings incentives and productivity options together into one schedule and requires the client to identify and develop the approaches it wishes to use.
https://www.designingbuildings.co.uk/wiki/File:Nec4-dbo-contracts.jpg

6.8. Recommendation on the Project Delivery Model for CLF

There are limitations in terms of the overall number of staff and many vacancies for management and operational staff, meaning that it is impossible to deliver waste management services comprehensively. There is also a lack of capability with respect to SWM expertise, low morale, and staff lack of the necessary training to operate vehicles, equipment, and machinery

From the discussion above, it is suggested that the facilities should be operated by outsourcing mode (Private Sector). The statement is further supported by the following points:

1. Management of CLF will be regulated through SOPs
2. Lower management costs for the Government
3. Settlement of the informal sector through the outsourcing contract
4. No operational costs to be paid by the client
5. Reduction in the waste transportation costs from GTS to the landfill site.
6. Lower disposal costs at the landfill site
7. Outsourcing mode attract private sector to generate revenue by installing compost plant.
8. The organic waste will be used as a resource in bioreactor landfill to maximize and regulate the landfill gas recovery system and conversion of methane component of the gas into CNG. The conversion of organic waste into LFG and Methane component conversion will generate a high revenue and contribute to the substantially of the project which also attract private sector to operate and maintain CLF at applicable term & condition
9. The basic operational monitoring will be through the selected software internally. The third-party monitoring will comprise of monthly review of performance and operational performance audits.

The total operating cost of the outsourced model might be lesser than the self-operated model because the private operator may generate significant revenue from compost (bio gas) besides from other sources like energy from waste which may compensate over all operation cost of CLF which is presently entirely borne by public sector. However, considering the above and other tangible benefits, outsourced model (DBO) may be adopted for CLF operations.

7. COST ESTIMATES AND ECONOMIC ANALYSIS

This section provides the findings of economic analysis of infrastructure investment of the sanitary landfill at Jam Chakro. This Section reports comprises on the Net Present Value (NPV) and Economic Internal Rate of Return (EIRR) of the project and the assumptions used therein.

This section provides the findings of economic analysis of infrastructure investment of the Sanitary Landfill (SLF) at Jam Chakro Karachi. This Section reports comprises on the Net Present Value (NPV) and Economic Internal Rate of Return (EIRR) of the project and the assumptions used therein.

Economic benefits from improved waste collection and transfer are difficult to monetize and attribute, though international best practices show that such enhancements can improve quality of life and social cohesion in the city.

Generally, the surrounding area of sanitary landfills are comprised of villages population and their residents. Commercial and residential activities are very negligible and faraway from site.

Considering above, the economic analysis of the sanitary landfill have been prepared based upon many assumptions as given in this section. The designing & development of environment friendly SLF and the proper mechanism for garbage disposal and transfer will improve social and environment status of surrounding residing areas and their residents besides also improve the social as well health quality of the residents in the entire city. The Improvement due to designing & development of existing SLF and its disposal & transfer, environment friendly. Mechanism is listed below:

- Improvement in time taken by Vehicle for unloading the waste.
- Improvement in environment quality of surrounding area of SLFs as well entire city (Reduce Health Hazard)
- Improvement in Socio Economic condition (Improve Productivity)
- Others tangible and intangible benefits

7.1. Approach and Methodology for Economic Analysis

The economic analysis of above stated project is based upon reviewed of different models and methods used by lending and donor agencies for similar and relevant type of projects. The economic analysis was undertaken in accordance with WB and other lending agencies guidelines. The analysis describes the economic rationale, the rationale for public intervention, and the scenario without the project as well with the Project. It is assumed that in the future scenario without the project the existing solid waste management systems deteriorate, and reduced services force residents to use other, less efficient means of waste disposal. The economic analysis compares the economic internal rate of return (EIRR) with the economic opportunity cost of capital (EOCC). The NPV and EIRR of SLF has been determined by quantifying, to the extent possible, the economic benefits accruing from the investment over a specific time (assumed to be 06 years) and comparing these with the capital and incremental O&M costs attributable to the project (at economic prices) and determining the present value of the resulting net economic flows. The historical discount rate is 11 percent for the above stated SLF development plan. Project life is assumed to be 06 years.

Benefits are assumed to accrue beginning after two years of its implementation. The inflation rate for annual O&M costs is assumed to be 3.5% of capital cost, starting after two years. Economic prices are assumed to be 0.76 times financial prices, and all costs have been converted to economic prices. The population growth rate is assumed to be 2.5 % and the household size to be five persons. In addition to the capital cost (cost of construction), the cost of design and supervision consultancy has been attributed to the project at Rs. 350 million of the capital cost. All other assumptions are also outlined for the SLF designing & development project. Conventional cost–benefit analysis methodology is applied for the economic analysis based on the project with GHG emission and without GHG emission because this benefit will improve the economy as well the viability of the project. As the existing SLF system is functioning without any proper mechanism

and SOPs at a higher cost than international norms, the project will not provide any enhanced or new waste collection/transfer services over the current system. Therefore, the methodology of evaluating improved services with consumers' willingness to pay is not applicable, as in this case, the project will deliver a new design mechanism. The future without the project assumes that municipal waste transfer services would deteriorate and break down. This would bring higher collection and disposal costs and associated environmental, social, and health consequences. Thus, the main economic benefits of the project are the savings that would be incurred in the future with the project.

7.1.1. Economic Rationale

The rationale for government intervention in the SWM sector as well SLF results from the increasing concern over deteriorating assets and facilities in the Karachi city. This has increased the cost of transfer of municipal waste and the potential for health and environmental costs to the public. In recognition of the need to design and developed SLF under Package 2 of SLF development, the government has proposed embarking on an investment program through WB financing, with this project as the start of a major sector-wide program.

7.1.2. Parameters Considered for Economic Assessment

The main parameters of the study, i.e., factors that remain constant from case to case, and are common for the projects, are briefly described below:

Waste Classification: The surveys and composition of waste evaluated by collection of waste from each SLF and evaluated their composition and availability of recycle waste and its economic value. The economic costs have been estimated by first adding taxes, duties, etc. Then ratio of costs excluding taxes, duties etc., was computed for different category of recycle waste to determine economic cost from market price.

Discount Rate: A risk free discount rate of 11 percent has been used for discounting future costs and benefits to compute net present value and as a cut off point for internal rate of return (IRR).

Project Life: Project life of 06 years has been used in line with common practice for all infrastructure projects.

Construction Period: The construction period has been taken at 2 years for the purposes of economic analysis. It is assumed that physical work would be evenly spread over the specified period.

Population and Waste Growth rates: The population and its growth completely impact on waste generation and SLF capacity. The population growth of each district as per census 2017 is adopted and annual per capita waste growth rate of 1.5% is considered in waste projections.

7.1.3. Economic Benefits

The stated project of Package 2 of SLF designing and development will generate a lot of economic quantifiable and unquantifiable benefits. Every benefit in economic term, not necessary to measurable but it impact prove that this project beneficial for city/residents/town/ surrounding areas, etc., and all above stated areas get the benefits but could not measure these unquantifiable benefits. The project gets quantifiable benefits for the economic analysis are discuss below:

Time saving in waste handling at SLF: The improvement in unloading time saving the time has been spend by each vehicle in SLF with and without project benefitted. In economic saving of time is measurable. So that based upon Time Motion surveys conducted at SLF, the time for unloading and other purpose spend by vehicle were recorded and it is also calculated the time will take vehicle after its implementation. It is estimated that each vehicle will take less time stay in SLF due to proper its design and mechanism to unload

waste in minimum waste of time in SLF. The assumption for time motion benefits is calculated as given in **Table 36.**

Table 36: Time and Motion Benefits

Time Motion Benefits	Value
Time Cost (Rs. /minutes)	8.41
Average Existing time unloading etc. per transfer of vehicle (m)	21.50
Proposed time unloading etc. per transfers of vehicle (m)	7.50
Average Existing Number of vehicles trips deposited per day	201

Using all the above-mentioned assumptions, the total quantified benefits of this head (undiscounted) over 06 years is calculated at PKR 8.6 million.

Saving in Medical Expenditure of surrounding area of SLFs: This project funded for improvement of environment of surrounding areas/localities, etc as well the entire city. It is estimated that the entire population living surrounding areas will be benefitted with improved environment and reduce health hazards. The designing of SLF and proper environment friendly mechanism ultimately benefit to surrounding localities and residents as well entire city. It will reduce their medical bills as well improve their productivity. These economic benefits are calculated on SLF based upon social and environment surveys were conducted surrounding localities of SLF. These Assumptions are provided in **Table 37**.

Table 37: Health-Related Benefits Associated with the Project

Existing Population around SLF (Number)	5,000
Number of House Hold around SLF	1,000
Average Income per month average per house Rs.	35,000
Average Existing medical expenses per month per house 4.5% of income	1,575
Average Expected Medical Expenses per month after SLF Setup 3.4 % of income	1,190
Average Existing leave from work due to environment/ health issue per month surrounding areas (No of days)	2

Benefits attributable to this head have been quantified in monetary terms to the extent possible using reasonable assumptions based upon surveys conducted surrounding localities and population residing in this location. This improvement can lead to different health related benefits. These quantified benefits include:

- Economic impact of potential health improvements. savings in monthly medical expenditures for households, and reduction in labor days lost, may be accounted for by quantifying this benefit.

Economic benefits of potential health improvements due to improved Environment friendly SLF mechanism have been quantified by using the monthly income data was collected from surrounding households of SLF. Using all the above-mentioned assumptions, the total quantified benefits of this head (undiscounted) over 06 years is calculated at PKR 4.62 million.

Improvement in Productivity of Surrounding Localities/Residents: This project will also improve the socio-economic condition of surrounding localities of package 2 SLF. The following benefits attributable to the project have been quantified in monetary terms to the extent possible using reasonable assumptions of two days leave due to environment/ health issue per month surrounding areas.

Economic impact of potential health improves the productivity, and each resident due to less leave from work ultimately improve their productivity as well uplift their socio-economic conditions in terms of more earning and involving in social economic activities more energetic way has been calculated for SLF. The total quantified benefits of this head are calculated at PKR 32.31 million

Improvement in Health quality of Sanitary Workers: Sanitary workers are also working in unfriendly environment due to this environment their productivity is poor as well they mostly remain away from job and their number of leave per month are above the usual leave from job. This project also improves the productivity of Sanitary Workers, working in Package 2 SLF (**Table 38**).

Table 38: Health-Related Benefits for Sanitary Workers Associated with the Project

Average Number of sanitation Workers in a transfer vehicle	3
Average Number of sanitation Workers visit per day with transfer vehicle at SLF	603
Per month leave due to health hazards	2
Average salary of Sanitary workers per month (PKRs)	35,000

Using all the above-mentioned assumptions, the total quantified benefits of this head is calculated at PKR 19.5 million.

Scavengers Benefits/Income: A large number of Scavengers are working at SLF package 2, In this context a survey was conducted on SLF to estimate the income / benefits the scavengers are getting from existing SLF by sorting the valuable recycle waste from the entire waste un loaded at SLF. **Table 39** shows the benefits getting by the Scavengers from SLF.

Table 39: Scavenger Benefits/Income

Details	Total
Average Existing Income per Scavenger (income (PKR/day))	875
Average Numbers of Scavengers visit at SLF per day	1,065

The above table reveals that the total benefits Scavengers are getting from SLF of Package 2, is estimated at PKR 340.13 million. These benefits may be the MRF revenue if it is part of the project.

Improvement in Productivity of entire Karachi City Residents: This project will also improve the socio-economic condition of entire city's residents by implementing of package 2 SLF. The following benefits attributable to the project have been quantified in monetary terms to the extent possible using reasonable assumptions of two days leave due to environment/ health issue per month surrounding areas (**Table 40**).

Table 40: City-wide Health-Related Benefits Associated with the Project

Average Number of Houses in Karachi city	441,677
Average per month per house income Karachi city	37,800
Average Household affect health hazard due to no proper SWM System (% of total population)	3.5
Per month leave due to health hazard (20% household)	2

Economic impact of potential health improves the productivity, and each resident due to less leave from work ultimately improve their productivity as well uplift their socio-economic conditions in terms of more earning and involving in social economic activities more energetic way has been calculated for SLF. The total quantified benefits of this head are calculated at PKR 539.40 million

GHG Emission Reduction Benefits: This project will also reduce GHG emission. This benefit has been quantified by considering the shadow price of carbon. The benefits and its assumption for calculation of GHG emission reduction cost/benefits is presented in **Table 41**.

Table 41: GHG Emission Reduction Benefit (Shadow Carbon Price)

Average per years Shadow Low Carbon Price ($/$t_{eq}$ CO_2)	23
Average Shadow per years Shadow High Carbon Price ($/$t_{eq}$ CO_2)	47
Total SWM Sector Emission (t_{eq} CO_2 /year)	11,757,000

Increase Emission per year as per capita waste production growth rate (%)	1.5
Landfill Emission Reduction (t_{eq} CO_2 /year)	1,803,405
Landfill Emission Reduction per Year, % of total SWM sector emissions	15.3
Average per years Shadow Carbon Price (Low Rate) Benefits ($)	41,750,000
Average per years Shadow Carbon Price (High Rate) Benefits ($)	84,200,000

The SLF project results in GHG emissions reduction of 1.8 million t_{eq} CO_2 per year on average. The total SWM Sector emission has been counted 11.76 million t_{eq} CO_2. GHG accounting presented that Carbon prices are drawn from the guidance, including low-cost and high-cost scenarios as shown in above table. The carbon price low rate has been considered for the calculation of this benefits which will be utilized in economic appraisal model for calculation of economic viability with and without GHG emission reduction for the project package 2. The benefits at lowest carbon rate has been estimated at PKR11,690,000,000

7.2. SLF Capital Cost

7.2.1. SLF Capital Investment

The summary of the estimated capital costs for SLF is provided in Table 42. This cost included the estimated take-off quantities of the materials, earth works, and equipment, construction, contingencies, consultancies, etc.

Table 42: Estimated Capital Development Costs for the Sanitary Landfill

SLF site	Estimated Capital investment
Jam Chakro SLF	18,900,000,000
Total	**18,900,000,000**

The capital cost of the SLF is estimated at PKR 18.9 billion.

7.3. Results of the Economic Appraisal

The Economic Appraisals have been carried out by two scenarios with GHG emission reduction benefits and without GHG emission reduction benefits. The economic models are presented in **Annexure F**. The economic results such as NPV, EIRR, Benefit Cost Ratio etc., based upon GHG emission reduction benefits and without GHG emission reduction benefits have been calculated for separately for SLF. The above stated Economic Results for both scenarios are presented in following sections.

7.3.1. Economic Appraisal, With and Without GHG Emission Reduction Benefits

The economic appraisal results with and without GHG emission reduction benefits have been calculated as shown in **Table 43.**

Table 43: Economic Appraisal Results with and without GHG Emission Reduction Benefits

Economic Parameters	With GHG Emission Reduction Benefits (Shadow Carbon Price)	With Out GHG Emission Reduction Benefits (Shadow Carbon Price)
Net Present Value - NPV (PKR)	19,350,673,714	(11,489,773,584)
Economic Internal Rate of Return - EIRR (%)	45.6%	-36.4%
Benefit Cost Ratio - BCR	2.58	0.23

Table 43 reveals that economic appraisal results are positive for with GHG emission reduction benefits scenario and EIRR for SLF with and without GHG emission reduction benefits is estimated at 45.6 % and (36.4)% respectively. The benefits cost ratios with and without GHG emission reduction benefits is

estimated at 2.58 and 0.23 respectively. The NPV with and without GHG emission reduction benefits is estimated at PKR 19,350,673,714 and PKR (11,489,773,584) respectively.

7.4. Revenue / Cost Recovery Options

In view of the technical options available for the treatment of municipal waste, there are many technical methods of intermediate treatment of municipal waste although some of them are effective only for small scale systems and some other options are technically sophisticated (refer to **Section 4**).

Considering the waste characteristics, the waste amount for treatment and the available and applicable technologies; the composting, MRF, RDF, and Biogas are the technical options may generate significant revenue for SLF project. These all technical options which may generate sufficient revenue for the project but these all need detailed techno- financial feasibility for the each of the stated options.

The details of Assumptions, Benefits Calculation and EIRR Computation are attached as **Annexure F in Excel File.**

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. Site Suitability

The Diagnostic Report (**Annexure A**) provided an assessment of the suitability of the site against a number of criteria specified in international guidelines relating to the siting and development of sanitary landfills. The Diagnostic Report considered the site location, the physical characteristics of the site and socio-economic setting of the site. The conclusion reached was that the site was, on the balance of considerations, suitable to be developed as a sanitary landfill, notwithstanding that it failed to comply with several of the criteria specified.

The key consideration in this regard was the presence of the existing open dump adjacent to the location proposed for the sanitary landfill and which has been in use for a considerable period of time and around which existing communities had developed. Significant environmental impacts that might be anticipated from waste disposal activities are already present in the surrounding location and have not precluded continuing urbanization of the area. From a socio-economic perspective there is already resilience built into the surrounding communities; the adoption of sanitary landfilling, as against open dumping of waste, should lessen the impacts of waste disposal on the surrounding communities.

8.2. Site Constraints

As indicated in the Diagnostic Report the proposed site for the sanitary landfill does not meet the stipulated minimum requirements with respect to the following:

- Setback from residential areas (for example, Haji Ibrahim Goth);
- Adequate buffer zones;
- Distance to surface water bodies (viz. Hub Dam Canal);
- Distance to a religious or educational facility;
- Site capacity;
- Suitability of bedrock strata; and
- Proximity to fault lines.

In the absence currently of alternative sites, the choice is between extending the open dump prolonging unsanitary methods of waste disposal or developing a sanitary/engineered landfill in the selected location.

Several of the constraints noted above can be, and have been addressed, through appropriate engineering of the site, as discussed in **Section 5** of this Feasibility Study. The nature of the bedrock strata can be overcome, for example, by appropriate site engineering that focuses on the prevention of leachate migration from the base of the sanitary landfill through the provision of a basal lining system. The provision of engineering measures for landfill gas collection and management serve to lessen the potential environmental impact on adjacent communities. Design of the faulty incorporating appropriate seismic design standards will help to mitigate the proximity of the fault line.

More critical is the constraint associated with a limited site capacity. The Conceptual Design presented in this Feasibility Study indicates that the site has a limited volumetric capacity of around 16 million m^3 of void space. Whilst this is not a small site, when viewed against the actual or potential waste input rate, the site has a lifespan projected to be around seven (7) years only at a waste input rate of 5,000 tons per day, even without making any provision for the receipt and disposal of special waste and industrial waste. The lifespan may be increased by adopting operational practices that aim to increase the level of compaction and the rate of waste decomposition (for example, by shredding waste, use of heavy trash compactors, recirculation of leachate) but even with high *in situ* waste densities of 1.2 t/m^3 (which are very difficult to achieve in the early years of site operation) the lifespan only reaches 10.5 years at 5,000 tons per day input.

Should waste input rates increase over time, as the population increases, then the site life may become less than (7) years, potentially as low as five (5) years.

8.3. Economic and Financial Viability

The development of modern sanitary landfills invariably necessitates large capital investments. The site at Jam Chakro is no different; the estimated capital investment costs are of the order of PKR 19 billion (subject to re-assessment during detailed engineering design). The economic analyses indicate that, without accounting for the potential benefits associated with the reduction in GHG emissions, the site development has a negative NPV and a strongly negative EIRR.

Large capital investments in sanitary landfills normally demand that the site provides a minimum site life of 15-20 years in order to justify the level of investment required. This lifespan is not achievable at the current selected site and, therefore, firm guidance is required from the Client as to whether to proceed with the Detailed Design of this site in consideration of the level of capital investment required.

LOCAL GOVERNMENT DEPARTMENT
GOVERNMENT OF SINDH

TEMPO

TÜMAŞ

Turkish Engineering Consulting and Contracting Company-TÜMAŞ

Banglow 102/1 Phase 6 street 6 DHA, Karachi, Pakistan

ANNEX II - Survey Tools

CHECKLIST FOR PHYSICAL BASELINE CONDITIONS

PHYSICAL ENVIRONMENT

a. Type of area

- Mountainous
- Arid
- Semi-arid
- Forest
- Dense forest
- Populated
- Densely populated

Any other _____specify)

b. Landuse of area

- Agriculture
- Barren
- Built-up
- Desert
- Access road
- Wetland

Any other _____(specify)

c. Geological conditions

- is the geology of the area rocky _____
- is the origin of rocks sedimentary/igneous/metamorphic
- any other _____ (specify)

d. Seismology

- is there any record of earthquakes in the past 50 years
- presence of faults/fractures
- any other details _____ (specify)

e. Topography & soils

- are the soils mixtures of sand /silt/clay/gravel/rock/clayey silt_____
- any other _____ (specify)

Proposed site	Soil description

Other features

- Drains
- Hills
- Plain Areas
- Any other _____ (specify)

f. Climate historical data from nearest weather station ( )

Temperature	Wind	Relative humidity	precipitation	Evapotranspiration

g. Surface and Ground water

Source of surface water

- Rivers
- Hill Torrents
- Surface Ponds
- Any other_____ (Specify)
- Surface water quality visual? _____

Sources of ground water

- Wells
- Hand Pumps
- Tube wells
- Any other_____ (Specify)
- Quality and Approx. depth _____

g. Air Quality

- Is the area visually pollution free _____
- Identification of point sources (Industries Refineries, power plants) or any other _____ (specify)
- Identification of non- point sources (cars, trucks, tractors) or any other _____ (specify)

h. Liquid effluents

- liquid effluents sources (industries/household/commercial)
- if any other _____ (specify)
- Identification of any disposal source for waste water from plant _____ _____

Describe Details

i. Solid Waste

- Types of waste (Municipal, commercial, institutional, agriculture industrial, biomedical) any other _____ (Specify)
- Waste Disposal facility (Landfill, dumping stations)
- Approx. waste generated (tons/day)_____
- Responsible solid waste management authority? _____

- Waste management (Good or Poor)_____if poor, specify the reasons (lack of awareness among people, authority is not responsible enough)

j. Noise

- Sources of noise (traffic/industry or other _____(Specify)
- Areas under high noise pollution? _____

k. Natural Hazards

- Does the project area has any previous records of flooding _____
- Are there any records of drought _____
- Any other_____(Specify)

l. Nearby Infrastructures in Study Area

Sr. No.	Infrastructure	Details
1.	Transmission Line Crossing	
2.	Surface Water Body	
3.	Water Supply Line	
4.	Roads	
5.	Quarry Area	
6.	Developmental Project	
7.	Sensitive Receptor	
8.	Solid Waste Management/ Collection/ Setup in area	
9.	Other (specify)	

Community/Public Consultation

1- Identification: Date_____

Settlement:
_____

UC:_____ Tehsil:_____District: _____

Location of Meeting_____

Resource Person _____ Contact No._____

2. What types of impacts do you expect due to implementation of project in the area?
_____
_____
_____
_____
_____
_____
_____
_____

3. Questions& Response

Question	Response

4. General Remarks and suggestions of the participants:

_____
_____
_____
_____
_____
_____

5. General Observations of Interviewer:

_____
_____
_____
_____
_____
_____
_____

List of Participants

Sr. No.	Name	Occupation	Signature/ Thumb (NIC)
1			
2			
3			

4			
5			
6			
7			
8			
9			

Questionnaire for Socioeconomic Baseline Survey

Date. ---------- Photo No. ---------- ID No. ----------
-

1. IDENTIFICATION

1.1 Name of Respondent_____

1.2 Father's Name_____ **1.3 Cell. No:** _____

1.3 Permanent Address of the Respondent:

Village: _____Town _____ Tehsil _____ District: _____

1.5 Located _____Caste_____

1.6 Demographic Profile of Respondent (Children up to 10 yrs (#): M_____, F _____ T_____)

Sr. No.	(a) Relationship with Respondent (See codes)	(b) Sex (See Codes)	Age (Yrs.)	(c) Education (See Codes)	(d) Name of Business/ Occupation (See Codes)		Income from Business/ Occupation (Rs. / Annum)		(e) Health Condition
					Main	Secondary	Main	Secondary	
1	Self								
2									
3									
4									
5									
6									
7									
8									
9									
10									

Demographic Codes:

a) Relationship: 1=Self, 2=Wife, 3=Son, 4=Daughter, 5=Father, 6=Mother, 7=Brother, 8=Sister, 9=Grand Father, 10=Grand Mother, 11=Sister in Law, 12=Nephew, 13=Father-in-Law, 14=Mother-in-Law, 15=Niece, 16=Uncle,17=Aunty, 18= Son-in-law, 19= Daughter, 20= S. in Law,21=D. in Law, 22= Other_____

b). Sex: 1=Male, 2=Female, 3= Transgender

c). Education: 1= Primary 2= Middle 3= Metric, 4= Intermediate, 5= Graduate, 6= Post Graduate, 7=Law, 8=Engineer, 9=MBBS, 10=Technical Diploma, 11=Dars-e-Nizami, 12=Can Read Quran, 13= Can Insert Signatures, 14= Illiterate

d). Occupations:1=Agriculturist, 2=Shopkeeper, 3=Hotel, 4=Mechanic, 5=Barber, 6=Butcher, 7=Cobbler, 8= Business, 9= Govt. Servant,10=Private Servant, 11=Labor, 12=Student, 13=House-Maid, 14=Housewife, 15=Advocate, 16=Livestock/Dairy, 17=Fishing, 18=Driver, 19=Health Related, 20=Teaching, 21=Entertainer, 22=Gone Abroad, 23=Retired/Old, 24=Other_____

e). Health: 1= Good, 2= Average, 3= Poor

1.8) Language Spoken _____Religion_____

1.9) Type of family system: 1.Joint: _____ 2.Nuclear_____

2. AVERAGE MONTHLY EXPENDITURE ON FOOD AND NON- FOOD ITEMS (Rs.)

Items	Expenses
Food	
Non-food	
Utilities	
Health	
Education Care	
Other	

3. HOUSING CONDITIONS

3.1 Personal_____ Rented_____ Other_____

3.2 Type of Structure

(i) Katcha_____ (ii) Semi Pacca_____ (iii) Pacca_____

4. ACCESS TO SOCIAL AMENITIES *(TICK)*

Social Amenities	Available (Yes-No)	Satisfactory (Yes-No)	Reasons for Not Satisfaction
Electricity			
Gas			
Water Supply			
Water Filtration plant			
Telephone			
Sewerage/Drainage			
Hospital			
School (Boys-Girls)			
College (Boys-Girls)			
University (Boys-Girls)			
Religious Institution			
Road			
Source of Cooking if Sui Gas is not available			

5. CREDIT UTILIZATION

5.1 Have you obtained credit during last year? Yes___ No_____ if yes, source of credit:

a) Formal b) Informal

5.2 Please write the name of relevant source

Formal source (s) _____

Informal source (s) _____

Purpose of Loan _____

6. WOMEN'S PARTICIPATION AND ROLE IN DIFFERENT HOUSEHOLD ACTIVITIES

6.1 Participation and Decision Making (Tick)

Activities	Participation Extent (%)	Decision Making Extent (%)

Household activities		
Child caring		
Farm/Crop activities		
Livestock rearing		
Sale & Purchase of properties		
Social obligations (marriage, birthday & other functions)		
Local representation (councilor/political gathering)		

7. SOURCE OF DRINKING WATER:

1. Public Water Supply 2.Hand Pumps 3. Borehole 4. Any other __

7.1 Quality of water: Good_____ Poor: _____

If Poor (Reason) _____

8. DOES ANY NGO EXIST IN YOUR AREA?

Yes_____ No_____

If yes, Name of NGO -: _____

8.1 Are you member of NGO? yes---------- No---------- if yes,

Role in NGO-:_____

9. PERCEPTION OF RESPONDENTS FOR ACTION ASSOCIATED WITH THE PROJECT:

Possible impacts/effects of the Project	**Increase**	**Decrease**
Employment opportunities		
Industrial Development Opportunities		
Living standard		
Unemployment		
Income generating activities		
Improvement in transport		
Mobility (Access to Resources)		
Physical Displacement		
Other specify		

10. ANY OTHER HISTORICAL /ARCHEOLOGICAL MONUMENT IN OR NEARBY THE PROPOSED PROJECT AREA?

1. Yes_____ 2. No_____ If yes, please specify

Name _____ Type_____ Distance from the proposed project ____

11. MAJOR DISEASES COMMON IN THE PROPOSED PROJECT AREA

_____

_____

_____

12. IN YOUR OPINION, WHAT ARE SOME PRESSING NEEDS OF THIS AREA?

_____
_____
_____
_____

13. GENERAL REMARKS OF THE RESPONDENT

_____
_____
_____
_____

14. GENERAL OBSERVATIONS OF INTERVIEWER

_____
_____
_____
_____

Name of Interviewer: _____ Date: _____

ECOLOGICAL CHECKLIST FOR ESIA/ESMP

	Data Sheet No.		**Date**	/ /	**Expert Name**			
	Location/Village			**District**		**RD/KMs.**		
	BIODIVERSITY FEATURES							
(i)	**Vegetation Description**							
	Forests (Trees, Herbs, Shrubs)	Yes/No	**Ecological Zone/Forest Type**		**Legal Status**			
	Species Composition	ROW			**No of Trees (Possibly Affected)**			
	Diameter Class	0-15 cm	16-30 cm	31-45 cm	46-50 cm	51-65 cm	66-80 cm	81-95cm	Above 95 cm
	Rangeland	Yes/No	**Agricultural Land**	Yes/No		**Crop Type**		
(ii)	**Wildlife/ Fauna Description**							
	Wildlife Protected Areas (Notified or Sensitive)							
	Mammals	Yes/No						
	Reptiles	Yes/No						
	Amphibians	Yes/No						
	Aquatic Habitat	Yes/No						
	Avifauna/Birds	Yes/No						
	Natural Wetland	Yes/No						
	Endangered Species	Yes/No						
	Other Biodiversity Features							

ANNEX III - Tentative Drawings for Community Development Plan

HAJI IBRAHIM GOTH JAM CHAKRO

LIST OF DRAWINGS

S.NO	DESCRIPTION OF DRAWINGS	DRAWING NO.
	GENERAL DRAWINGS	
1.	LIST OF DRAWING	JC/HI/GN - 01
2.	SITE LOCATION PLAN	JC/HI/GN - 02
3.	TOPOGRAPHIC SURVEY KEY PLAN	JC/HI/GN - 03
4.	TOPOGRAPHIC SURVEY PLAN	JC/HI/GN - 04
	ROAD WORKS	
5.	ROAD LAYOUT PLAN	JC/HI/GN - 05
	SEWERAGE SYSTEM	
6.	SEWERAGE SYSTEM LAYOUT PLAN LINE-01	JC/HI/SS-LP - 01
7.	SEWERAGE SYSTEM LAYOUT PLAN LINE-02	JC/HI/SS-LP - 01
8.	SEWERAGE SYSTEM LAYOUT PLAN LINE-03	JC/HI/SS-LP - 01
9.	SEWERAGE SYSTEM LAYOUT PLAN LINE-04	JC/HI/SS-LP - 01
10.	DETAIL OF PIPE TRENCH & SEWERAGE MANHOLE	JC/HI/SS-DD - 01
11.	DETAIL OF SPETIC TANK	JC/HI/SS-DD - 02
12.	DETAIL OF SOAK AWAY	JC/HI/SS-DD - 02
	WATER SUPPLY SYSTEM	
13.	WATER LAYOUT PLAN	JC/HI/WS-LP - 01

KEY PLAN

NOTES:

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:
FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

CLIENT:

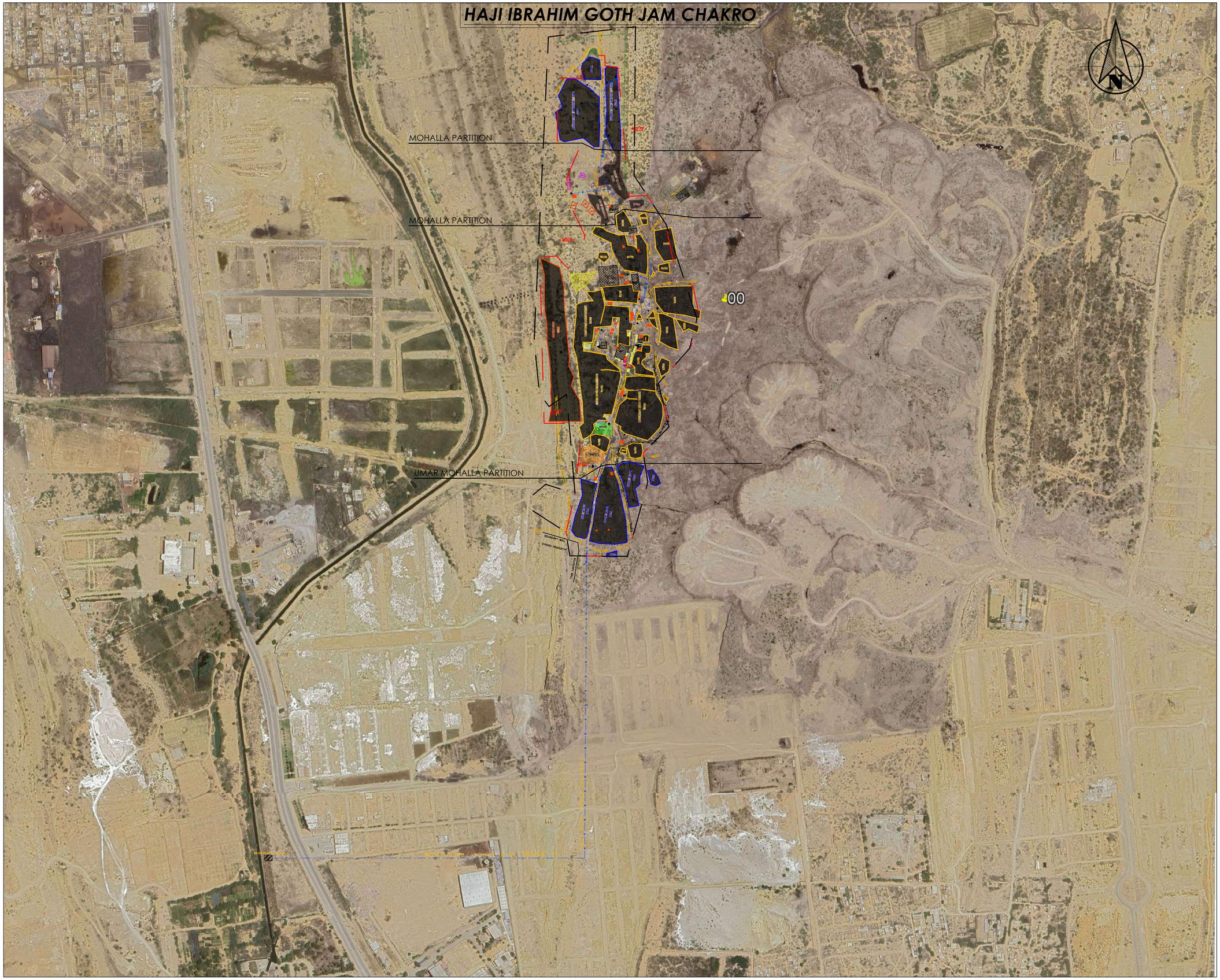
CONSULTANT:

DRAWING TITLE:

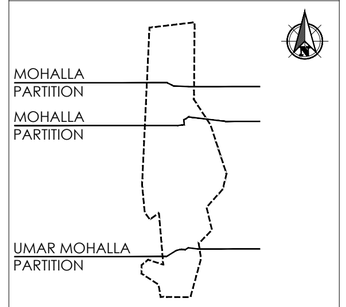
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DRAWN BY	SAIF ALI	SCALE:	
DESIGN BY	-------		---
CHECKED BY	SHERAZ AHMAD	SHEET SIZE:	
APPROVED BY	SHERAZ AHMAD		A2

DRAWING NO:	SHEET:	REV.
JC/HI/GN-01	01 OF 01	00



KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.

REFERENCE DRAWINGS	
DRAWING NO.	DRAWING TITLE
JC/HI/GN-04	TOPOGRAPHIC SURVEY PLAN

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:

FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

CLIENT:

SWEEP
Solid Waste Emergency and Efficiency Project

CONSULTANT:

TÜMAS

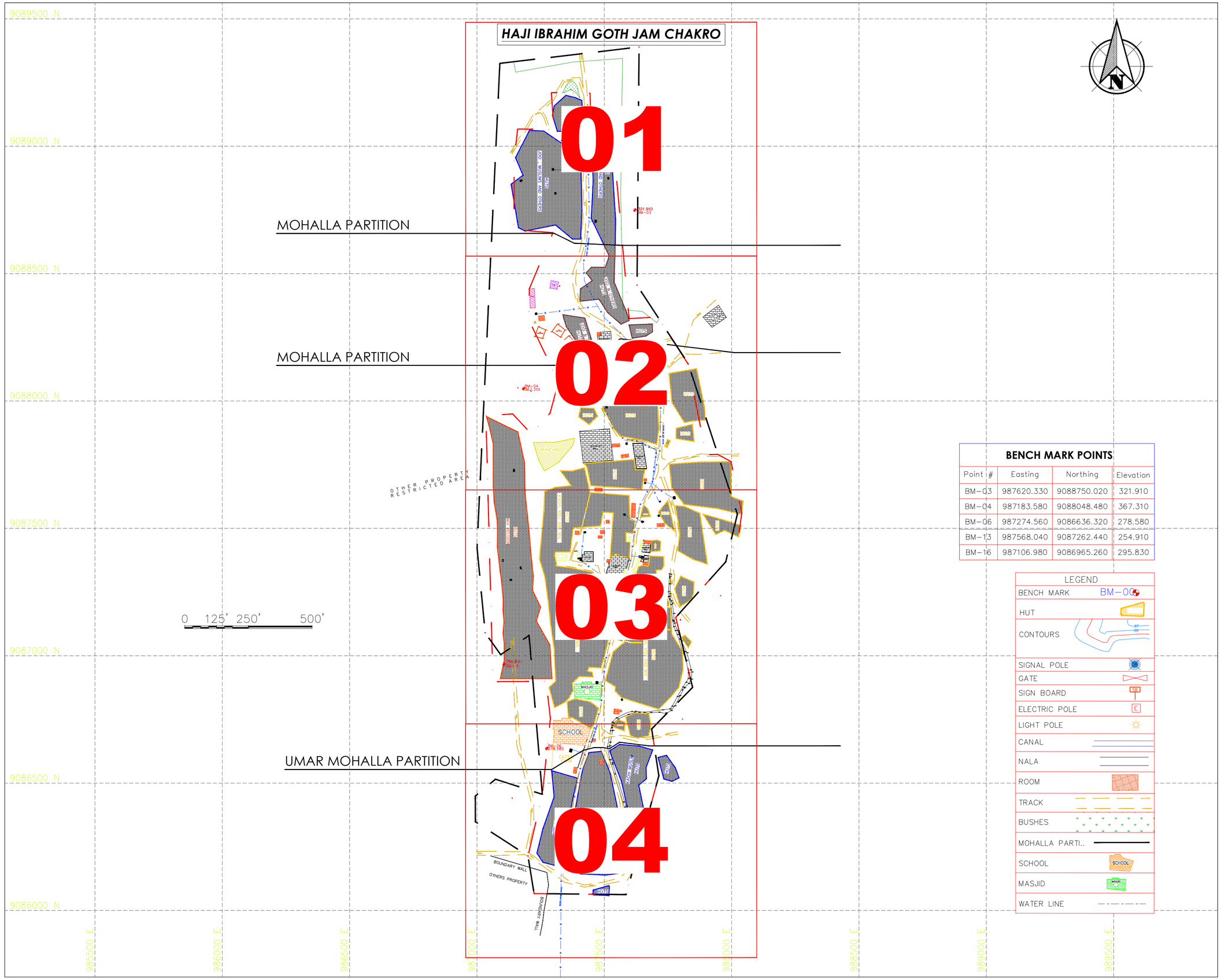
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SITE LOCATION PLAN

DRAWN BY	SAIF ALI	SCALE:	
DESIGN BY	-------		1"=400'
CHECKED BY	SHERAZ AHMAD	SHEET SIZE:	
APPROVED BY	SHERAZ AHMAD		A2

DRAWING NO:	SHEET:	REV.
JC/HI/GN-02	01 OF 01	00

TOPOGRAPHIC SURVEY



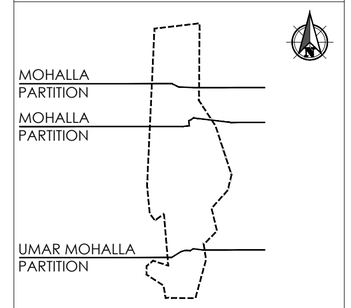
BENCH MARK POINTS

Point #	Easting	Northing	Elevation
BM-03	987620.330	9088750.020	321.910
BM-04	987183.580	9088048.480	367.310
BM-06	987274.560	9086636.320	278.580
BM-13	987568.040	9087262.440	254.910
BM-16	987106.980	9086965.260	295.830

LEGEND

- BENCH MARK BM-06
- HUT
- CONTOURS
- SIGNAL POLE
- GATE
- SIGN BOARD
- ELECTRIC POLE
- LIGHT POLE
- CANAL
- NALA
- ROOM
- TRACK
- BUSHES
- MOHALLA PARTI..
- SCHOOL
- MASJID
- WATER LINE

KEY PLAN



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REFERENCE DRAWINGS

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CLIENT:

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CONSULTANT:

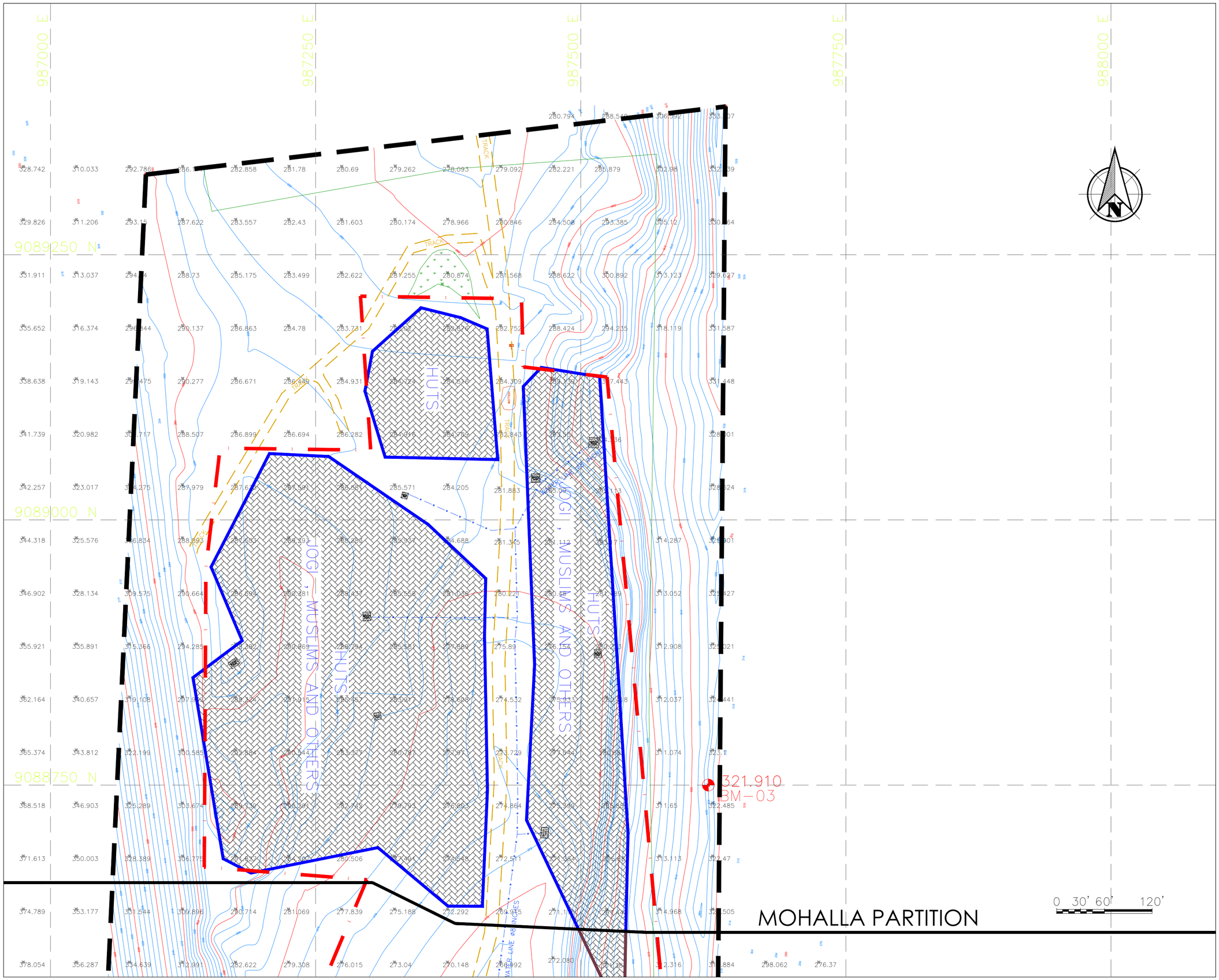
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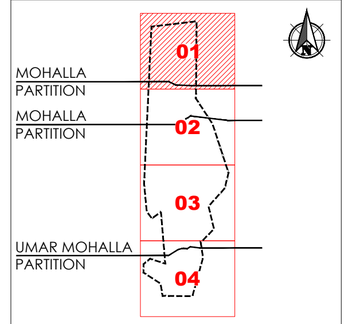
TOPOGRAPHIC SURVEY
KEY PLAN

DRAWN BY	SAIF ALI	SCALE: 1"=250'
DESIGN BY	-------	
CHECKED BY	SHERAZ AHMAD	SHEET SIZE: A2
APPROVED BY	SHERAZ AHMAD	

DRAWING NO:	SHEET:	REV.
JC/HI/GN-03	01 OF 01	00



KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.
2. FOR LEGEND REFER DWG. NO. JC/HI/GN-03

REFERENCE DRAWINGS	
DRAWING NO.	DRAWING TITLE
JC/HI/GN-03	TOPOGRAPHIC SURVEY KEY PLAN

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

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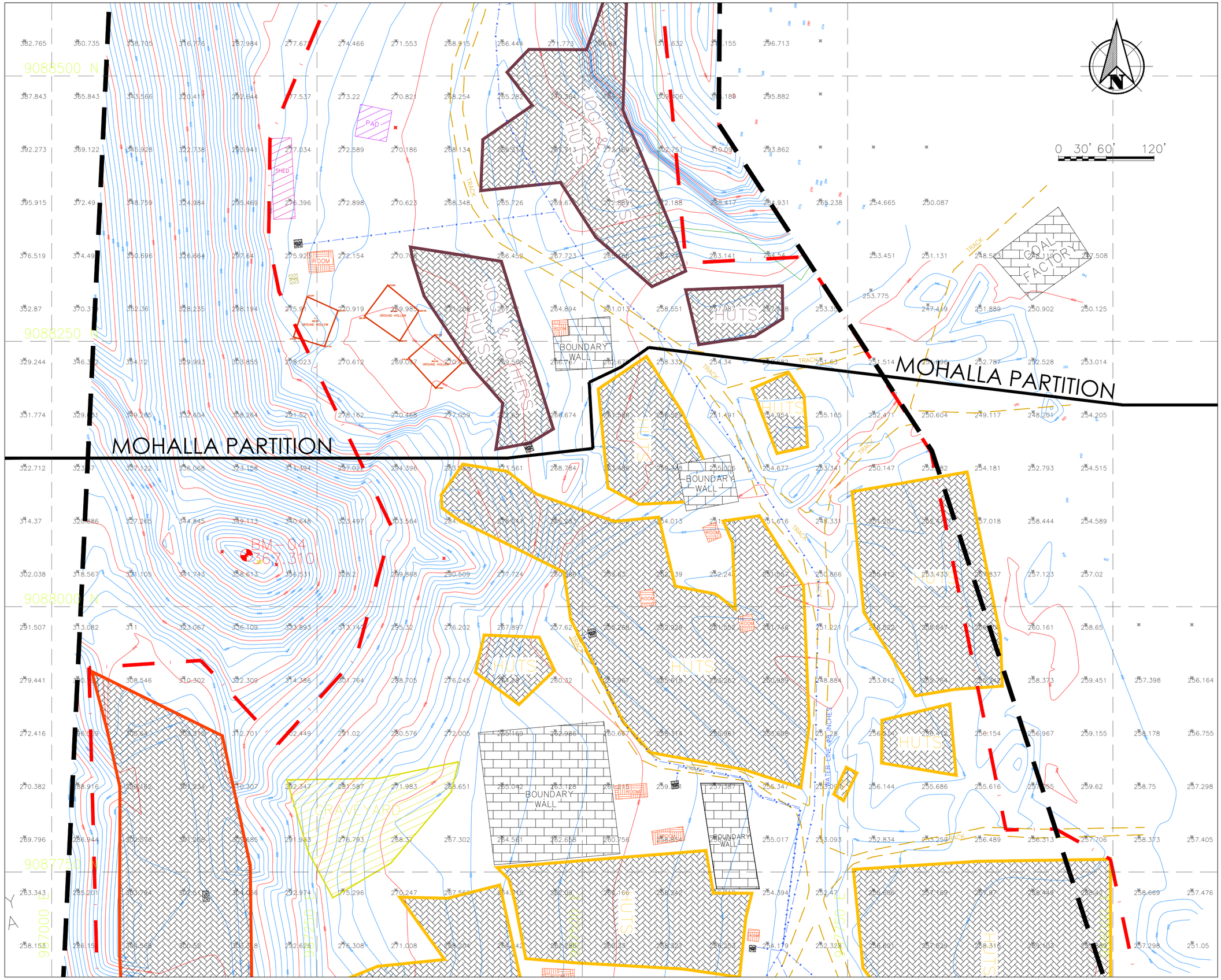
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DRAWING TITLE:

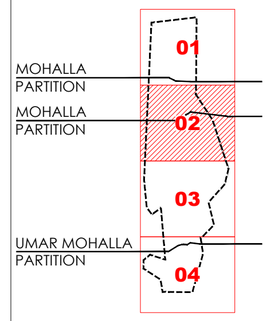
TOPOGRAPHIC SURVEY PLAN

DRAWN BY	SAIF ALI	SCALE: 1"=60'
DESIGN BY	--------	
CHECKED BY	SHERAZ AHMAD	SHEET SIZE: A2
APPROVED BY	SHERAZ AHMAD	

DRAWING NO:	SHEET:	REV.
JC/HI/GN-04	01 OF 04	00



KEY PLAN



NOTES:

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2. FOR LEGEND REFER DWG. NO. JC/HI/GN-03

REFERENCE DRAWINGS	
DRAWING NO.	DRAWING TITLE
JC/HI/GN-03	TOPOGRAPHIC SURVEY KEY PLAN

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

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CLIENT:

SWEEP Solid Waste Emergency and Efficiency Project

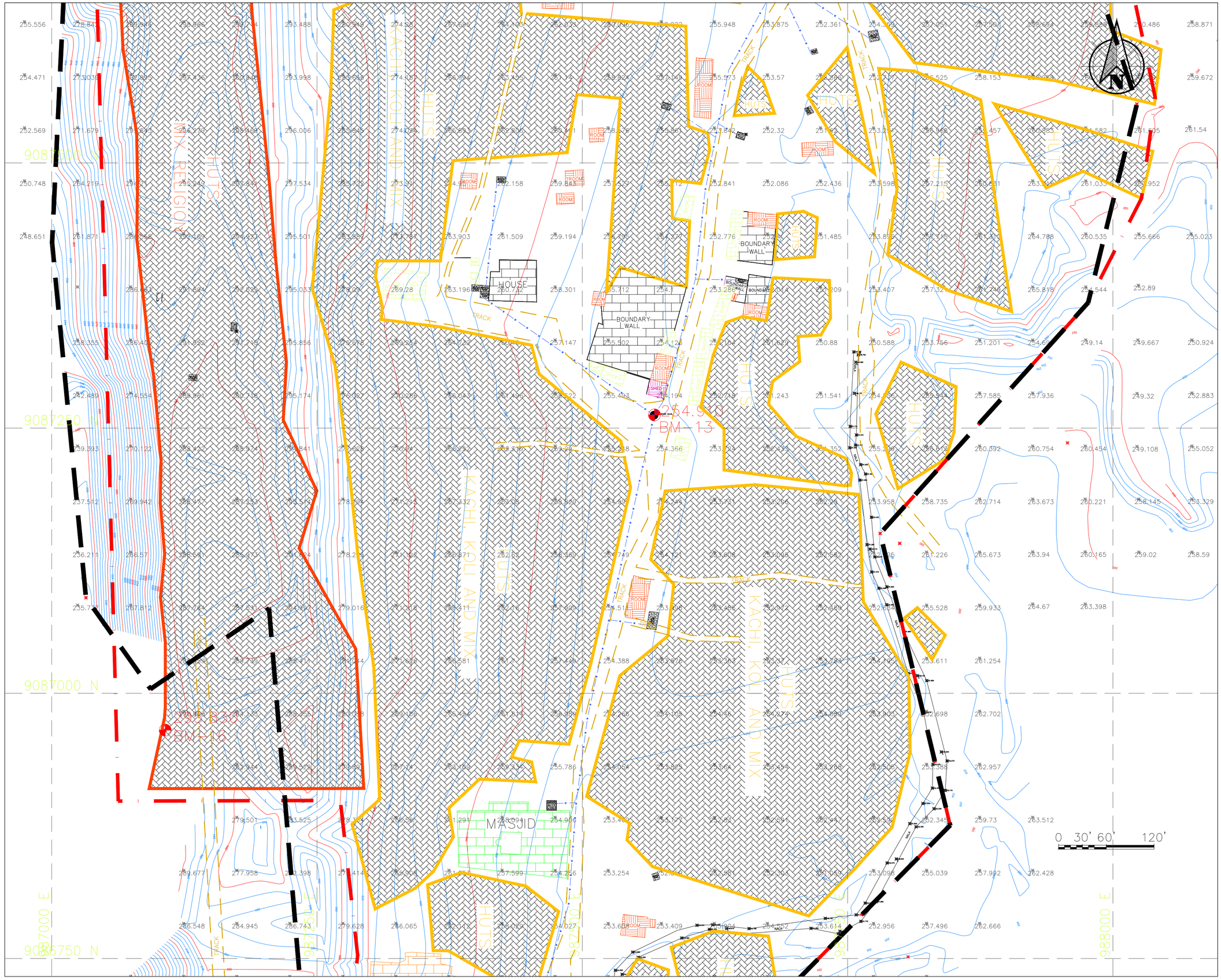
CONSULTANT:

TUMAS

DRAWING TITLE:

TOPOGRAPHIC SURVEY PLAN

DRAWN BY	SAIF ALI	SCALE:	
DESIGN BY	-------		1"=60'
CHECKED BY	SHERAZ AHMAD	SHEET SIZE:	
APPROVED BY	SHERAZ AHMAD		A2
DRAWING NO:		SHEET:	REV.
JC/HI/GN-04		02 OF 04	00


KACHI KOLIANDO NIMX
KACHI KOLIANDO NIMX
KACHI KOLIANDO NIMX

UMAR MOHALLA PARTITION

SCHOOL

CATTLE FARM

KACHI MUSLIM HUTS

NON MUSLIM HUTS

KACHI MUSLIM HUTS

HUTS

HUTS

BM-06
278.580

BOUNDARY WALL

OYHERS PROPERTY

BOUNDARY WALL

TRACK

WATER LINE 48 INCHES

9086500 N

9086250 N

9086000 N

987000 E

987250 E

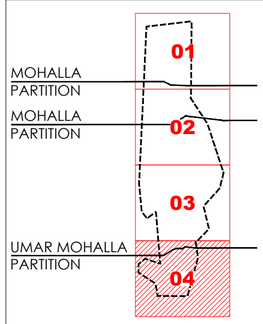
987500 E

987750 E

988000 E

0 30' 60' 120'

KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.
2. FOR LEGEND REFER DWG. NO. JC/HI/GN-03

REFERENCE DRAWINGS	
DRAWING NO.	DRAWING TITLE
JC/HI/GN-03	TOPOGRAPHIC SURVEY KEY PLAN

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

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CLIENT:

SWEEP Solid Waste Emergency and Efficiency Project

CONSULTANT:

TÜMAŞ

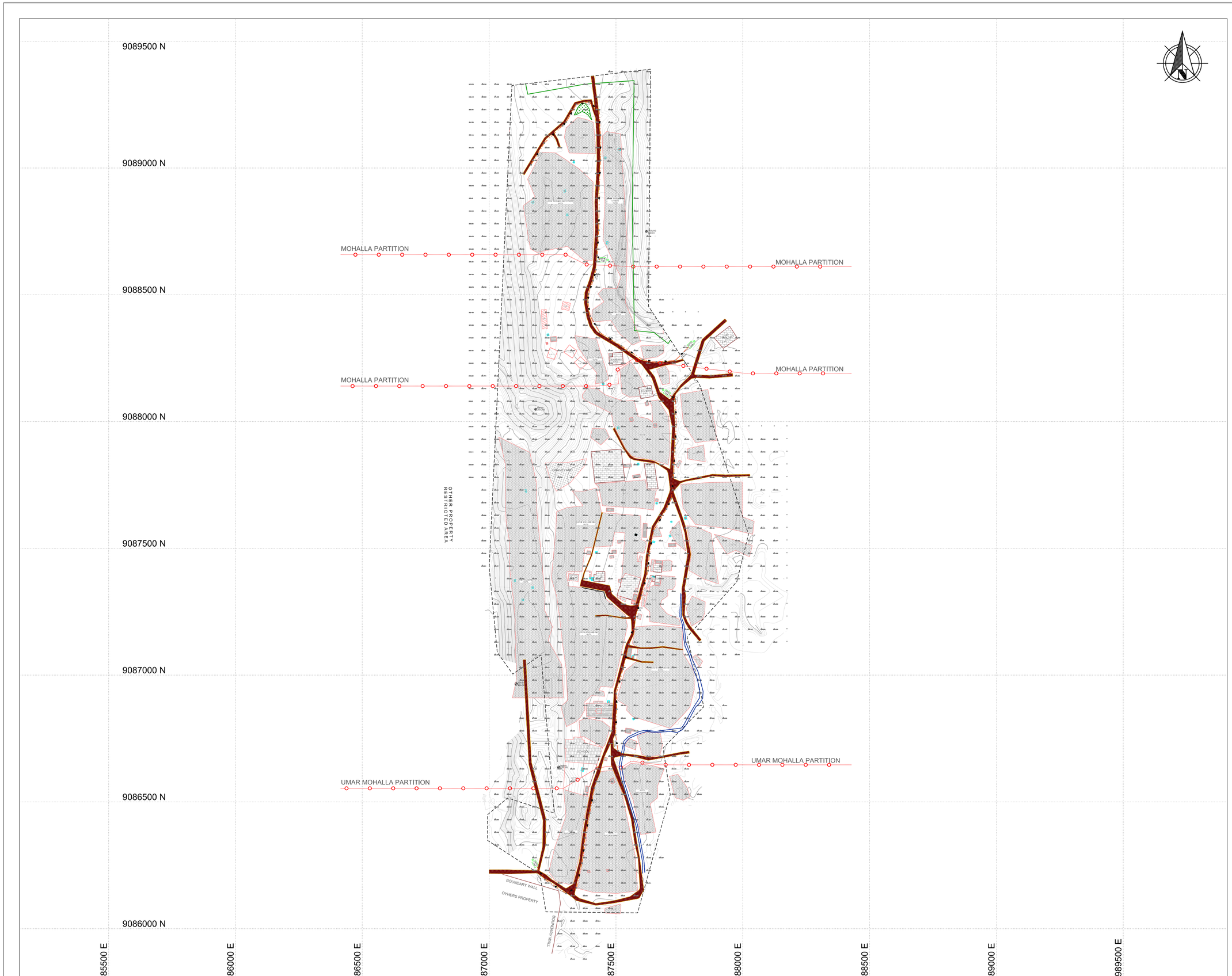
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TOPOGRAPHIC SURVEY PLAN

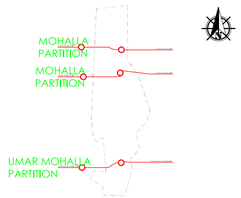
DRAWN BY	SAIF ALI	SCALE: 1"=60'
DESIGN BY	-------	
CHECKED BY	SHERAZ AHMAD	SHEET SIZE: A2
APPROVED BY	SHERAZ AHMAD	

DRAWING NO:	SHEET:	REV.
JC/HI/GN-04	04 OF 04	00

ROAD WORKS



KEY PLAN



TOPOGRAPHIC LEGENDS:

BENCH MARK	BM-##
SIGNAL POLE	
SING BOARD	SB
ELECTRIC POLE	E
LIGHT POLE	
DITCH	
STREET	
HUT	
ROOM	
SCHOOL	
MASJID	
WATER LINE	W
WATER TANK	WATER TANK
MOHALLA PARTITION	

PROPOSED LEGENDS:

STREET PAVERS 199000Sq Ft

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:

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CLIENT:

SWEEP Solid Waste Emergency and Efficiency Project

CONSULTANT:

TÜMAŞ

DRAWING TITLE:

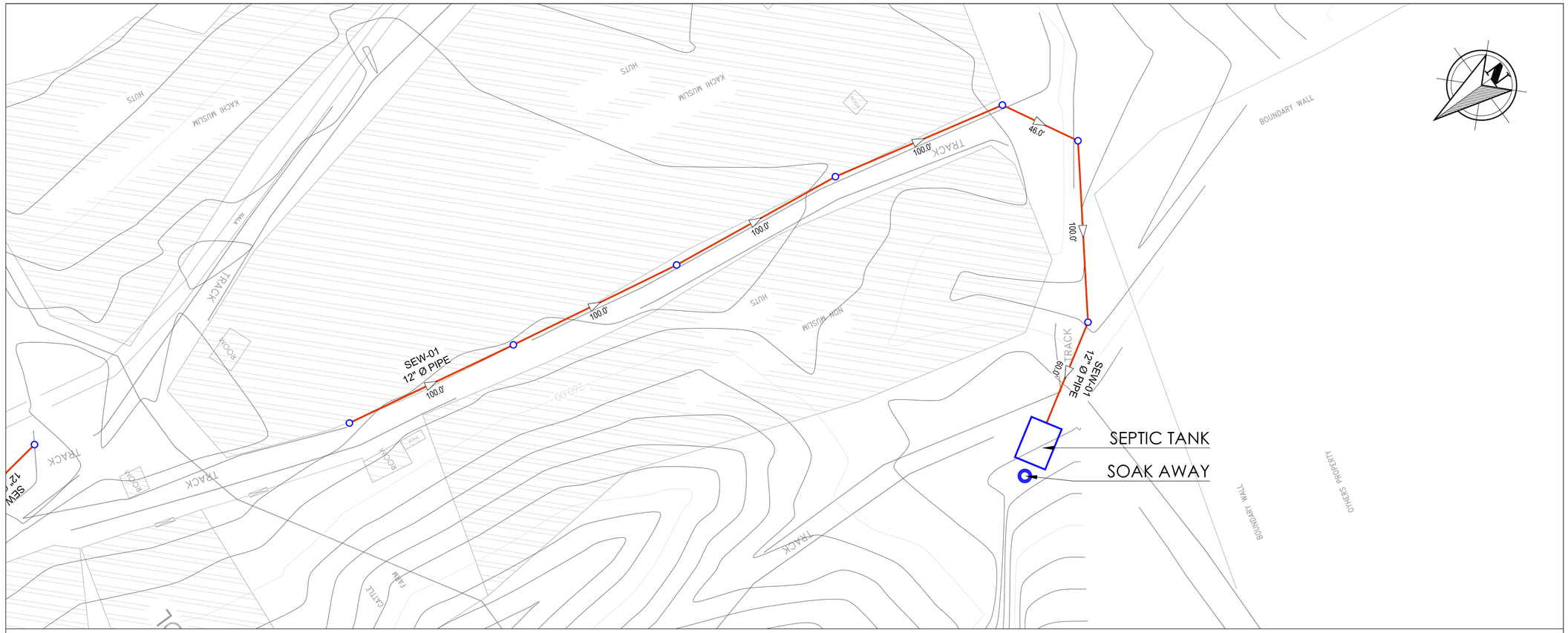
ROAD LAYOUT PLAN

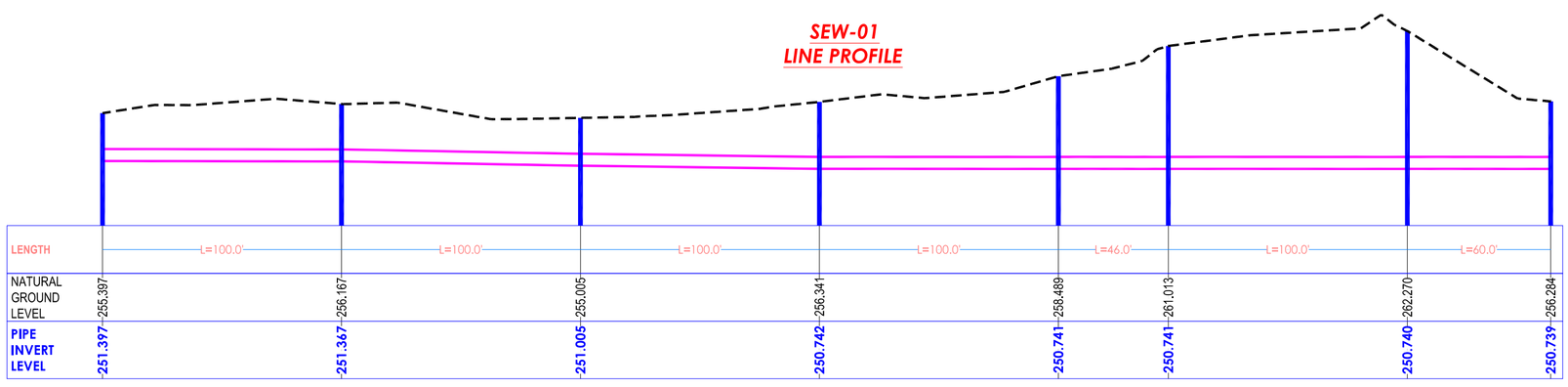
DRAWN BY	SAIF ALI	SCALE:
DESIGN BY	JAWAD	1"=250'
CHECKED BY	SHERAZ AHMAD	SHEET SIZE:
APPROVED BY	SHERAZ AHMAD	A2

DRAWING NO:	SHEET:	REV.
JC/HI/GN-05	01 OF 01	00

SEWERAGE SYSTEM

LAYOUT PLAN





KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.

LEGENDS:

- SEWERAGE LINE
- MANHOLE
- SEPTIC TANK (SEPTIC TANK)
- SOAK AWAY

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
JC/HI/SS/DD-01	PIPE TRENCH & MANHOLE
JC/HI/SS/DD-02	DETAIL OF SEPTIC TANK
JC/HI/SS/DD-03	DETAIL OF SOAK AWAY

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:
FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

CLIENT:

SWEEP Solid Waste Emergency and Efficiency Project

CONSULTANT:

TÜMAŞ

DRAWING TITLE:

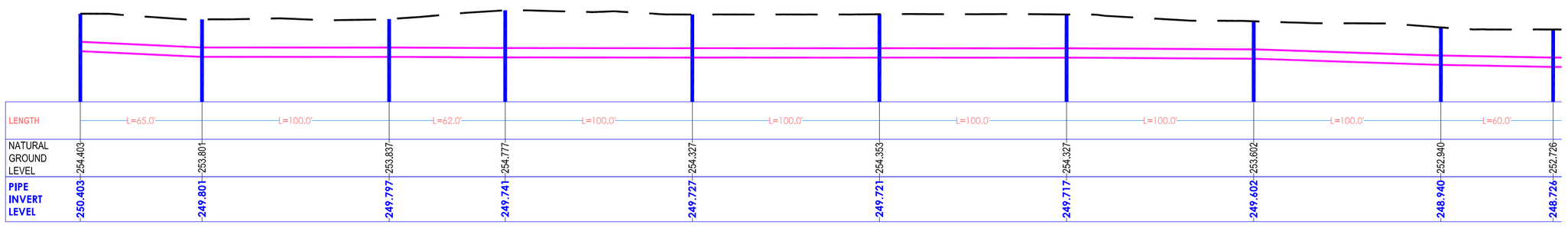
SEWERAGE LINE-01
DETAIL LAYOUT AND PROFILE

DRAWN BY	SAIF ALI	SCALE: 1"=40'
DESIGN BY	SAMEER ANWAR	
CHECKED BY	SAMEER ANWAR	SHEET SIZE: A2
APPROVED BY	SHERAZ AHMAD	

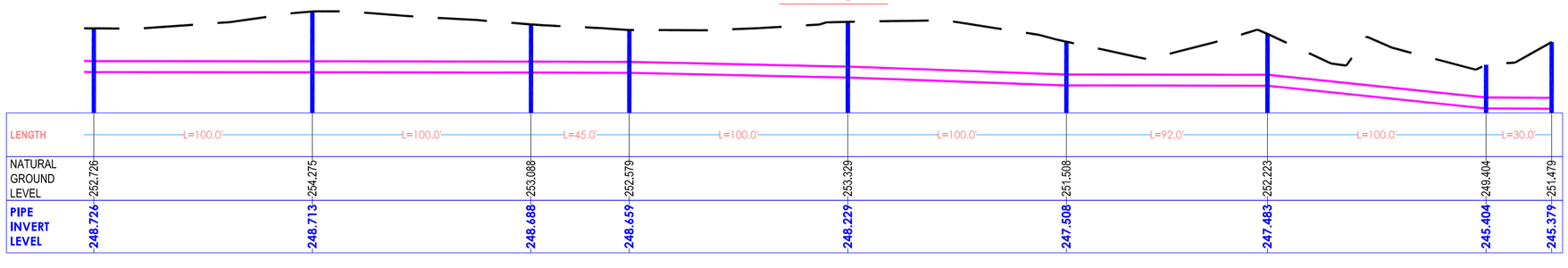
DRAWING NO:	SHEET:	REV.
JC/HI/SS/LP-01	01 OF 04	00



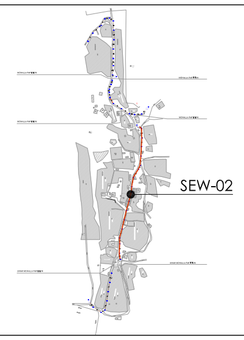
SEW-02
LINE PROFILE



SEW-02
LINE PROFILE



KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.

LEGENDS:

SEWERAGE LINE	
MANHOLE	
SEPTIC TANK	SEPTIC TANK
SOAK AWAY	

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
JC/HI/SS/DD-01	PIPE TRENCH & MANHOLE
JC/HI/SS/DD-02	DETAIL OF SEPTIC TANK
JC/HI/SS/DD-03	DETAIL OF SOAK AWAY

DATE	DESCRIPTION	REV.
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CONSULTANT:

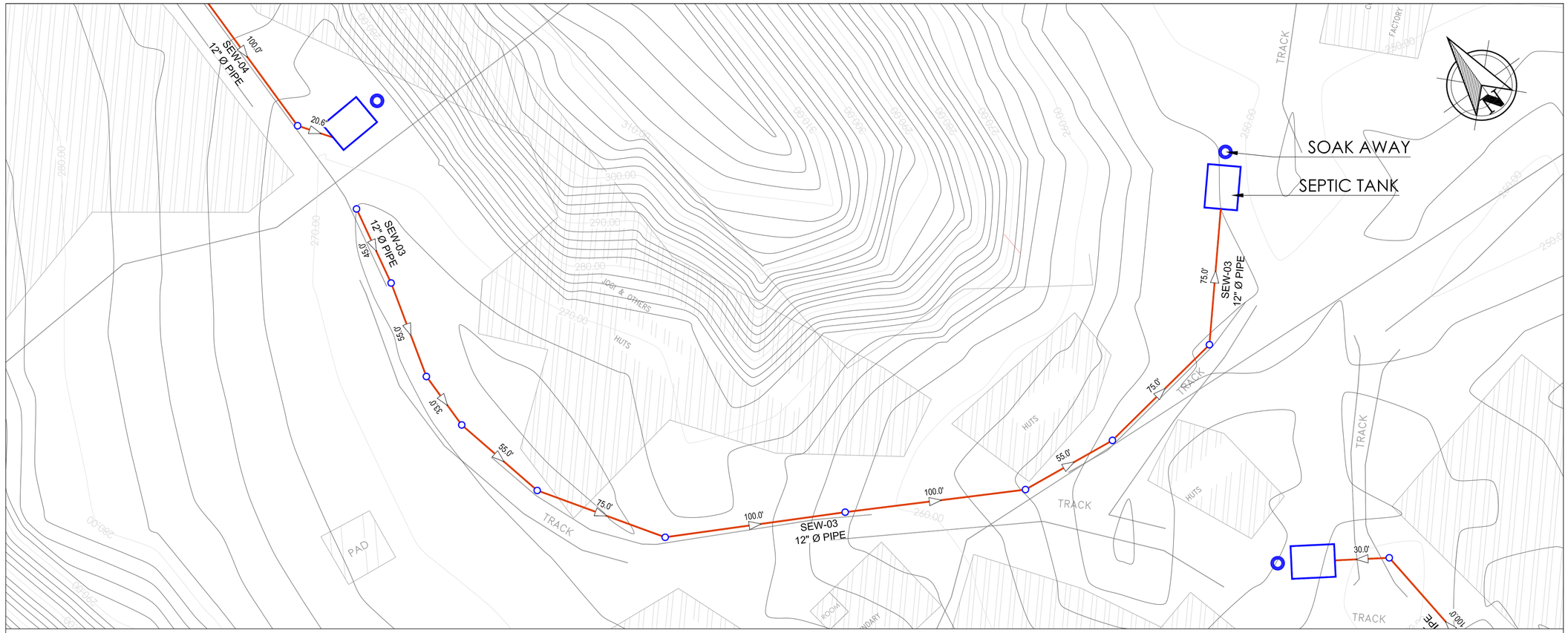
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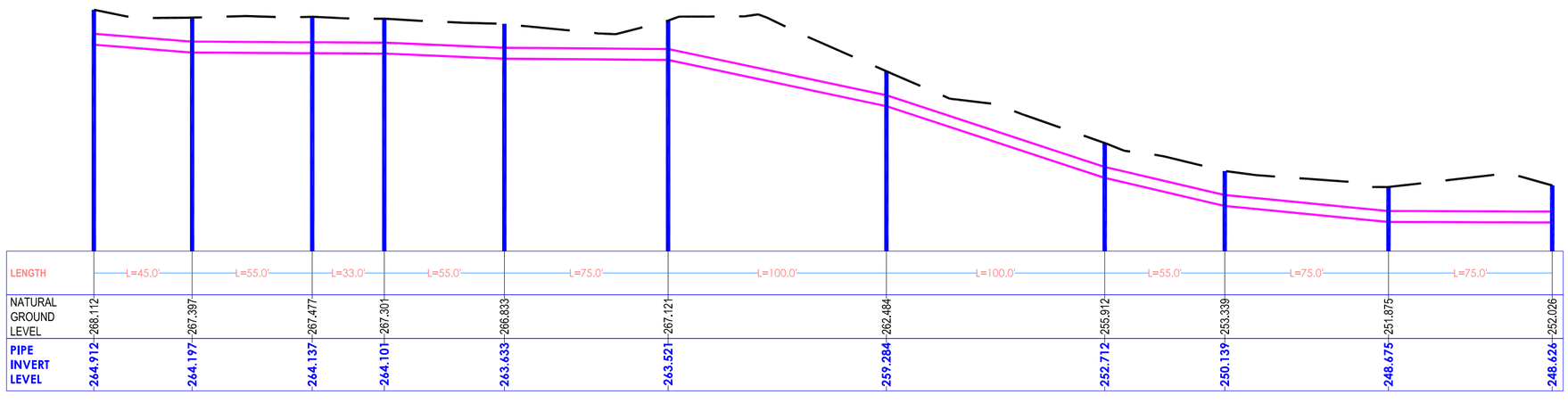
SEWERAGE LINE-02
DETAIL LAYOUT AND PROFILE

DRAWN BY	SAIF ALI	SCALE:	1"=40'
DESIGN BY	SAMEER ANWAR		
CHECKED BY	SAMEER ANWAR	SHEET SIZE:	A2
APPROVED BY	SHERAZ AHMAD		

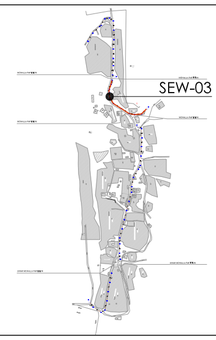
DRAWING NO:	SHEET:	REV.
JC/HI/SS/LP-02	01 OF 01	00



SEW-03
LINE PROFILE



KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.

LEGENDS:

SEWERAGE LINE	
MANHOLE	
SEPTIC TANK	SEPTIC TANK
SOAK AWAY	

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
JC/HI/SS/DD-01	PIPE TRENCH & MANHOLE
JC/HI/SS/DD-02	DETAIL OF SEPTIC TANK
JC/HI/SS/DD-03	DETAIL OF SOAK AWAY

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:
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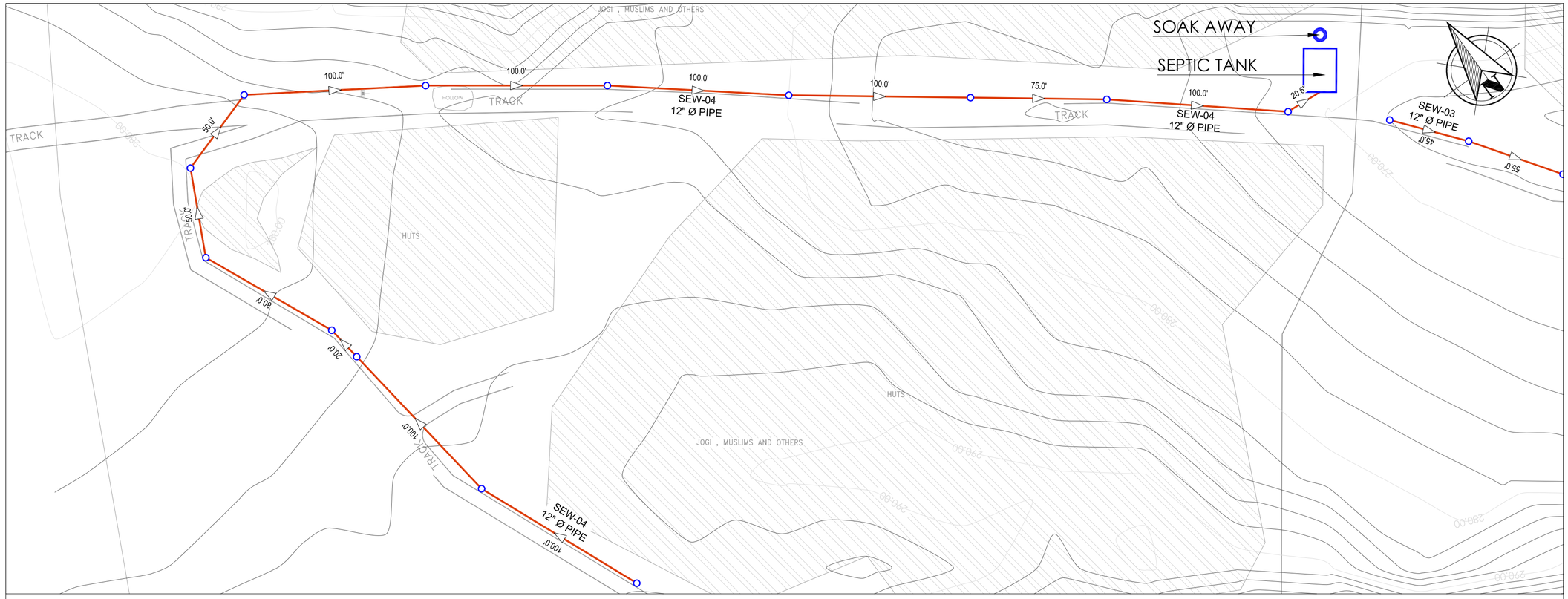
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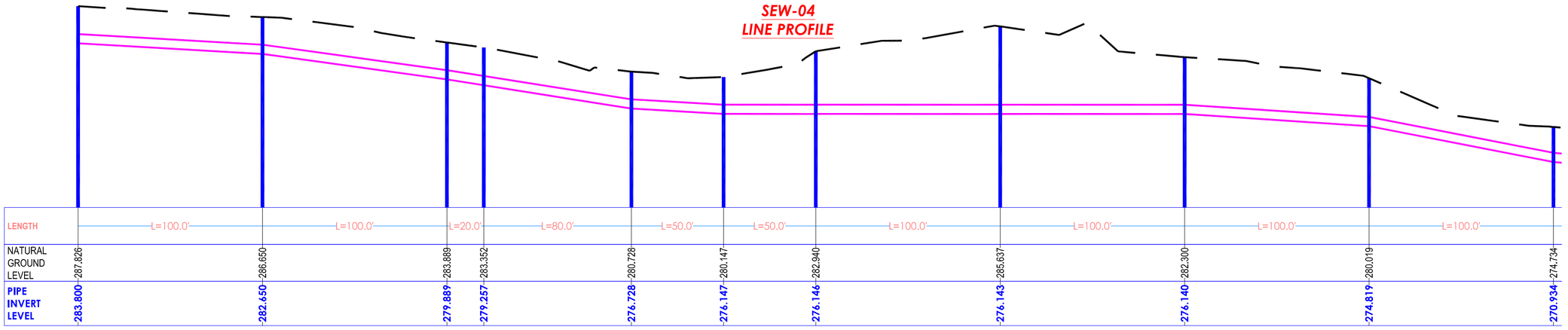
SEWERAGE LINE-03
DETAIL LAYOUT AND PROFILE

DRAWN BY	SAIF ALI	SCALE: 1"=40'
DESIGN BY	SAMEER ANWAR	
CHECKED BY	SAMEER ANWAR	SHEET SIZE: A2
APPROVED BY	SHERAZ AHMAD	

DRAWING NO:	SHEET:	REV.
JC/HI/SS/LP-03	01 OF 01	00

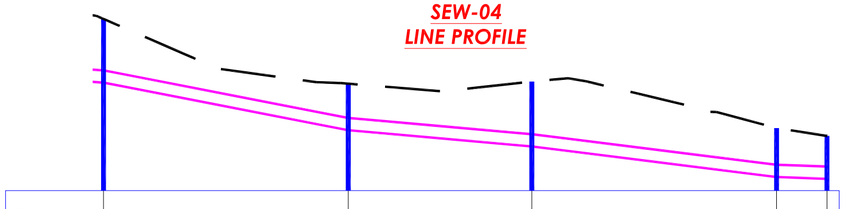


SEW-04
LINE PROFILE



LENGTH		L=100.0'		L=100.0'	L=20.0'	L=80.0'	L=50.0'	L=50.0'	L=100.0'	L=100.0'	L=100.0'	L=100.0'
NATURAL GROUND LEVEL	287.826		286.650		283.889	283.352	280.728	280.147	282.940	285.637	282.300	280.019	274.734
PIPE INVERT LEVEL	**283.800**		**282.650**		**279.889**	**279.257**	**276.728**	**276.147**	**276.146**	**276.143**	**276.140**	**274.819**	**270.934**

SEW-04
LINE PROFILE



LENGTH		L=100.0'	L=75.0'	L=100.0'	L=20.6'
NATURAL GROUND LEVEL	280.019	274.734	274.906	271.108	270.464
PIPE INVERT LEVEL	**274.819**	**270.934**	**269.606**	**267.108**	**266.964**

KEY PLAN



NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.

LEGENDS:

- SEWERAGE LINE
- MANHOLE
- SEPTIC TANK (SEPTIC TANK)
- SOAK AWAY

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
JC/HI/SS/DD-01	PIPE TRENCH & MANHOLE
JC/HI/SS/DD-02	DETAIL OF SEPTIC TANK
JC/HI/SS/DD-03	DETAIL OF SOAK AWAY

DATE	DESCRIPTION	REV.
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CLIENT:

SWEEP – Solid Waste Emergency and Efficiency Project

CONSULTANT:

TÜMAŞ

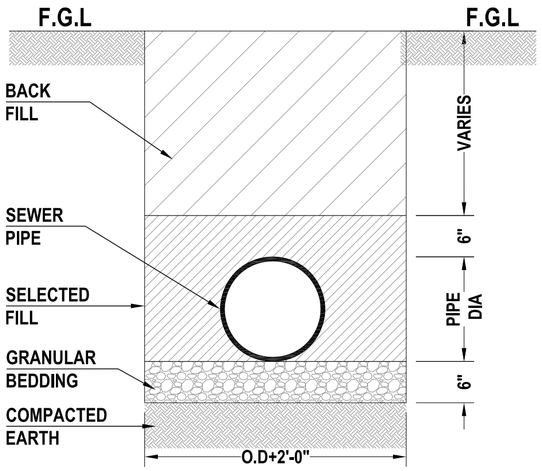
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SEWERAGE LINE-04
DETAIL LAYOUT AND PROFILE

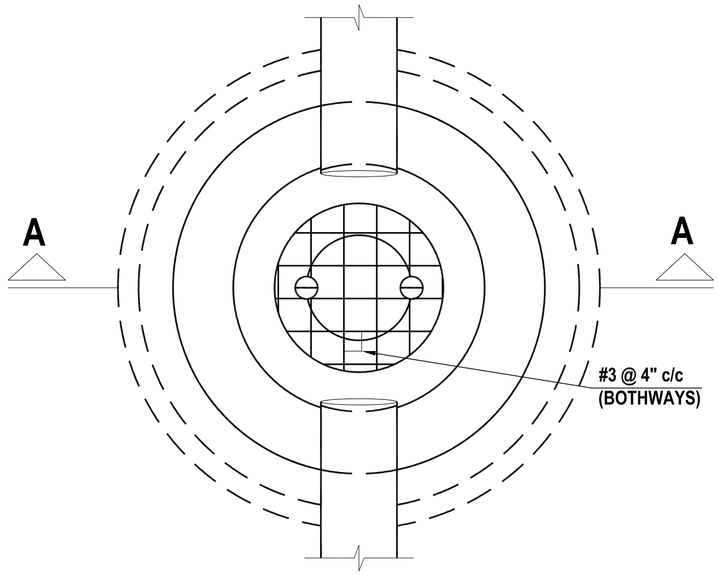
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DESIGN BY	SAMEER ANWAR		
CHECKED BY	SAMEER ANWAR	SHEET SIZE:	A2
APPROVED BY	SHERAZ AHMAD		

DRAWING NO:	SHEET:	REV.
JC/HI/SS/LP-04	01 OF 01	00

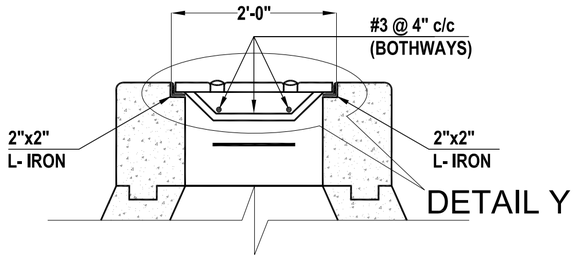
DETAIL DRAWINGS



DETAIL OF SEWER PIPE TRENCH

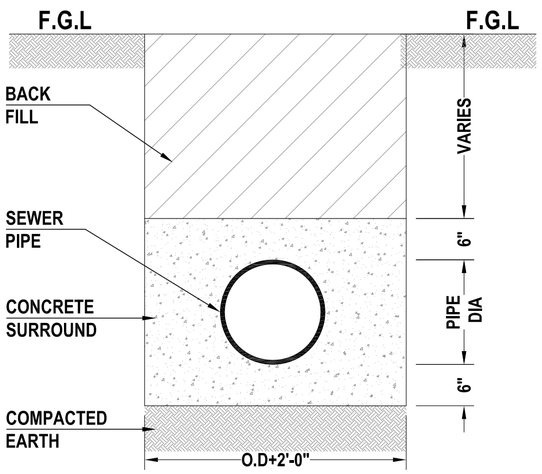


MANHOLE

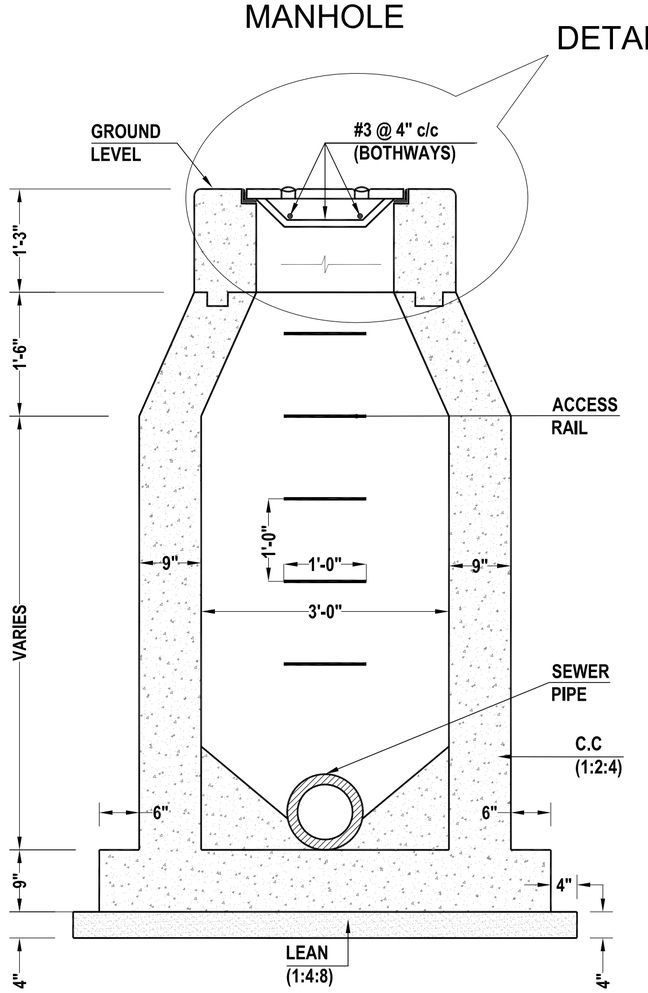


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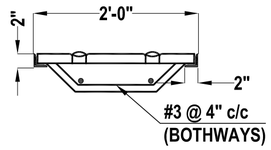
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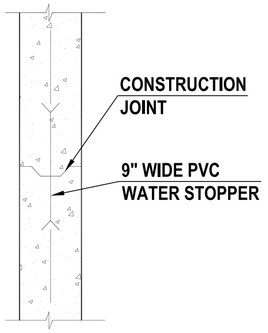
TYPICAL SECTION OF SEWER PIPE TRENCH UNDER THE ROAD



SECTION A



DETAIL Y



TYPICAL CONSTRUCTION JOINT

KEY PLAN

NOTES:

REFERENCE DRAWINGS	
DRAWING NO.	DRAWING TITLE
JC/HI/SS/LP-01	SEWERAGE LAYOUT PLAN

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:
FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

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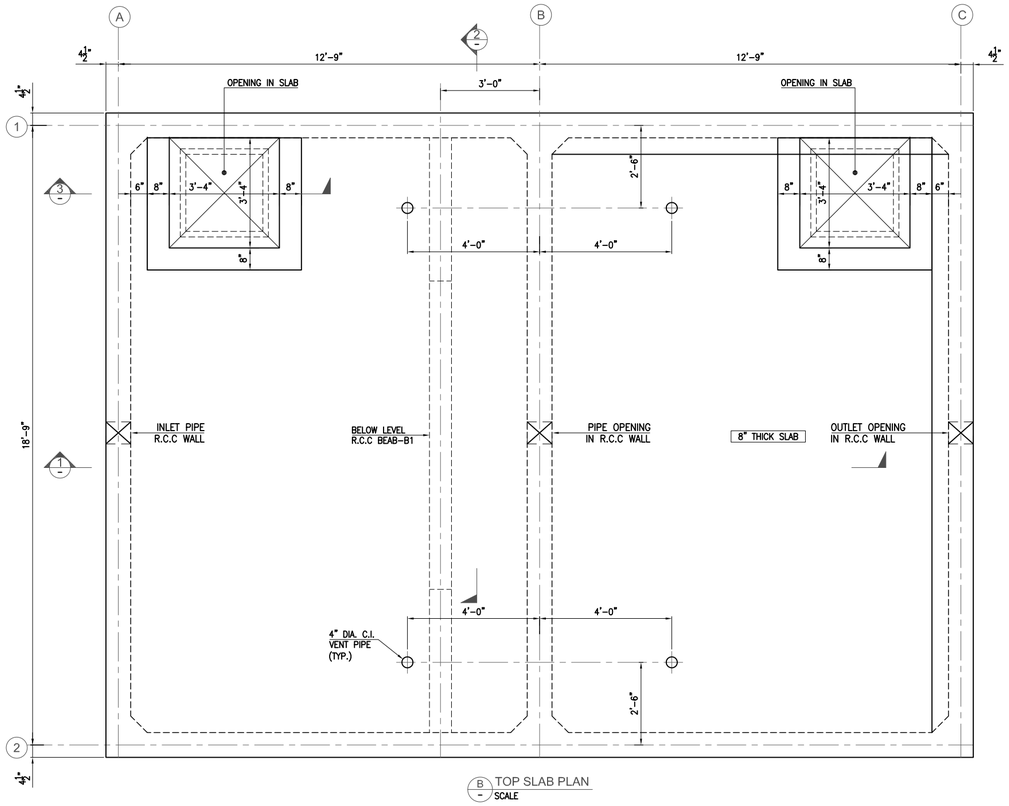
CONSULTANT:

DRAWING TITLE:

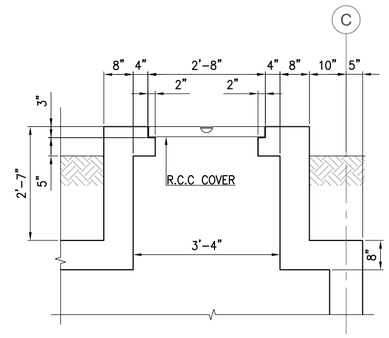
DETAIL OF PIPE TRENCH
&
SEWER MANHOLE

DRAWN BY	SAIF ALI	SCALE:
DESIGN BY	SAMEER ANWAR	---
CHECKED BY	SAMEER ANWAR	SHEET SIZE:
APPROVED BY	SHERAZ AHMAD	A2

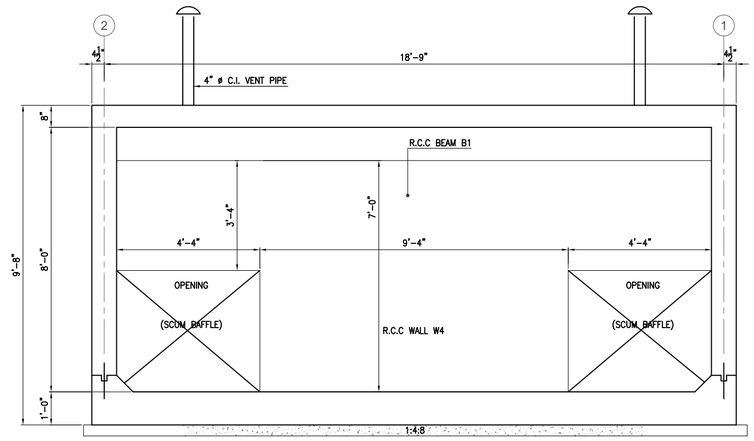
DRAWING NO:	SHEET:	REV.
JC/HI/SS/DD-01	01 OF 01	00



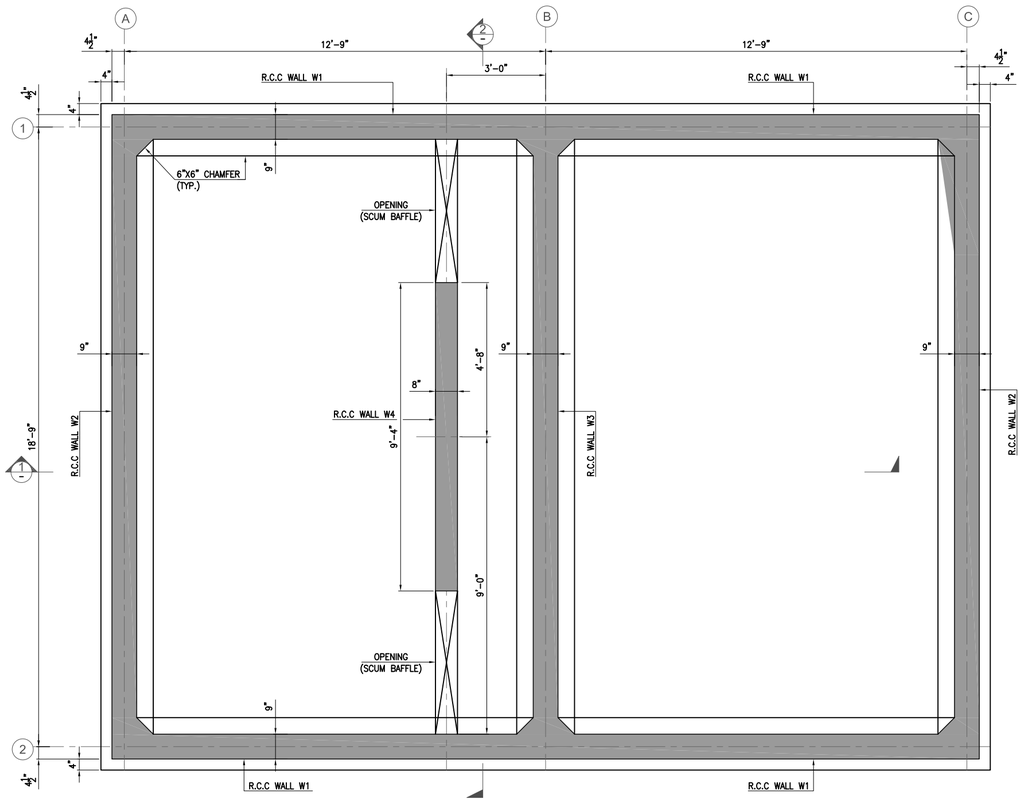
B TOP SLAB PLAN
SCALE



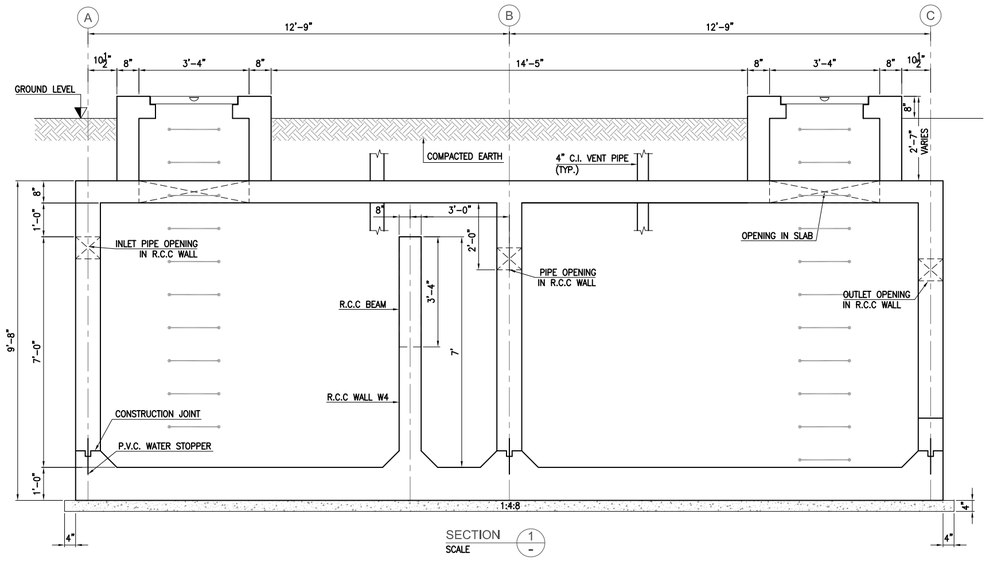
SECTION 3
SCALE



SECTION 2
SCALE



A BOTTOM SLAB PLAN
SCALE



SECTION 1
SCALE

KEY PLAN

NOTES:

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
JC/HI/SS/LP-01	SEWERAGE LAYOUT PLAN
JC/HI/SS/DD-03	DETAIL OF SOAK AWAY

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:
FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

CLIENT:

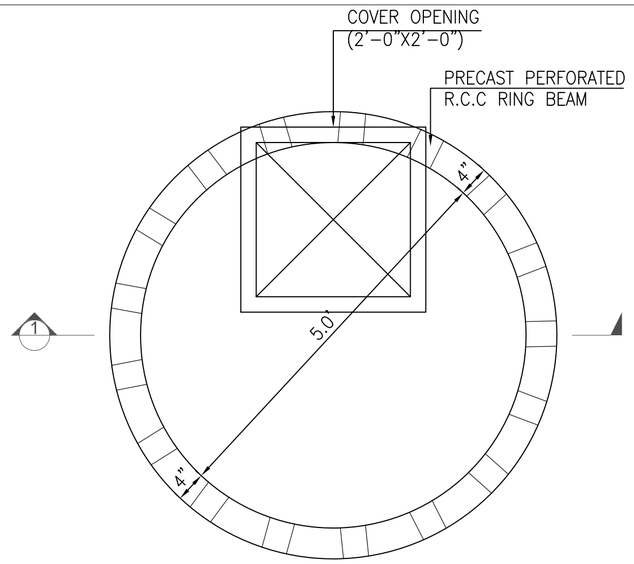
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DRAWING TITLE:

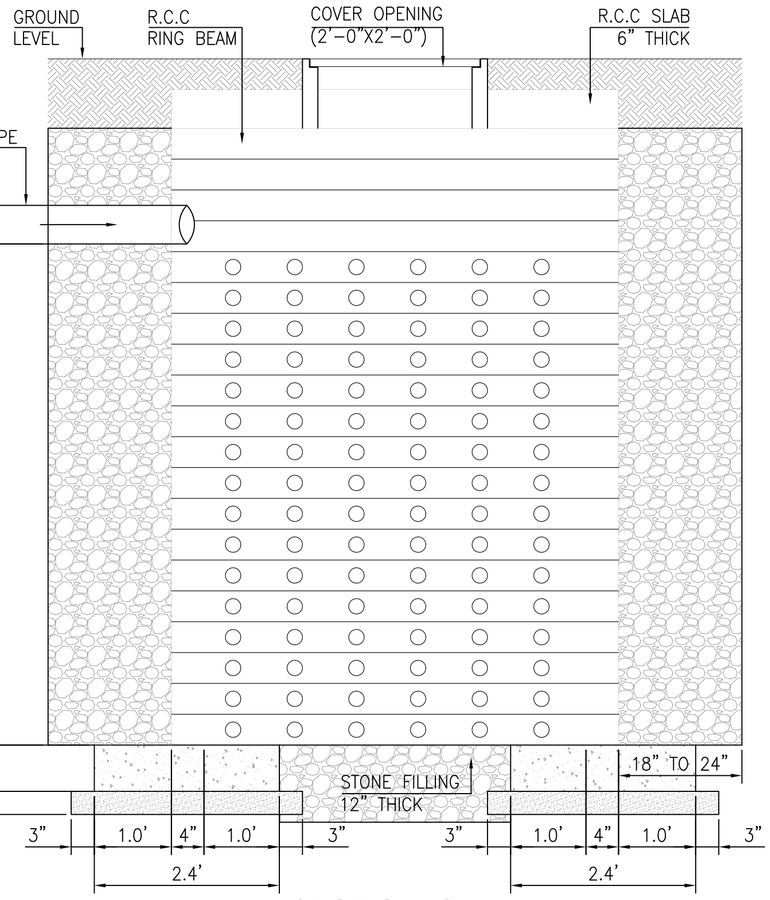
DETAIL OF SEPTIC TANK

DRAWN BY	SAIF ALI	SCALE:	
DESIGN BY	SAMEER ANWAR		---
CHECKED BY	SAMEER ANWAR	SHEET SIZE:	
APPROVED BY	SHERAZ AHMAD		A2

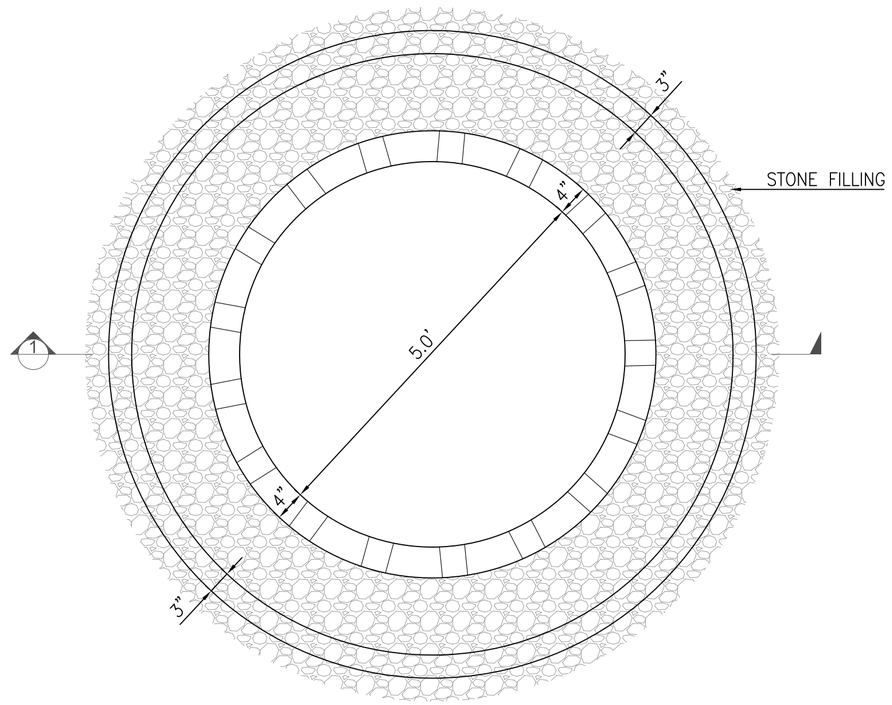
DRAWING NO:	SHEET:	REV.
JC/HI/SS/DD-02	01 OF 01	00



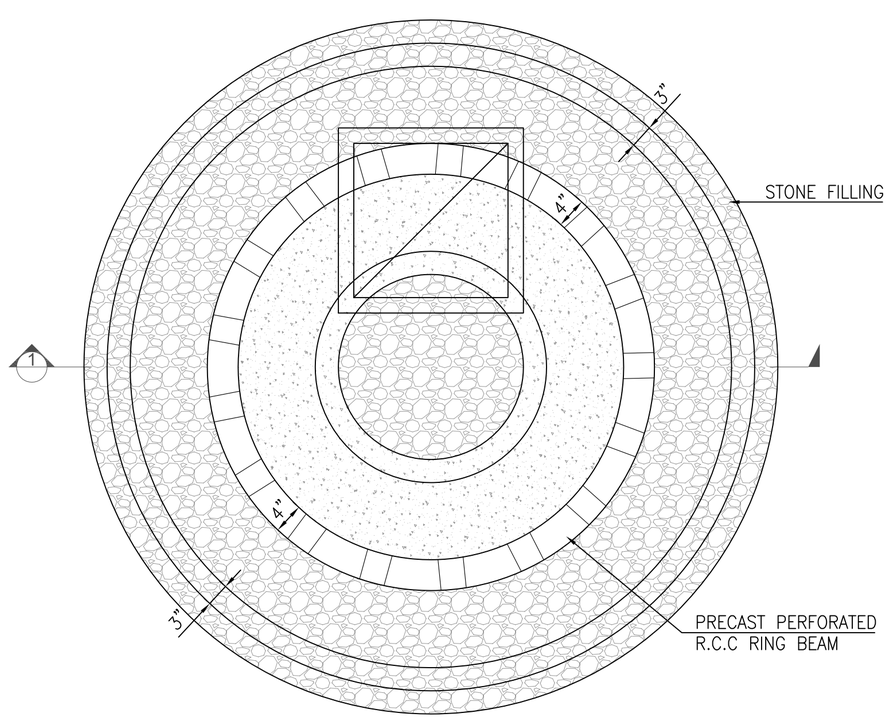
TOP SLAB PLAN



SECTION-01



PLAN



FOUNDATION PLAN

KEY PLAN

NOTES:

REFERENCE DRAWINGS	
DRAWING NO.	DRAWING TITLE
JC/HI/SS/LP-01	SEWERAGE LAYOUT PLAN
JC/HI/SS/DD-02	DETAIL OF SEPTIC TANK

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:
FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

CLIENT:

CONSULTANT:

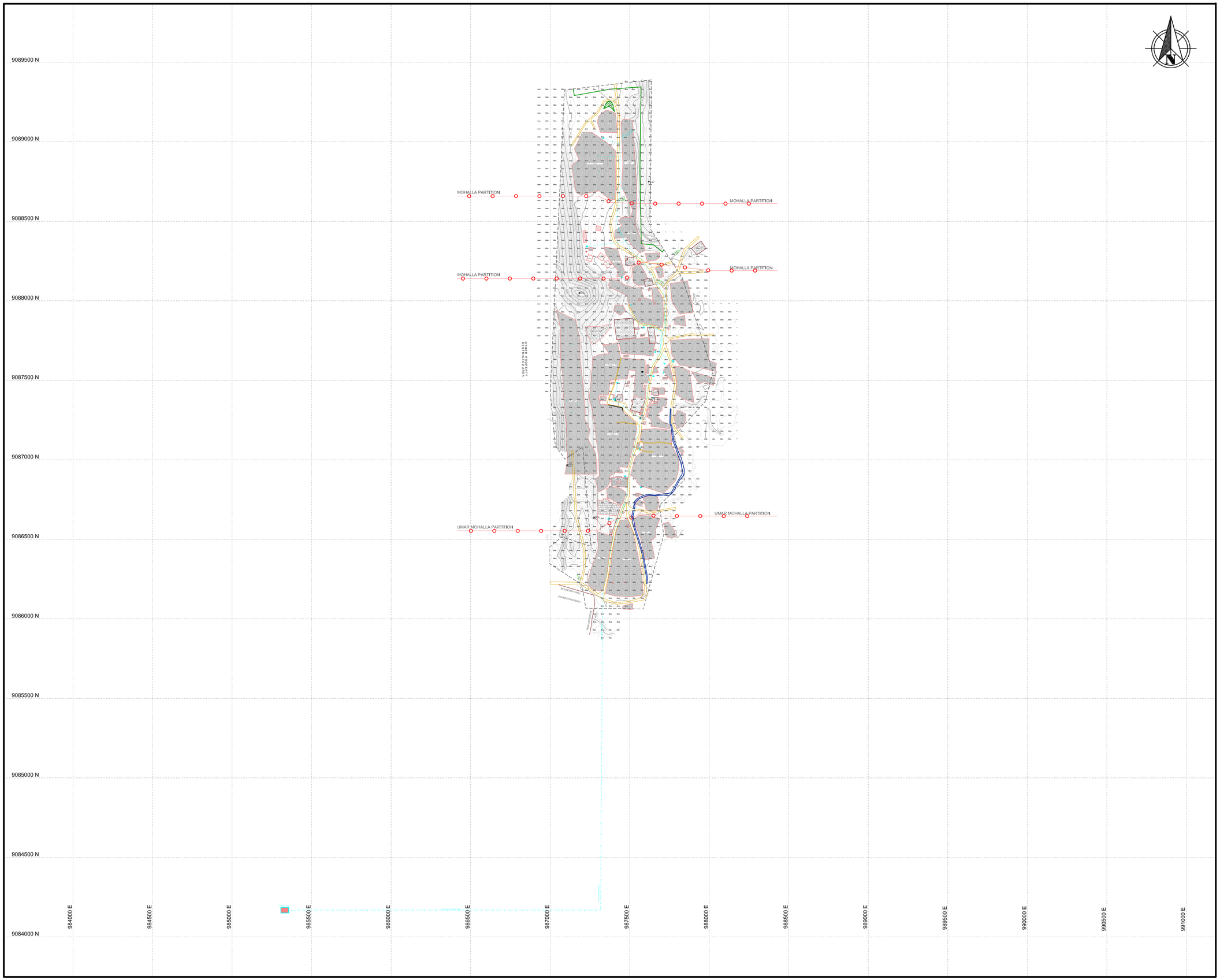
DRAWING TITLE:

DETAIL OF SOAK AWAY

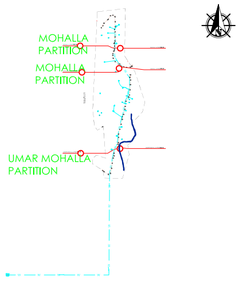
DRAWN BY	SAIF ALI	SCALE:	
DESIGN BY	SAMEER ANWAR		---
CHECKED BY	SAMEER ANWAR	SHEET SIZE:	
APPROVED BY	SHERAZ AHMAD		A2

DRAWING NO:	SHEET:	REV.
JC/HI/SS/DD-03	01 OF 01	00

EXISTING WATER SYSTEM



KEY PLAN



TOPOGRAPHIC LEGENDS:

BENCH MARK	BM-##
SIGNAL POLE	
SING BOARD	SB
ELECTRIC POLE	E
LIGHT POLE	
DITCH	
STREET	
HUT	
ROOM	
SCHOOL	
MASJID	
WATER LINE	W
WATER TANK	WATER TANK
MOHALLA PARTITION	

DATE	DESCRIPTION	REV.
2023/SEP/08	ISSUED FOR APPROVAL	00

PROJECT:

FEASIBILITY STUDY, PRELIMINARY DESIGN, DETAILED DESIGN AND PREPARATION OF BIDDING DOCUMENTS, & CONSTRUCTION SUPERVISION FOR THE CONSTRUCTION OF A NEW LANDFILL CELL AND SIX TRANSFER STATIONS IN KARACHI.

CLIENT:

SWEEP Solid Waste Emergency and Efficiency Project

CONSULTANT:

TÜMAŞ

DRAWING TITLE:

EXISTING WATER SUPPLY SYSTEM LAYOUT PLAN

DRAWN BY	SAIF ALI	SCALE:
DESIGN BY	-------	1"=400'
CHECKED BY	SHERAZ AHMAD	SHEET SIZE:
APPROVED BY	SHERAZ AHMAD	A2

DRAWING NO:	SHEET:	REV.
JC/HI/WS-LP-01	01 OF 01	00

ANNEX IV - Comparison of Stringent Environmental Standards

Comparison of International and Local Environmental Quality Standards

The WB-ESF requires application of pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards. The ESF states that when host country regulations differ from these standards, the EIA will achieve whichever is more stringent.

In order to select the most stringent standards applicable, a mix of local (SEQS) and international (IFC) regulations have been selected. The IFC EHS Guidelines, General EHS Guidelines: Environmental, Noise Management has noise level guidelines for daytime and night time, which are applicable. Considering the high baseline noise levels in the Project Area, it shall be ensured that the increase in noise levels is minimized as far as possible. Also, Project related noise levels in the Project Area are not allowed to increase the existing levels by 3dB or more. Furthermore, it shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the Project Area.

The **Table 3.4** presents IFC workplace noise standards that are applicable to the construction workers. It should also be noted that IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the Project should not result in an increase of more than 3 dB over existing ambient noise at the nearest receptor location off-site.

Table Error! No text of specified style in document.**.1 - IFC Work Environment Noise Limits**

Sr. No.	Type of Work, workplace	IFC General EHS Guidelines
1	Heavy Industry (no demand for oral communication)	85 Equivalent level Leq,8h
2	Light industry (decreasing demand for oral communication)	50-65 Equivalent level Leq,8h

A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 3.5** below. In the case of most pollutants, the SEQS standards for ambient air quality are more stringent in comparison to WHO/IFC standards. The most stringent parameters for each respective pollutant are highlighted in green. However, the comparison will be made with both IFC/WHO and SEQS standards.

Table Error! No text of specified style in document.**.2 - Comparison of International and Local Ambient Air Quality Standards***

Sr. No.	Pollutants	WHO/IFC		SEQS	
		Avg. Time	Standard	Avg. Time	Standard
1	SO_2	24 hr 10 min	20 ug/m^3 500 ug/m^3	Annual Mean 24 hrs	80 ug/m^3 120 ug/m^3
2	CO	-	-	8 hrs 1 hr	5 mg/m^3 10 mg/m^3
3	NO_2	1 yr 1 hr	40 ug/m^3 200 ug/m^3	Annual Mean 24 hrs	40 ug/m^3 80 ug/m^3
4	O_3	8 hrs	100 ug/m^3	1 hr	130 ug/m^3
5	TSP	-	-	Annual Mean 24 hrs	360 ug/m^3 500 ug/m^3
6	PM_{10}	1 yr 24 hr	20 ug/m^3 50 ug/m^3	Annual Mean 24 hrs	120 ug/m^3 150 ug/m^3
7	$PM_{2.5}$	1 yr 24 hr	10 ug/m^3 25 ug/m^3	Annual Mean 24 hrs	15 ug/m^3 35 ug/m^3

Table Error! No text of specified style in document..**2 - Comparison of International and Local Ambient Air Quality Standards***					
Sr. No.	**Pollutants**	**WHO/IFC**		**SEQS**	
		Avg. Time	**Standard**	**Avg. Time**	**Standard**
** In instances where the airshed is significantly degraded and the pollutant levels are already exceeding the ambient pollutant concentrations provided in the table above, it shall be ensured that the Project activities cause as small an increase in pollution levels as feasible, and amounts to a fraction of the applicable short term and annual average air quality guidelines or standards as established in the Project specific environmental assessment.*					

Similar to the standards for air quality, the comparison of noise standards provided in **Table 3.6** clearly shows that SEQS standards for noise are more stringent in comparison to the IFC standards. The only exception is the daytime noise level standard for Industrial areas where the IFC standard is more stringent i.e. 70 dB(A) in comparison to SEQS i.e. 75 dB(A). However, the comparison will be made with both IFC/WHO and SEQS standards.

Table Error! No text of specified style in document..**3 - Comparison of International and Local Noise Standards**					
Sr. No.	**Category of Area/Zone**	**Limit in dB(A) Leq**			
		SEQS		**WHO/IFC**	
		Day Time 06:00 – 22:00	**Night Time 22:00-06:00**	**Day Time 07:00 – 22:00**	**Night Time 22:00-07:00**
1	Residential area (A)	55	45	55	45
2	Commercial area (B)	65	55	70	70
3	Industrial area (C)	75	65	70	70
4	Silence zone (D)	50	45	55	45
** In instances where baseline noise levels are already exceeding the standards above, it will need to be ensured that the Project activities do not cause an increment of more than 3 dB(A) from the baseline noise levels.*					

A comparison of water quality standards provided in **Table 3.7** and **Table 3.8** clearly shows the SEQS standards for surface and drinking water quality as compared to WHO standards.

Table Error! No text of specified style in document..**4 - Comparison of National and International Drinking Water Standards**				
Sr. No.	**Parameter**	**Units**	**SEQS**	**WHO Standards**
1	Temperature (During Sample Collection)	^{O}C	NS	NS
2	Color	Pt-Co	≤15TCU	<15TCU
3	pH	pH unit	6.5-8.5	6.5-8.5
4	Turbidity	NTU	<5	<5
5	Total, Hardness	mg/L	<500.00	NS
6	Total Dissolved Solid (TDS)	mg/L	<1000.00	<1000.00
7	Total Suspended Solid (TSS)	mg/L	NS	NS
8	Ammonia	mg/L	NS	NS
9	Fluoride F^{-}	mg/L	<1.50	1.50
10	Sulfate (SO_4^{-2})	mg/L	NS	NS
11	Chloride(Cl^{-})	mg/L	<250.00	250
12	Nitrate $(NO_3)^{-}$	mg/L	<50.00	50.00

Table Error! No text of specified style in document.**.4 - Comparison of National and International Drinking Water Standards**

Sr. No.	Parameter	Units	SEQS	WHO Standards
13	Odor	-	Non Objectionable / Acceptable	Non Objectionable / Acceptable
14	Taste	-	Non Objectionable / Acceptable	Non Objectionable / Acceptable
15	Sodium	mg/L	NS	NS
16	Iodine	ppm	NS	NS
17	Arsenic (As)	mg/L	< 0.05	0.01
18	Iron (Fe^{3+})	mg/L	NS	NS
19	Zinc (Zn^{2+})	mg/L	5.0	3.0
20	Conductivity	µS/cm	NS	NS
21	Bicarbonate	mg/L	NS	NS
22	Nitrite	mg/L	<3	3
23	Magnesium	mg/L	NS	NS
24	Calcium as Ca	mg/L	NS	NS
25	Phosphate	mg/L	NS	NS
26	Potassium	mg/L	NS	NS
27	Boron	mg/L	<0.3	0.3
28	SAR Iodine (I)	mg/L	NS	NS
29	Aluminum	mg/L	< 0.2	0.2
30	Antimony	mg/L	<0.005	0.02
31	Cadmium	mg/L	0.01	0.003
32	Mercury	mg/L	<0.001	0.001
33	Nickel	mg/L	<0.02	0.02
34	Selenium	mg/L	0.01	0.01
35	Barium	mg/L	0.7	0.7
36	Total Chromium	mg/L	<0.05	0.05
37	Copper	mg/L	2	2
38	Lead	mg/L	<0.05	0.01
39	Cyanide (CN)	mg/L	<0.05	0.07
	Manganese	mg/L	<0.5	0.5
40	Total Coliforms	cfu/100ml	0/100 ml	0/100 ml
41	Fecal Coli forms (E.Coli)	cfu/ml	0/100 ml	0/100 ml

NS = Not Specified
** The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed Project. However, the comparison will be made with both WHO and SEQS standards.*

Table Error! No text of specified style in document.**.5 - Comparison of National and International Surface Water Standards**

Sr. No.	Parameter	Units	SEQS	WHO Class V (Agriculture)	FAO Standards
1	Temperature	^{O}C	--	--	--
2	pH	pH unit	6-9	<5.3	6.0-8.5
3	COD	mg/L	150	>30	--
4	(BOD_5)	mg/L	80	--	--

Table Error! No text of specified style in document.**.5 - Comparison of National and International Surface Water Standards**

Sr. No.	Parameter	Units	SEQS	WHO Class V (Agriculture)	FAO Standards
5	Solids, Total dissolved (TDS)	mg/L	3500	--	0-2000
6	Solids, Total suspended (TSS)	mg/L	200	--	--
7	Chloride	mg/L	1000	--	0-1065
8	Fluoride (F^-)	mg/L	10	--	--
9	Oil & grease	mg/L	10	--	--
10	Phenols, Total (Phenolic Compounds)	mg/L	0.10	--	--
11	Cyanide(CN^-)	mg/L	01.00	--	--
12	Anionic Detergents as MBAS	mg/L	20.00	--	--
13	Sulfate (SO_4^{-2})	mg/L	600	--	0-960
14	Sulfide (S)	mg/L	01.00	--	--
15	Ammonia NH_3	mg/L	40.00	--	--
16	Cadmium (Cd)	mg/L	0.10	>0.0039 mg/L	--
17	Chromium (Cr) as Hexavalent & Trivalent	mg/L	1.00	>0.016 mg/L	--
18	Copper (Cu)	mg/L	1.00	>0.018 mg/L	--
19	Lead	mg/L	0.50	>0.082 mg/L	--
20	Nickel	mg/L	1.00	>1.4 mg/L	--
21	Zinc	mg/L	5.00	>0.12 mg/L	--
22	Iron	mg/L	8.00	--	--
23	Manganese	mg/L	1.50	--	--
24	Selenium	mg/L	0.50	--	--
25	Silver	mg/L	1.00	--	--
26	Arsenic	mg/L	1.00	>0.36 mg/L	--
27	Barium	mg/L	1.50	--	--
28	Magnesium	mg/L	--	--	0-61
29	Nitrate	mg/L	--	--	0-10
30	Sodium	mg/L	--	--	0-920
31	Boron	mg/L	6.00	--	0-2
32	Mercury	mg/L	0.01	>0.0024 mg/L	--
33	Chlorine	mg/L	01.00	--	--
34	Total Toxic Metals	mg/L	02.00	--	--
35	Turbidity	NTU	NS	--	--
36	Oxygen, Dissolved	mg/L	NS	--	--

Table Error! No text of specified style in document.**.5 - Comparison of National and International Surface Water Standards**

Sr. No.	Parameter	Units	SEQS	WHO Class V (Agriculture)	FAO Standards
37	Pesticides	µg/L	NS	--	--
38	Nutrients as Potassium	mg/L	--	--	0-2
39	Nutrients as Nitrogen	mg/L	--	--	--
40	Nutrients as Phosphorous	mg/L	--	--	--
41	Total Coliform	MPN/100ml	--	--	--
42	Fecal Coliform	MPN/100ml	--	--	--

NS = Not Specified
** The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed Project. However, the comparison will be made with both WHO and SEQS standards.*

As per the above comparisons, the SEQS are more stringent than international standards for most of the environmental parameters. Nevertheless, in the assessment that will be conducted, the individual more stringent standard for each parameter shall be utilized as the standard for environmental compliance, where each of these have been highlighted in green in the above tables.

ANNEX V - Environmental Monitoring Reports

GEL/LAB/31819-T

Date : 22/3/2023

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1)	**Name of Company**	:	**Solid Waste Emergency & Efficiency Project (SWEEP)**
2)	**Address**	:	GTS Jam Chakro Site 1
3)	**Date of Analysis**	:	13-14 /Mar/2023
4)	**Test Method**	:	Noise Level Meter
5)	**No. of Samples**	:	24 Hour

S. No.	Time	Average dB
1	*18:00*	66.2
2	*19:00*	65.8
3	*20:00*	65.2
4	*21:00*	67.4
5	*22:00*	68.5
6	*23:00*	62.5
7	*0:00*	60.2
8	*1:00*	58.5
9	*2:00*	50.4
10	*3:00*	51.2
11	*4:00*	49.8
12	*5:00*	49.5
13	*6:00*	50.4
14	*7:00*	53.7
15	*8:00*	54.2
16	*9:00*	63.8
17	*10:00*	64.2
18	*11:00*	65.6
19	*12:00*	67.2
20	*13:00*	68.5
21	*14:00*	69.8
22	*15:00*	68.3
23	*16:00*	67.7
24	*17:00*	68.2

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
Ph: (92-21) 35113804-5 Fax: (92-21) 35113806 Email:info@gel.com.pk

GEL/LAB/31819-U

Date : 22/3/2023

NOISE LEVEL ESTIMATION RESULTS	GEL/QMR/FF/708/04C Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

1) **Name of Company** : **Solid Waste Emergency & Efficiency Project (SWEEP)**
2) **Address** : GTS Jam Chakro Site 2
3) **Date of Analysis** : 14-15 /Mar/2023
4) **Test Method** : Noise Level Meter
5) **No. of Samples** : 24 Hour

S. No.	Time	Average dB
1	18:00	65.8
2	19:00	66.4
3	20:00	64.7
4	21:00	63.8
5	22:00	64.5
6	23:00	63.2
7	0:00	60.5
8	1:00	59.4
9	2:00	52.8
10	3:00	50.2
11	4:00	49.2
12	5:00	50.3
13	6:00	49.8
14	7:00	48.3
15	8:00	48.7
16	9:00	64.2
17	10:00	63.2
18	11:00	64.8
19	12:00	66.3
20	13:00	67.9
21	14:00	68.6
22	15:00	69.2
23	16:00	68.5
24	17:00	67.7

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

Global Environmental Lab (Pvt) Ltd
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GEL/LAB/31819-V

Date : **22/3/2023**

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1)	**Name of Company**	:	**Solid Waste Emergency & Efficiency Project (SWEEP)**
2)	**Address**	:	GTS Jam Chakro Site 3
3)	**Date of Analysis**	:	15-16 /Mar/2023
4)	**Test Method**	:	Noise Level Meter
5)	**No. of Samples**	:	24 Hour

S. No.	Time	Average dB
1	*18:00*	64.8
2	*19:00*	63.2
3	*20:00*	65.4
4	*21:00*	62.2
5	*22:00*	60.2
6	*23:00*	61.4
7	*0:00*	61.5
8	*1:00*	59.6
9	*2:00*	58.2
10	*3:00*	50.3
11	*4:00*	49.2
12	*5:00*	49.6
13	*6:00*	49.3
14	*7:00*	49.5
15	*8:00*	48.2
16	*9:00*	65.2
17	*10:00*	66.4
18	*11:00*	67.3
19	*12:00*	69.8
20	*13:00*	69.2
21	*14:00*	68.3
22	*15:00*	68.4
23	*16:00*	69.5
24	*17:00*	70.2

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

GEL/LAB/31819-W

Date : 22/3/2023

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1) **Name of Company** : **Solid Waste Emergency & Efficiency Project (SWEEP)**
2) **Address** : GTS Jam Chakro Site 4
3) **Date of Analysis** : 16-17 /Mar/2023
4) **Test Method** : Noise Level Meter
5) **No. of Samples** : 24 Hour

S. No.	Time	Average dB
1	18:00	63.8
2	19:00	62.3
3	20:00	64.5
4	21:00	62.7
5	22:00	60.2
6	23:00	58.7
7	0:00	59.3
8	1:00	61.4
9	2:00	58.5
10	3:00	53.2
11	4:00	50.4
12	5:00	48.2
13	6:00	48.9
14	7:00	48.2
15	8:00	49.4
16	9:00	66.2
17	10:00	68.9
18	11:00	67.5
19	12:00	68.9
20	13:00	69.7
21	14:00	67.5
22	15:00	67.7
23	16:00	66.8
24	17:00	69.1

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

GEL/LAB/31819-X

Date : 22/3/2023

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1) **Name of Company** : **Solid Waste Emergency & Efficiency Project (SWEEP)**
2) **Address** : GTS Jam Chakro Site 5
3) **Date of Analysis** : 17-18 /Mar/2023
4) **Test Method** : Noise Level Meter
5) **No. of Samples** : 24 Hour

S. No.	Time	Average dB
1	18:00	66.8
2	19:00	67.3
3	20:00	68.2
4	21:00	63.6
5	22:00	60.7
6	23:00	59.9
7	0:00	60.2
8	1:00	56.4
9	2:00	55.2
10	3:00	52.8
11	4:00	51.5
12	5:00	50.8
13	6:00	50.2
14	7:00	49.4
15	8:00	49.2
16	9:00	69.2
17	10:00	67.4
18	11:00	66.8
19	12:00	66.3
20	13:00	65.8
21	14:00	68.8
22	15:00	66.9
23	16:00	65.2
24	17:00	68.4

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

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GEL/LAB/31819-Y

Date : **22/3/2023**

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1) **Name of Company** : **Solid Waste Emergency & Efficiency Project (SWEEP)**
2) **Address** : GTS Jam Chakro Site 6
3) **Date of Analysis** : 18-19 /Mar/2023
4) **Test Method** : Noise Level Meter
5) **No. of Samples** : 24 Hour

S. No.	Time	Average dB
1	18:00	67.9
2	19:00	66.2
3	20:00	67.2
4	21:00	66.5
5	22:00	61.7
6	23:00	60.8
7	0:00	59.5
8	1:00	53.2
9	2:00	53.8
10	3:00	51.7
11	4:00	50.2
12	5:00	51.5
13	6:00	49.7
14	7:00	48.2
15	8:00	48.6
16	9:00	70.2
17	10:00	68.1
18	11:00	64.5
19	12:00	65.8
20	13:00	66.4
21	14:00	67.2
22	15:00	69.5
23	16:00	64.7
24	17:00	68.5

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

GEL/LAB/31819-Z

Date : **22/3/2023**

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1)	**Name of Company**	:	**Solid Waste Emergency & Efficiency Project (SWEEP)**
2)	**Address**	:	GTS Jam Chakro Site 7
3)	**Date of Analysis**	:	19-20 /Mar/2023
4)	**Test Method**	:	Noise Level Meter
5)	**No. of Samples**	:	24 Hour

S. No.	Time	Average dB
1	*18:00*	66.8
2	*19:00*	63.8
3	*20:00*	64.9
4	*21:00*	64.2
5	*22:00*	62.9
6	*23:00*	61.8
7	*0:00*	61.5
8	*1:00*	60.2
9	*2:00*	60.5
10	*3:00*	58.7
11	*4:00*	63.2
12	*5:00*	55.2
13	*6:00*	50.7
14	*7:00*	49.8
15	*8:00*	47.3
16	*9:00*	66.7
17	*10:00*	70.4
18	*11:00*	70.5
19	*12:00*	71.2
20	*13:00*	68.1
21	*14:00*	65.3
22	*15:00*	66.7
23	*16:00*	63.8
24	*17:00*	67.9

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

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GEL/LAB/31819-AA

Date : 22/3/2023

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1) **Name of Company** : **Solid Waste Emergency & Efficiency Project (SWEEP)**
2) **Address** : GTS Jam Chakro Site 8
3) **Date of Analysis** : 20-21 /Mar/2023
4) **Test Method** : Noise Level Meter
5) **No. of Samples** : 24 Hour

S. No.	Time	Average dB
1	18:00	68.9
2	19:00	66.2
3	20:00	64.5
4	21:00	63.8
5	22:00	61.2
6	23:00	60.2
7	0:00	58.9
8	1:00	55.4
9	2:00	56.2
10	3:00	52.7
11	4:00	51.3
12	5:00	48.8
13	6:00	47.2
14	7:00	47.8
15	8:00	48.5
16	9:00	70.8
17	10:00	70.2
18	11:00	69.3
19	12:00	67.9
20	13:00	64.5
21	14:00	63.2
22	15:00	69.4
23	16:00	70.5
24	17:00	71.8

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

Global Environmental Lab (Pvt) Ltd
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GEL/LAB/31819-AB

Date : 22/3/2023

NOISE LEVEL ESTIMATION RESULTS

GEL/QMR/FF/708/04C
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

1) **Name of Company** : **Solid Waste Emergency & Efficiency Project (SWEEP)**
2) **Address** : GTS Jam Chakro Site 9
3) **Date of Analysis** : 21-22 /Mar/2023
4) **Test Method** : Noise Level Meter
5) **No. of Samples** : 24 Hour

S. No.	Time	Average dB
1	18:00	68.8
2	19:00	67.5
3	20:00	64.2
4	21:00	62.9
5	22:00	61.1
6	23:00	61.3
7	0:00	56.7
8	1:00	54.2
9	2:00	53.8
10	3:00	50.5
11	4:00	51.8
12	5:00	47.3
13	6:00	48.8
14	7:00	47.3
15	8:00	47.9
16	9:00	66.2
17	10:00	64.3
18	11:00	62.8
19	12:00	63.7
20	13:00	63.6
21	14:00	70.2
22	15:00	69.1
23	16:00	65.8
24	17:00	67.6

SEQS LIMIT is 55 dB for Noise level at day time in Residential Area
SEQS LIMIT is 45 dB for Noise level at night time in Residential Area

Approved By G.M. Field Operations

End of the Report

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GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORT

GEL/QMR/FF/708/01
Revision #: 00
ISSUE #: 02
ISSUE DATE:01.01.2023

Report Reference No: GEL/LAB/31271-A/32799/0323 Reporting Date: 17/03/2023
Department : Chemical Lab
Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)
Address : Jam Chakro Landfill Side Grab/Composite: Grab
Nature of Sample : Drinking Water (Masjid Alnoor Hassan Brohi Goth LAT 25.035657 LONG 67.038793)
Date of Sample Collection/Received : 17/02/2023
Sample Collected/Provided By: GEL
Date of Completion of Analysis: 17/03/2023

S.No	Parameter	Unit	SSDWQ Limit	Result	Method
1	Turbidity	NTU	<5	<1	Merch Method (077)
2	Aluminium	mg/l	<0.2	<0.02	Hach Method 8012
3	Conductivity	µS/cm		618	Conductivity Meter
4	Temperature	°C	.....	27	Thermometer
5	Chromium Total	mg/l	<0.05	0.062	AAS-APHA 3030E
6	SAR Iodine (I)		.....	0.041	ASTM D4785
7	Iodine	ppm	.....	0.02	8031
8	pH Value*	.....	6.5-8.5	6.37	APHA 4500H+B
9	Colour	PtCo	= 15	04	Hach Method 8025
10	Odour	.....	N/O	N/O	Physical
11	Taste	.....	N/O	N/O	Physical
12	Total Suspended Solids	mg/l	.....	01	Hach 8006
13	Total Dissolved Solids	mg/l	<1000	598	APHA 2540 C
14	Total Hardness*	mg/l	<500	149.9	APHA 2340 C
15	Calcium*	mg/l	.....	41.81	APHA 3500B
16	Magnesium*	mg/l	.....	11	APHA 3500B
17	Bicarbonate	mg/l	.....	118.64	APHA 2320B
18	Nitrate	mg/l	<50	1.6	Hach Method 8171
19	Nitrite	mg/l	<3	0.047	Hach Method 8507
20	Chloride	mg/l	<250	163.5	APHA 4500 CL B
21	Ammonia	mg/l		<0.02	Hach Method 8038
22	Fluoride*	mg/l	<1.5	0.49	Hach Method 8029
23	Sulphate*	mg/l	.....	27	Hach Method 8051
24	Phosphate	mg/l	.....	<0.02	Hach Method 8048
25	Cyanide	mg/l	<0.05	<0.010	Merck Test (1.14561)
26	Arsenic	mg/l	<0.05	<0.005	Merck Test (1.17927)
27	Boron	mg/l	0.3	0.10	1.00826 Merck
28	Barium	mg/l	0.7	<1	HACH 8014
29	Manganese	mg/l	<0.5	<0.005	AAS-APHA 3030E
30	Antimony	mg/l	<0.005	<0.005	AAS-APHA 3030E
31	Lead *	mg/l	<0.05	<0.005	AAS-APHA 3030E
32	Copper*	mg/l	2.0	0.067	AAS-APHA 3030E
33	Cadmium *	mg/l	0.01	<0.003	AAS-APHA 3030E
34	Nickel *	mg/l	<0.02	<0.005	AAS-APHA 3030E
35	Mercury	mg/l	<0.001	<0.001	Boris's Mercury Check
36	Selenium	mg/l	0.01	<0.005	Vogal (III, 62-C)
37	Iron*	mg/l	.....	0.362	AAS-APHA 3030E
38	Zinc	mg/l	5.0	0.051	AAS-APHA 3030E
39	Sodium	mg/l	.....	70.286	AAS-APHA 3030E
40	Potassium	mg/l	.....	16.642	AAS-APHA 3030E

Temperature: 25 °C ± 3 Humidity: N/A UCM: On demand

SSDWQ = Sindh Standards for Drinking Water Quality
*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations
8013 = Adapted frpm palin, A.T , Inst water Eng
**=Subcontracted from Baharia University

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORT

GEL/QMR/FF/708/01
Revision #: 00
ISSUE #: 02
ISSUE DATE:01.01.2023

Report Reference No: GEL/LAB/31271-B/32800/0323
Reporting Date: 21/03/2023
Department : Chemical Lab
Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)
Address : Jam Chakro Landfill Side
Grab/Composite: Grab
Nature of Sample : Drinking Water (Down Stream Hub Dam Canal LAT 25.02567 LONG 67.020858)
Date of Sample Collection/Received : 17/02/2023
Sample Collected/Provided By: GEL
Date of Completion of Analysis: 17/03/2023

S.No	Parameter	Unit	SSDWQ Limit	Result	Method
1	Turbidity	NTU	<5	<1	Merch Method (077)
2	Aluminium	mg/l	<0.2	<0.02	Hach Method 8012
3	Conductivity	µS/cm		625	Conductivity Meter
4	Temperature	°C	.....	27	Thermometer
5	Chromium Total	mg/l	<0.05	0.057	AAS-APHA 3030E
6	SAR Iodine (I)		.....	<0.03	ASTM D4785
7	Iodine	ppm	.....	0.02	8031
8	pH Value*	.....	6.5-8.5	6.21	APHA 4500H+B
9	Colour	PtCo	= 15	04	Hach Method 8025
10	Odour	.....	N/O	N/O	Physical
11	Taste	.....	N/O	N/O	Physical
12	Total Suspended Solids	mg/l	.....	01	Hach 8006
13	Total Dissolved Solids	mg/l	<1000	570	APHA 2540 C
14	Total Hardness*	mg/l	<500	39.93	APHA 2340 C
15	Calcium*	mg/l	.....	9.74	APHA 3500B
16	Magnesium*	mg/l	.....	3.78	APHA 3500B
17	Bicarbonate	mg/l	.....	42.09	APHA 2320B
18	Nitrate	mg/l	<50	1.7	Hach Method 8171
19	Nitrite	mg/l	<3	0.041	Hach Method 8507
20	Chloride	mg/l	<250	148.65	APHA 4500 CL B
21	Ammonia	mg/l		<0.02	Hach Method 8038
22	Fluoride*	mg/l	<1.5	0.46	Hach Method 8029
23	Sulphate*	mg/l	.....	29	Hach Method 8051
24	Phosphate	mg/l	.....	<0.02	Hach Method 8048
25	Cyanide	mg/l	<0.05	<0.010	Merck Test (1.14561)
26	Arsenic	mg/l	<0.05	<0.005	Merck Test (1.17927)
27	Boron	mg/l	0.3	0.11	1.00826 Merck
28	Barium	mg/l	0.7	<1	HACH 8014
29	Manganese	mg/l	<0.5	<0.005	AAS-APHA 3030E
30	Antimony	mg/l	<0.005	<0.005	AAS-APHA 3030E
31	Lead *	mg/l	<0.05	<0.005	AAS-APHA 3030E
32	Copper*	mg/l	2.0	0.042	AAS-APHA 3030E
33	Cadmium *	mg/l	0.01	<0.003	AAS-APHA 3030E
34	Nickel *	mg/l	<0.02	<0.005	AAS-APHA 3030E
35	Mercury	mg/l	<0.001	<0.001	Boris's Mercury Check
36	Selenium	mg/l	0.01	<0.005	Vogal (III, 62-C)
37	Iron*	mg/l	.....	0.421	AAS-APHA 3030E
38	Zinc	mg/l	5.0	0.063	AAS-APHA 3030E
39	Sodium	mg/l	.....	97.413	AAS-APHA 3030E
40	Potassium	mg/l	.....	21.416	AAS-APHA 3030E

Temperature: 25 °C ± 3 Humidity: N/A UCM: On demand

SSDWQ = Sindh Standards for Drinking Water Quality
*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations
8013 = Adapted frpm palin, A.T , Inst water Eng
**=Subcontracted from Baharia University

Approved By
G.M. Lab

End of the Report

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GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORT	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 02 ISSUE DATE:01.01.2023

Report Reference No: GEL/LAB/31271-C/32832/0323 Reporting Date: 20/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Drinking Water (Up Stream Hub Dam Canal LAT 25.028893 LONG 67.023786)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 20/03/2023

S.No	Parameter	Unit	SSDWQ Limit	Result	Method
1	Turbidity	NTU	<5	<1	Merch Method (077)
2	Aluminium	mg/l	<0.2	<0.02	Hach Method 8012
3	Conductivity	µS/cm		602	Conductivity Meter
4	Temperature	°C	.....	28	Thermometer
5	Chromium Total	mg/l	<0.05	0.033	AAS-APHA 3030E
6	SAR Iodine (I)		.....	0.04	ASTM D4785
7	Iodine	ppm	.....	<0.01	8031
8	pH Value*	.....	6.5-8.5	8.31	APHA 4500H+B
9	Colour	PtCo	= 15	<1	Hach Method 8025
10	Odour	.....	N/O	N/O	Physical
11	Taste	.....	N/O	N/O	Physical
12	Total Suspended Solids	mg/l	.....	<1	Hach 8006
13	Total Dissolved Solids	mg/l	<1000	492	APHA 2540 C
14	Total Hardness*	mg/l	<500	123.69	APHA 2340 C
15	Calcium*	mg/l	.....	50.64	APHA 3500B
16	Magnesium*	mg/l	.....	0.62	APHA 3500B
17	Bicarbonate	mg/l	.....	31.11	APHA 2320B
18	Nitrate	mg/l	<50	0.7	Hach Method 8171
19	Nitrite	mg/l	<3	0.016	Hach Method 8507
20	Chloride	mg/l	<250	178.38	APHA 4500 CL B
21	Ammonia	mg/l		<0.02	Hach Method 8038
22	Fluoride*	mg/l	<1.5	0.20	Hach Method 8029
23	Sulphate*	mg/l	.....	08	Hach Method 8051
24	Phosphate	mg/l	.....	<0.02	Hach Method 8048
25	Cyanide	mg/l	<0.05	<0.010	Merck Test (1.14561)
26	Arsenic	mg/l	<0.05	<0.005	Merck Test (1.17927)
27	Boron	mg/l	0.3	0.07	1.00826 Merck
28	Barium	mg/l	0.7	<1	HACH 8014
29	Manganese	mg/l	<0.5	<0.005	AAS-APHA 3030E
30	Antimony	mg/l	<0.005	<0.005	AAS-APHA 3030E
31	Lead *	mg/l	<0.05	<0.005	AAS-APHA 3030E
32	Copper*	mg/l	2.0	<0.005	AAS-APHA 3030E
33	Cadmium *	mg/l	0.01	<0.003	AAS-APHA 3030E
34	Nickel *	mg/l	<0.02	<0.005	AAS-APHA 3030E
35	Mercury	mg/l	<0.001	<0.001	Boris's Mercury Check
36	Selenium	mg/l	0.01	<0.005	Vogal (III, 62-C)
37	Iron*	mg/l	.....	0.038	AAS-APHA 3030E
38	Zinc	mg/l	5.0	0.012	AAS-APHA 3030E
39	Sodium	mg/l	.....	86.470	AAS-APHA 3030E
40	Potassium	mg/l	.....	16.566	AAS-APHA 3030E

Temperature: 25 °C ± 3 Humidity: N/A UCM: On demand

*=Accredited
AAS=Atomic Absorption Spectrophotometry
This report is not valid for any negotiations
SSDWQ = Sindh Standards for Drinking Water Quality
UCM = Uncertainty measurement
N/O = Non Objectionable
The result are related only to the sample tested
Statement of conformity : on demand
Opinions and Interpretation; on demand
8013 = Adapted from palin, A.T , Inst water Eng
**=Subcontracted from Bahria university

Approved By
G.M. Lab

End of the Report

GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORT

GEL/QMR/FF/708/01
Revision #: 00
ISSUE #: 02
ISSUE DATE:01.01.2023

Report Reference No: GEL/LAB/31271-D/32833/0323
Reporting Date: 20/03/2023
Department : Chemical Lab
Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)
Address : Jam Chakro Landfill Side
Grab/Composite: Grab
Nature of Sample : Drinking Water (Haji Ibrahim Goth LAT 25.035657 LONG 67.038793)
Date of Sample Collection/Received : 17/02/2023
Sample Collected/Provided By: GEL
Date of Completion of Analysis: 20/03/2023

S.No	Parameter	Unit	SSDWQ Limit	Result	Method
1	Turbidity	NTU	<5	<1	Merch Method (077)
2	Aluminium	mg/l	<0.2	<0.02	Hach Method 8012
3	Conductivity	µS/cm		744	Conductivity Meter
4	Temperature	°C	.....	28	Thermometer
5	Chromium Total	mg/l	<0.05	0.037	AAS-APHA 3030E
6	SAR Iodine (I)		.....	0.04	ASTM D4785
7	Iodine	ppm	.....	0.02	8031
8	pH Value*	.....	6.5-8.5	7.90	APHA 4500H+B
9	Colour	PtCo	= 15	<1	Hach Method 8025
10	Odour	.....	N/O	N/O	Physical
11	Taste	.....	N/O	N/O	Physical
12	Total Suspended Solids	mg/l	.....	<1	Hach 8006
13	Total Dissolved Solids	mg/l	<1000	710	APHA 2540 C
14	Total Hardness*	mg/l	<500	145.12	APHA 2340 C
15	Calcium*	mg/l	.....	51.81	APHA 3500B
16	Magnesium*	mg/l	.....	3.30	APHA 3500B
17	Bicarbonate	mg/l	.....	46.36	APHA 2320B
18	Nitrate	mg/l	<50	0.8	Hach Method 8171
19	Nitrite	mg/l	<3	0.026	Hach Method 8507
20	Chloride	mg/l	<250	297.3	APHA 4500 CL B
21	Ammonia	mg/l		<0.02	Hach Method 8038
22	Fluoride*	mg/l	<1.5	0.26	Hach Method 8029
23	Sulphate*	mg/l	.....	10	Hach Method 8051
24	Phosphate	mg/l	.....	<0.02	Hach Method 8048
25	Cyanide	mg/l	<0.05	<0.010	Merck Test (1.14561)
26	Arsenic	mg/l	<0.05	<0.005	Merck Test (1.17927)
27	Boron	mg/l	0.3	0.05	1.00826 Merck
28	Barium	mg/l	0.7	<1	HACH 8014
29	Manganese	mg/l	<0.5	<0.005	AAS-APHA 3030E
30	Antimony	mg/l	<0.005	<0.005	AAS-APHA 3030E
31	Lead *	mg/l	<0.05	<0.005	AAS-APHA 3030E
32	Copper*	mg/l	2.0	<0.005	AAS-APHA 3030E
33	Cadmium *	mg/l	0.01	<0.003	AAS-APHA 3030E
34	Nickel *	mg/l	<0.02	<0.005	AAS-APHA 3030E
35	Mercury	mg/l	<0.001	<0.001	Boris's Mercury Check
36	Selenium	mg/l	0.01	<0.005	Vogal (III, 62-C)
37	Iron*	mg/l	.....	0.086	AAS-APHA 3030E
38	Zinc	mg/l	5.0	0.027	AAS-APHA 3030E
39	Sodium	mg/l	.....	136.478	AAS-APHA 3030E
40	Potassium	mg/l	.....	27.688	AAS-APHA 3030E

Temperature: 25 °C ± 3 Humidity: N/A UCM: On demand

*=Accredited
AAS=Atomic Absorption Spectrophotometry
This report is not valid for any negotiations
SSDWQ = Sindh Standards for Drinking Water Quality
UCM = Uncertainty measurement
N/O = Non Objectionable
The result are related only to the sample tested
Statement of conformity : on demand
Opinions and interpretation; on demand
8013 = Adapted frpm palin, A.T , Inst water Eng
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Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31272-A/32061/0223 Reporting Date: 24/02/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Drinking Water(Masjid Alnoor Hassan Brohi Goth LAT 25.035657 LONG 67.038793)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 21/02/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	0	36	Membrane Filtration Method
2	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
3	E.Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Drinking Water.

Remarks
Bacteriological Analysis of submitted sample found beyond mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31272-B/32064/0223
Reporting Date: 24/02/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side
Grab/Composite: Grab

Nature of Sample : Drinking Water(Down Stream Hub Dam Canal LAT 25.02567 LONG 67.020858)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 21/02/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
3	E.Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Drinking Water.

Remarks
Bacteriological Analysis of submitted sample found within mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31272-C/32062/0223 Reporting Date: 24/02/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Drinking Water(Up Stream Hub Dam Canal LAT 25.028893 LONG 67.023786)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 21/02/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
3	E.Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Drinking Water.

Remarks
Bacteriological Analysis of submitted sample found within mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31272-D/32063/0223 Reporting Date: 24/02/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Drinking Water(Haji Ibrahim Goth LAT 25.035657 LONG 67.038793)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 21/02/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
3	E.Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 °C ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Drinking Water.

Remarks
Bacteriological Analysis of submitted sample found within mentioned limits.

Approved By
G.M. Lab

End of the Report

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Test Report	GEL/QMR/FF/708/01 Revision # : 00 ISSUE # : 02 ISSUE DATE : 01.01.2023

Report reference No.: GEL/LAB/31273-A/32825/0323 — Reporting Date: 17-03-2023

Department: Chemical Lab

Name of industry: Solid Waste Emergency & Efficiency Project (SWEEP)

Address: Jam Chakro

Nature of sample: Leachate (near Haji Ibrahim)

Date of completion of analysis: 15/02/2023 — Grab/Composite: Grab

Sample collected/Provided by: GEL

Date of completion of analysis: 17/03/2023

S.No.	Parameters.	Units	Result	SEQS/IFC Standard	Method
1	Temperature	°C	28	≤3°/-	Thermometer
2	pH	pH Unit	8.51	6-9/6-9	APHA 4500H+ B
3	Biochemical Oxygen Demand (BOD5) @	mg/L	8676	80/140	Hach BOD track 10099
4	Chemical Oxygen Demand (COD)	mg/L	24100	150/125	Hach Method 8000
5	Total Suspended Solids (TSS)	mg/L	8525	200/88	Hach Method 8006
6	Total Dissolved Solids (TDS)	mg/L	18770	3500/-	APHA 2540 C
7	Oil & grease	mg/L	<1		APHA 5520B
8	Phenolic Compounds (as phenol)	mg/L	145	0.1-0.026	Merck Cell Test 14551
9	Chloride (as Cl^-)	mg/L	6644.65	1000/-	APHA 4500 Cl B
10	Fluorides (as F^-)	mg/L	5.82	10/-	Hach Method 8029
11	Cyanide (as CN^-) total	mg/L	0.235	1.0/-	Merck Test (1.14561)
12	An-ionic Detergent (as MBAS)	mg/L	0.185	20/-	Merck Test (1.14697)
13	Sulfate (SO42-)	mg/L	2400	600/-	Hach Method 8051
14	Sulfide	mg/L	0.42	1.0/-	Hach Method 8131
15	Ammonia (as NH_3)	mg/L	414	40/10	Hach Method 8038
16	Pesticides	ug/L	<1.00	0.15/-	EPA 3510 + USEPA 8081
17	Cadmium (Cd)	mg/L	<0.003	0.1/-	AAS-APHA 3030E
18	Chromium (trivalent)	mg/L	0.741	1.0/-	By Difference
19	Copper (Cu)	mg/L	0.179	1.0/-	AAS-APHA 3030E
20	Lead (Pb)	mg/L	0.141	0.5/-	AAS-APHA 3030E
21	Mercury (Hg)	mg/L	0.01	0.01/-	Boris's Mercury Check
22	Selenium (Se)	mg/L	<0.005	0.5/-	Vogal (III, 62-C)
23	Nickel (Ni)	mg/L	0.149	1.0/-	AAS-APHA 3030E
24	Silver (Ag)	mg/L	<0.003	1.0/-	AAS-APHA 3030E
25	Total Toxic Metals	mg/L	1.48	2.0/-	Sum of toxic metals
26	Zinc (Zn)	mg/L	0.437	5.0/0.2	AAS-APHA 3030E
27	Arsenic (As)	mg/L	0.05	1.0/-	Merck Test (1.17927)
28	Barium (Ba)	mg/L	9	1.5/-	Hach Method 8014
29	Iron (Fe)	mg/L	20.4	8.0/-	AAS-APHA 3030E
30	Manganese (Mn)	mg/L	<0.005	1.5/-	AAS-APHA 3030E
31	Boron (B)	mg/L	15.25	6.0/-	Merck Test 1.00826

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32	Chlorine	mg/L	<0.02	1.0/-	Hach Method 8051
33	Total nitrogen	mg/L	210	-/10	Merck Test (1.14763.0001)
34	Total phosphorus	mg/L	1.25	-/2	Hach Method 8190
35	a-Terpineol	mg/L	-	-/0.033	-
36	Chromium (hexavalent)	mg/L	0.362		Hach Method 8023
37	Benzoic Acid	mg/L	-	-/0.12	-
38	p-Cresol	mg/L	1	-/0.025	BTEX EPA 5030 + EPA 8260 B

SEQS = Sindh Environmental Quality Standards
SEQS for Municipal and Liquid Industrial Effluents into Inland Waters
SEQS for Municipal and Liquid Industrial Effluents into Sewage Treatment
SEQS for Municipal and Liquid Industrial Effluents into Sea
This report is not valid for any negotiations
UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Opinions and interpretation; on demand
This report is not valid for any negotiations
*=Accredited
** =The Value For Industry Is 200mg/l
AAS=Atomic Absorption Spectrophotometry

Approved By GM

End of the Reports

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Test Report	GEL/QMR/FF/708/01 Revision # : 00 ISSUE # : 02 ISSUE DATE : 01.01.2023

Report reference No.: GEL/LAB/31273-B — Reporting Date: 17-03-2023

Department: Chemical Lab

Name of industry: Solid Waste Emergency & Efficiency Project (SWEEP)

Address: Jam chakro

Nature of sample: Leachate (Near Dumping Site 01)

Date of completion of analysis: 15/02/2023 — Grab/Composite: Grab

Sample collected/Provided by: GEL

Date of completion of analysis: 20/03/2023

S.No.	Parameters.	Units	Result	SEQS/IFC Standard	Method
1	Temperature	°C	29	≤3°/-	Thermometer
2	pH	pH Unit	8.12	6-9/6-9	APHA 4500H+ B
3	Biochemical Oxygen Demand (BOD5) @	mg/L	5365	80/140	Hach BOD track 10099
4	Chemical Oxygen Demand (COD)	mg/L	14500	150/125	Hach Method 8000
5	Total Suspended Solids (TSS)	mg/L	13900	200/88	Hach Method 8006
6	Total Dissolved Solids (TDS)	mg/L	52663	3500/-	APHA 2540 C
7	Oil & grease	mg/L	6	10-Oct	APHA 5520B
8	Phenolic Compounds (as phenol)	mg/L	125	0.1-0.026	Merck Cell Test 14551
9	Chloride (as Cl^-)	mg/L	25805	1000/-	APHA 4500 Cl B
10	Fluorides (as F^-)	mg/L	18	10/-	Hach Method 8029
11	Cyanide (as CN^-) total	mg/L	0.312	1.0/-	Merck Test (1.14561)
12	An-ionic Detergent (as MBAS)	mg/L	7	20/-	Merck Test (1.14697)
13	Sulfate (SO42-)	mg/L	450	600/-	Hach Method 8051
14	Sulfide	mg/L	8.6	1.0/-	Hach Method 8131
15	Ammonia (as NH_3)	mg/L	266	40/10	Hach Method 8038
16	Pesticides	ug/L	<1.0	0.15/-	EPA 3510 + USEPA 8081
17	Cadmium (Cd)	mg/L	<0.003	0.1/-	AAS-APHA 3030E
18	Chromium (trivalent)	mg/L	0.282	1.0/-	By Difference
19	Copper (Cu)	mg/L	0.183	1.0/-	AAS-APHA 3030E
20	Lead (Pb)	mg/L	0.363	0.5/-	AAS-APHA 3030E
21	Mercury (Hg)	mg/L	0.012	0.01/-	Boris's Mercury Check
22	Selenium (Se)	mg/L	<0.005	0.5/-	Vogal (III, 62-C)
23	Nickel (Ni)	mg/L	0.103	1.0/-	AAS-APHA 3030E
24	Silver (Ag)	mg/L	<0.003	1.0/-	AAS-APHA 3030E
25	Total Toxic Metals	mg/L	0.66	2.0/-	Sum of toxic metals
26	Zinc (Zn)	mg/L	0.448	5.0/0.2	AAS-APHA 3030E
27	Arsenic (As)	mg/L	0.05	1.0/-	Merck Test (1.17927)
28	Barium (Ba)	mg/L	9	1.5/-	Hach Method 8014
29	Iron (Fe)	mg/L	19.65	8.0/-	AAS-APHA 3030E
30	Manganese (Mn)	mg/L	<0.005	1.5/-	AAS-APHA 3030E
31	Boron (B)	mg/L	7.9	6.0/-	Merck Test 1.00826

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32	Chlorine	mg/L	<0.02	1.0/-	Hach Method 8051
33	Total nitrogen	mg/L	256	-/10	Merck Test (1.14763.0001)
34	Total phosphorus	mg/L	64	-/2	Hach Method 8190
35	a-Terpineol	mg/L	-	-/0.033	-
36	Chromium (hexavalent)	mg/L	0.026		Hach Method 8023
37	Benzoic Acid	mg/L	-	-/0.12	-
38	p-Cresol	mg/L	0.8	-/0.025	BTEX EPA 5030 + EPA 8260 B

SEQS = Sindh Environmental Quality Standards
SEQS for Municipal and Liquid Industrial Effluents into Inland Waters
SEQS for Municipal and Liquid Industrial Effluents into Sewage Treatment
SEQS for Municipal and Liquid Industrial Effluents into Sea
This report is not valid for any negotiations
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Opinions and interpretation; on demand
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** =The Value For Industry is 200mg/l
AAS=Atomic Absorption Spectrophotometry

Approved By GM

End of the Reports

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TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31274-A/32065/0223
Reporting Date: 24/02/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side
Grab/Composite: Grab

Nature of Sample : Leachate (Inside GTS Location 1)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 21/02/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	<200	122	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO Guidelines for Waste water Reuse
No defined limits for waste water as per SEQS

Remarks
Fitness of submitted sample depends on the usage of waste water

Approved By
G.M. Lab

End of the Report

TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31274-B/32066/0223 Reporting Date: 24/02/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Leachate (Inside GTS Location 2)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 21/02/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	<200	109	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO Guidelines for Waste water Reuse
No defined limits for waste water as per SEQS

Remarks
Fitness of submitted sample depends on the usage of waste water

Approved By
G.M. Lab

End of the Report

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GEL Pvt Ltd

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TEST REPORT

GEL/QMR/FF/708/01
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31897-A/32878/0323 Reporting Date : 22/03/2023
Department : Chemical Lab
Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)
Address : Jam Chakro Landfill Side Grab/Composite: Grab
Nature of Sample : Waste Water
Date of Sample Collection/Received : 17/02/2023
Sample Collected/Provided By : GEL
Date of Completion of Analysis: 22/03/2023

S.No	Parameter	Unit	SEQS Limit 1	SEQS Limit 2	SEQS Limit 3	Result	Method
1	Lead (Pb)	mg/L		0.5	0.5	0.173	AAS-APHA 3030E
2	Chlorine	mg/l	1	1	1	<0.02	Hach Method 8051
3	Turbidity	NTU	.....	.....	.....	36	Merch Method (077)
4	Chromium (Trivalent)	mg/l	1.0	1.0	1.0	0.143	By Difference
5	Chromium (Hexavalent)	mg/l	1.0	1.0	1.0	0.275	Hach Method 8023
6	Dissolved Oxygen	mg/l	.....	.....	.....	01	DO Meter
7	Nutrient as Potassium	mg/l				50.175	APHA 3111 b 23RD Edition
8	Nutrient as Nitrogen	mg/l				61.413	By Calculation
9	Nutrient as Phosphorous	mg/l				6.71	APHA 4500 p B + C 23rd Edition
10	Chloro Pesticides	µg/l				<1.00	EPA 3510 + USEPA 8081
11	Temperature	°C	40=<3	40=<3	40=<3	28	Thermometer
12	pH Value*	.....	6-9	6-9	6-9	7.51	APHA 4500H+ B
13	TSS	mg/l	200	400	200	325	Hach Method 8006
14	TDS	mg/l	3500	3500	3500	2200	APHA 2540 C
15	BOD5	mg/l	80	250	80**	756	Hach BOD track 10099
16	COD*	mg/l	150	400	400	2100	Hach Method 8000
17	Oil & Grease	mg/l	10	10	10	<1	APHA 5520B
18	Phenolic Compound	mg/l	0.1	0.3	0.3	2.17	Merck Cell Test 14551
19	Sulphate*	mg/l	600	1000	SC**	565	Hach Method 8051
20	Sulphide	mg/l	1	1	1	1.75	Hach Method 8131
21	Magnesium*	mg/l	.....	.....	.....	34.35	APHA 3500B
22	Nitrate	mg/l	.....	.....	.....	3.1	Hach Method 8171
23	Chloride	mg/l	1000	1000	SC**	1637.48	APHA 4500 Cl B
24	Ammonia	mg/l	40	40	40	4.31	Hach Method 8038
25	Fluoride*	mg/l	10	10	10	1.79	Hach Method 8029
26	Cyanide	mg/l	1	1	1	0.063	Merck Test (1.14561)
27	An-ionic detergents	mg/l	20	20	20	0.721	Merck Test (1.14697)
28	Arsenic	mg/l	1.0	1.0	1.0	0.05	Merck Test (1,17927)
29	Boron	mg/l	6	6	6	5.91	Merck Test 1.00826
30	Barium	mg/l	1.5	1.5	1.5	03	Hach Method 8014
31	Manganese	mg/l	1.5	1.5	1.5	<0.005	AAS-APHA 3030E
32	Copper*	mg/l	1	1	1	0.175	AAS-APHA 3030E
33	Cadmium*	mg/l	0.1	0.1	0.1	<0.003	AAS-APHA 3030E
34	Iron*	mg/l	8	8	8	6.41	AAS-APHA 3030E
35	Nickel *	mg/l	1	1	1	0.075	AAS-APHA 3030E
36	Zinc	mg/l	5	5	5	0.631	AAS-APHA 3030E
37	Sodium	mg/l	.....	.....	.....	1060.90	AAS-APHA 3030E
38	Silver	mg/l	1	1	1	<0.003	AAS-APHA 3030E
39	Mercury	mg/l	0.01	0.01	0.01	<0.001	Boris's Mercury Check
40	Selenium	mg/l	0.5	0.5	0.5	<0.005	Vogal (III, 62-C)
41	Total toxic metals	mg/l	2	2	2	0.816	Sum of toxic metals

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: On demand

SEQS = Sindh Environmental Quality Standards
1 =SEQS for Municipal and Liquid Industrial Effluents into Inland Waters
2 =SEQS for Municipal and Liquid Industrial Effluents into Sewage Treatment
3 =SEQS for Municipal and Liquid Industrial Effluents into Sea
*=Accredited
AAS=Atomic Absorption Spectrophotometry
a =The Value For Industry Is 200mg/l
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations
**=Subcontracted from SGS

Approved By
G.M. Lab

End of the Report

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GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORT

GEL/QMR/FF/708/01
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31897-B/32879/0323 Reporting Date : 22/03/2023
Department : Chemical Lab
Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)
Address : Jam Chakro Landfill Side Grab/Composite: Grab
Nature of Sample : Waste Water
Date of Sample Collection/Received : 17/02/2023
Sample Collected/Provided By : GEL
Date of Completion of Analysis: 22/03/2023

S.No	Parameter	Unit	SEQS Limit 1	SEQS Limit 2	SEQS Limit 3	Result	Method
1	Lead (Pb)	mg/L		0.5	0.5	0.187	AAS-APHA 3030E
2	Chlorine	mg/l	1	1	1	<0.02	Hach Method 8051
3	Turbidity	NTU	.....	.....	.....	47	Merch Method (077)
4	Chromium (Trivalent)	mg/l	1.0	1.0	1.0	0.246	By Difference
5	Chromium (Hexavalent)	mg/l	1.0	1.0	1.0	0.351	Hach Method 8023
6	Dissolved Oxygen	mg/l	.....	.....	.....	01	DO Meter
7	Nutrient as Potassium	mg/l				49.413	APHA 3111 b 23RD Edition
8	Nutrient as Nitrogen	mg/l				62.615	By Calculation
9	Nutrient as Phosphorous	mg/l				5.541	APHA 4500 p B + C 23rd Edition
10	Chloro Pesticides	µg/l				<1.00	EPA 3510 + USEPA 8081
11	Temperature	^{o}C	40=<3	40=<3	40=<3	28	Thermometer
12	pH Value*	.....	6-9	6-9	6-9	7.81	APHA 4500H+ B
13	TSS	mg/l	200	400	200	370	Hach Method 8006
14	TDS	mg/l	3500	3500	3500	2530	APHA 2540 C
15	BOD5	mg/l	80	250	80**	558	Hach BOD track 10099
16	COD*	mg/l	150	400	400	1550	Hach Method 8000
17	Oil & Grease	mg/l	10	10	10	<1	APHA 5520B
18	Phenolic Compound	mg/l	0.1	0.3	0.3	1.17	Merck Cell Test 14551
19	Sulphate*	mg/l	600	1000	SC**	595	Hach Method 8051
20	Sulphide	mg/l	1	1	1	0.325	Hach Method 8131
21	Magnesium*	mg/l	.....	.....	.....	39.26	APHA 3500B
22	Nitrate	mg/l	.....	.....	.....	2.5	Hach Method 8171
23	Chloride	mg/l	1000	1000	SC**	1490.84	APHA 4500 Cl B
24	Ammonia	mg/l	40	40	40	3.41	Hach Method 8038
25	Fluoride*	mg/l	10	10	10	2.25	Hach Method 8029
26	Cyanide	mg/l	1	1	1	0.049	Merck Test (1.14561)
27	An-ionic detergents	mg/l	20	20	20	0.921	Merck Test (1.14697)
28	Arsenic	mg/l	1.0	1.0	1.0	0.05	Merck Test (1,17927)
29	Boron	mg/l	6	6	6	4.31	Merck Test 1.00826
30	Barium	mg/l	1.5	1.5	1.5	02	Hach Method 8014
31	Manganese	mg/l	1.5	1.5	1.5	<0.005	AAS-APHA 3030E
32	Copper*	mg/l	1	1	1	0.213	AAS-APHA 3030E
33	Cadmium*	mg/l	0.1	0.1	0.1	<0.003	AAS-APHA 3030E
34	Iron*	mg/l	8	8	8	7.15	AAS-APHA 3030E
35	Nickel *	mg/l	1	1	1	0.078	AAS-APHA 3030E
36	Zinc	mg/l	5	5	5	0.841	AAS-APHA 3030E
37	Sodium	mg/l	.....	.....	.....	951.35	AAS-APHA 3030E
38	Silver	mg/l	1	1	1	<0.003	AAS-APHA 3030E
39	Mercury	mg/l	0.01	0.01	0.01	<0.001	Boris's Mercury Check
40	Selenium	mg/l	0.5	0.5	0.5	<0.005	Vogal (III, 62-C)
41	Total toxic metals	mg/l	2	2	2	1.047	Sum of toxic metals

Temperature: 25 °C ± 3 Humidity: N/A UCM: On demand

SEQS = Sindh Environmental Quality Standards
1 =SEQS for Municipal and Liquid Industrial Effluents into Inland Waters
2 =SEQS for Municipal and Liquid Industrial Effluents into Sewage Treatment
3 =SEQS for Municipal and Liquid Industrial Effluents into Sea
*=Accredited
AAS=Atomic Absorption Spectrophotometry
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UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
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Approved By
G.M. Lab

End of the Report

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TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31898-A/32880/0323 Reporting Date: 22/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Waste Water

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 22/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	<200	186	Membrane Filtration Method
2	Fecal Coliform	cfu/100ml	<200	16	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO Guidelines for Waste water Reuse
No defined limits for waste water as per SEQS

Remarks
Fitness of submitted sample depends on the usage of waste water

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31898-B/32881/0323
Reporting Date: 22/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side
Grab/Composite: Grab

Nature of Sample : Waste Water

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 22/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Total Coliform	cfu/100ml	<200	162	Membrane Filtration Method
2	Fecal Coliform	cfu/100ml	<200	28	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO Guidelines for Waste water Reuse
No defined limits for waste water as per SEQS

Remarks
Fitness of submitted sample depends on the usage of waste water

Approved By
G.M. Lab

End of the Report

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Test Report	GEL/QMR/FF/708/01 Revision # : 00 ISSUE # : 02 ISSUE DATE : 01.01.2023

Report reference No.: GEL/LAB/31277-A Reporting Date: 17-03-2023

Department: Chemical Lab

Name of industry: Solid Waste Emergency & Efficiency Project (SWEEP)

Address: jam chakro

Nature of sample: Soil (Insideof GTS) Site 1

Date of completion of analysis: 15/02/2023 Grab/Composite: Grab

Sample collected/Provided by: GEL

Date of completion of analysis: 17/03/2023

S.No.	Parameters.	Units	Result	Method
1	Aluminum (Al)	mg/Kg	3245	ISO 11047:1998
2	Arsenic (As)	mg/Kg	2.8	Merck Test (1.17927)
3	Cadmium (Cd)	mg/Kg	<0.5	ISO 11047:1998
4	Chromium (Cr)	mg/Kg	312	ISO 11047:1998
5	Copper (Cu)	mg/Kg	18	ISO 11047:1998
6	Lead (Pb)	mg/Kg	15	ISO 11047:1998
7	Nickel (Ni)	mg/Kg	12	ISO 11047:1998
8	Zinc (Zn)	mg/Kg	32	ISO 11047:1998
9	Tin (Sn)	mg/Kg	0.2	AAS
10	Mercury, Hg	mg/Kg	<0.05	AAS
11	TPH C6-C9	mg/Kg	27	EPA 3510 + USEPA 3510 & 8015
12	TPH C10-C36	mg/Kg	255	EPA 3510 + USEPA 3510 & 8015
13	MtBE (Methyl-tert-butyl ether)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
14	TPH C37-C40	mg/Kg	23	EPA 3510 + USEPA 3510 & 8015
15	Acenaphthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
16	Benzo(a)pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
17	Chrysene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
18	Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
19	Flourene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
20	Indeno(1,2,3-cd) pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
21	Pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
22	Benzo (k) Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
23	Benzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
24	Bromobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
25	Bromodichloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
26	Bromoform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
27	n-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
28	tert-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
29	ChloroBenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
30	Chloroform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
31	Chloromethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
32	Dibromochloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
33	1,2-dibromo-3-chloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
34	Dibromomethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
35	1,2-dibromoethane (EDB)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
36	1,2-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
37	1,3-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

38	1,4-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
39	1,1-dichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
40	1,2-dichloroethane	mg/Kg	<10	EPA 5030 + USEPA 8260B
41	1,2-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
42	1,3-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
43	cis-1,3-dichloropropene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
44	Hexachlorobutadiene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
45	Isopropylbenzene (Cumene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
46	n-propylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
47	Styrene (Vinyl benzene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
48	1,1,2,2-tetrachloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
49	Toulene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
50	1,2,3-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
51	1,2,4-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
52	1,1,1-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
53	1,1,2-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
54	Trichloroethane (Trichloroethylene, TCE)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
55	1,3,5-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
56	1,2,4-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
57	o-Xylene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
58	Benzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
59	Toulene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
60	Ethylbenzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
61	o-Xylene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
62	m/p-xylene	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
63	Trichloroethene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
64	1,2,3-trichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
65	Anthracene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
66	sec-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

This report is not valid for any negotiations

UCM = Uncertainty measurement

The result are related only to the sample tested

Statement of conformity : on demand

Opinions and interpretation; on demand

**=Subcontracted from SGS

Approved By GM

End of the Reports

Global Environmental Lab (Pvt) Ltd

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Ph: (92-21) 35113804-5 Fax: (92-21) 35113806 Email:info@gel.com.pk

Test Report	GEL/QMR/FF/708/01 Revision # : 00 ISSUE # : 02 ISSUE DATE : 01.01.2023

Report reference No.: GEL/LAB/31277-B — Reporting Date: 17-03-2023

Department: Chemical Lab

Name of industry: Solid Waste Emergency & Efficiency Project (SWEEP)

Address: jam chakro

Nature of sample: Soil (Insideof GTS) Site 2

Date of completion of analysis: 15/02/2023 — Grab/Composite: Grab

Sample collected/Provided by: GEL

Date of completion of analysis: 17/03/2023

S.No.	Parameters.	Units	Result	Method
1	Aluminum (Al)	mg/Kg	3268	ISO 11047:1998
2	Arsenic (As)	mg/Kg	2.9	Merck Test (1.17927)
3	Cadmium (Cd)	mg/Kg	<0.5	ISO 11047:1998
4	Chromium (Cr)	mg/Kg	299	ISO 11047:1998
5	Copper (Cu)	mg/Kg	20	ISO 11047:1998
6	Lead (Pb)	mg/Kg	11	ISO 11047:1998
7	Nickel (Ni)	mg/Kg	13	ISO 11047:1998
8	Zinc (Zn)	mg/Kg	26	ISO 11047:1998
9	Tin (Sn)	mg/Kg	0.2	AAS
10	Mercury, Hg	mg/Kg	<0.05	AAS
11	TPH C6-C9	mg/Kg	27	EPA 3510 + USEPA 3510 & 8015
12	TPH C10-C36	mg/Kg	288	EPA 3510 + USEPA 3510 & 8015
13	MtBE (Methyl-tert-butyl ether)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
14	TPH C37-C40	mg/Kg	38	EPA 3510 + USEPA 3510 & 8015
15	Acenaphthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
16	Benzo(a)pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
17	Chrysene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
18	Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
19	Flourene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
20	Indeno(1,2,3-cd) pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
21	Pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
22	Benzo (k) Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
23	Benzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
24	Bromobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
25	Bromodichloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
26	Bromoform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
27	n-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
28	tert-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
29	ChloroBenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
30	Chloroform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
31	Chloromethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
32	Dibromochloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
33	1,2-dibromo-3-chloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
34	Dibromomethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
35	1,2-dibromoethane (EDB)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
36	1,2-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
37	1,3-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

38	1,4-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
39	1,1-dichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
40	1,2-dichloroethane	mg/Kg	<10	EPA 5030 + USEPA 8260B
41	1,2-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
42	1,3-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
43	cis-1,3-dichloropropene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
44	Hexachlorobutadiene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
45	Isopropylbenzene (Cumene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
46	n-propylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
47	Styrene (Vinyl benzene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
48	1,1,2,2-tetrachloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
49	Toulene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
50	1,2,3-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
51	1,2,4-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
52	1,1,1-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
53	1,1,2-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
54	Trichloroethane (Trichloroethylene, TCE)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
55	1,3,5-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
56	1,2,4-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
57	o-Xylene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
58	Benzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
59	Toulene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
60	Ethylbenzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
61	o-Xylene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
62	m/p-xylene	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
63	Trichloroethene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
64	1,2,3-trichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
65	Anthracene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
66	sec-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

This report is not valid for any negotiations

UCM = Uncertainty measurement

The result are related only to the sample tested

Statement of conformity : on demand

Opinions and interpretation; on demand

**=Subcontracted from SGS

Approved By GM

End of the Reports

Global Environmental Lab (Pvt) Ltd

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Test Report	GEL/QMR/FF/708/01 Revision # : 00 ISSUE # : 02 ISSUE DATE : 01.01.2023

Report reference No.: GEL/LAB/31310-A/32825/0323 Reporting Date: 21-03-2023

Department: Chemical Lab

Name of industry: Solid Waste Emergency & Efficiency Project (SWEEP)

Address: Jam Chakro Landfill Site

Nature of sample: Soil (East side of GTS) Site 3

Date of completion of analysis: 15/02/2023 Grab/Composite: Grab

Sample collected/Provided by: GEL

Date of completion of analysis: 21/03/2023

S.No.	Parameters.	Units	Result	Method
1	Aluminum (Al)	mg/Kg	3500	ISO 11047:1998
2	Arsenic (As)	mg/Kg	2.1	Merck Test (1.17927)
3	Cadmium (Cd)	mg/Kg	<0.50	ISO 11047:1998
4	Chromium (Cr)	mg/Kg	450	ISO 11047:1998
5	Copper (Cu)	mg/Kg	27	ISO 11047:1998
6	Lead (Pb)	mg/Kg	18	ISO 11047:1998
7	Nickel (Ni)	mg/Kg	13	ISO 11047:1998
8	Zinc (Zn)	mg/Kg	45	ISO 11047:1998
9	Tin (Sn)	mg/Kg	0.1	AAs
10	Mercury, Hg	mg/Kg	<0.05	AAS
11	TPH C6-C9	mg/Kg	43	EPA 3510 + USEPA 3510 & 8015
12	TPH C10-C36	mg/Kg	325	EPA 3510 + USEPA 3510 & 8015
13	TPH C37-C40	mg/Kg	48	EPA 3510 + USEPA 3510 & 8015
14	MtBE (Methyl-tert-butyl ether)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
15	Acenaphthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
16	Benzo(a)pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
17	Chrysene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
18	Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
19	Flourene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
20	Indeno(1,2,3-cd) pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
21	Pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
22	Benzo (k) Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
23	Benzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
24	Bromobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
25	Bromodichloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
26	Bromoform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
27	n-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
28	tert-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
29	ChloroBenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
30	Chloroform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
31	Chloromethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
32	Dibromochloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
33	1,2-dibromo-3-chloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
34	Dibromomethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

35	1,2-dibromoethane (EDB)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
36	1,2-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
37	1,3-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
38	1,4-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
39	1,1-dichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
40	1,2-dichloroethane	mg/Kg	<10	EPA 5030 + USEPA 8260B
41	1,2-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
42	1,3-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
43	cis-1,3-dichloropropene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
44	Hexachlorobutadiene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
45	Isopropylbenzene (Cumene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
46	n-propylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
47	Styrene (Vinyl benzene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
48	1,1,2,2-tetrachloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
49	Toulene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
50	1,2,3-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
51	1,2,4-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
52	1,1,1-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
53	1,1,2-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
54	TCE)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
55	1,3,5-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
56	1,2,4-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
57	o-Xylene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
58	Benzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
59	Toulene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
60	Ethylbenzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
61	o-Xylene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
62	m/p-xylene	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
63	Trichloroethene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
64	1,2,3-trichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
65	Anthracene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
66	sec-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

This report is not valid for any negotiations

UCM = Uncertainty measurement

The result are related only to the sample tested

Statement of conformity : on demand

Opinions and interpretation; on demand

**=Subcontracted from SGS

Approved By GM

End of the Reports

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Test Report	GEL/QMR/FF/708/01 Revision # : 00 ISSUE # : 02 ISSUE DATE : 01.01.2023

Report reference No.: GEL/LAB/31277-C/32825/0323 Reporting Date: 21-03-2023

Department: Chemical Lab

Name of Industry: Solid Waste Emergency & Efficiency Project (SWEEP)

Address: Jam Chakro Landfill Site

Nature of sample: Soil (East side of GTS) Site 4

Date of completion of analysis: 15/02/2023 Grab/Composite: Grab

Sample collected/Provided by: GEL

Date of completion of analysis: 21/03/2023

S.No.	Parameters.	Units	Result	Method
1	Aluminum (Al)	mg/Kg	3300	ISO 11047:1998
2	Arsenic (As)	mg/Kg	3.1	Merck Test (1.17927)
3	Cadmium (Cd)	mg/Kg	<0.50	ISO 11047:1998
4	Chromium (Cr)	mg/Kg	360	ISO 11047:1998
5	Copper (Cu)	mg/Kg	22	ISO 11047:1998
6	Lead (Pb)	mg/Kg	15	ISO 11047:1998
7	Nickel (Ni)	mg/Kg	15	ISO 11047:1998
8	Zinc (Zn)	mg/Kg	38	ISO 11047:1998
9	Tin (Sn)	mg/Kg	0.1	AAs
10	Mercury, Hg	mg/Kg	<0.05	AAS
11	TPH C6-C9	mg/Kg	30	EPA 3510 + USEPA 3510 & 8015
12	TPH C10-C36	mg/Kg	310	EPA 3510 + USEPA 3510 & 8015
13	TPH C37-C40	mg/Kg	38	EPA 3510 + USEPA 3510 & 8015
14	MtBE (Methyl-tert-butyl ether)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
15	Acenaphthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
16	Benzo(a)pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
17	Chrysene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
18	Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
19	Flourene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
20	Indeno(1,2,3-cd) pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
21	Pyrene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
22	Benzo (k) Fluoranthene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
23	Benzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
24	Bromobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
25	Bromodichloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
26	Bromoform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
27	n-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
28	tert-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
29	ChloroBenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
30	Chloroform (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
31	Chloromethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
32	Dibromochloromethane (THM)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
33	1,2-dibromo-3-chloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
34	Dibromomethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

35	1,2-dibromoethane (EDB)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
36	1,2-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
37	1,3-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
38	1,4-dichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
39	1,1-dichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
40	1,2-dichloroethane	mg/Kg	<10	EPA 5030 + USEPA 8260B
41	1,2-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
42	1,3-dichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
43	cis-1,3-dichloropropene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
44	Hexachlorobutadiene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
45	Isopropylbenzene (Cumene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
46	n-propylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
47	Styrene (Vinyl benzene)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
48	1,1,2,2-tetrachloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
49	Toulene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
50	1,2,3-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
51	1,2,4-trichlorobenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
52	1,1,1-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
53	1,1,2-trichloroethane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
54	TCE)	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
55	1,3,5-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
56	1,2,4-Trimethylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
57	o-Xylene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
58	Benzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
59	Toulene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
60	Ethylbenzene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
61	o-Xylene (BTEX)	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
62	m/p-xylene	mg/Kg	<5.0	EPA 3510+USEPA 3510 & 8015
63	Trichloroethene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
64	1,2,3-trichloropropane	mg/Kg	<5.0	EPA 5030 + USEPA 8260B
65	Anthracene	mg/Kg	<1.0	USEPA 3540 C & 8100/8270
66	sec-butylbenzene	mg/Kg	<5.0	EPA 5030 + USEPA 8260B

This report is not valid for any negotiations

UCM = Uncertainty measurement

The result are related only to the sample tested

Statement of conformity : on demand

Opinions and interpretation; on demand

**=Subcontracted from SGS

Approved By GM

End of the Reports

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GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-A/32918/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 01)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	<1	HACH 8014
5	Boron	mg/l	0.11	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	1190.22	APHA 4500 CL C
8	Chromium	mg/l	0.022	AAS-APHA 3030E
9	Colour	PtCo	04	Physical
10	Copper*	mg/l	<0.005	AAS-APHA 3030E
11	Cyanide	mg/l	<0.010	Merck Test (1.14561)
12	Fluoride*	mg/l	0.37	Hach Method 8029
13	Lead*	mg/l	0.024	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	0.8	Hach Method 8171
18	Nitrite	mg/l	0.007	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	7.95	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	3230	APHA 2540 C
24	Total Hardness*	mg/l	700.94	APHA 2340 C
25	Turbidity	NTU	11	Merck Method (077)
26	Zinc	mg/l	0.067	AAS-APHA 3030E
27	Iron*	mg/l	1.725	AAS-APHA 3030E
28	Bicarbonate	mg/l	214.11	APHA 2320B
29	Calcium*	mg/l	140.83	APHA 3500B
30	Conductivity	µS/cm	4120	Conductivity Meter
31	Magnesium*	mg/l	84.90	APHA 3500B
32	Potassium	mg/l	110	AAS-APHA 3030E
33	Sulphate*	mg/l	75	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	21	Hach Method 8006
36	Ammonia	mg/l	0.47	Hach Method 8038
37	Sodium	mg/l	770.98	AAS-APHA 3030E
38	Phosphate	mg/l	0.47	Hach Method 8048
39	SAR Iodine (I)		0.42	ASTM D4785
40	Iodine	ppm	0.06	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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GEL Pvt Ltd

PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-B/32919/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 02)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	02	HACH 8014
5	Boron	mg/l	0.29	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	8602.88	APHA 4500 CL C
8	Chromium	mg/l	0.091	AAS-APHA 3030E
9	Colour	PtCo	04	Physical
10	Copper*	mg/l	<0.005	AAS-APHA 3030E
11	Cyanide	mg/l	0.047	Merck Test (1.14561)
12	Fluoride*	mg/l	2.17	Hach Method 8029
13	Lead*	mg/l	0.036	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	1.5	Hach Method 8171
18	Nitrite	mg/l	0.015	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	6.99	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	18820	APHA 2540 C
24	Total Hardness*	mg/l	3449.15	APHA 2340 C
25	Turbidity	NTU	13	Merck Method (077)
26	Zinc	mg/l	0.059	AAS-APHA 3030E
27	Iron*	mg/l	3.321	AAS-APHA 3030E
28	Bicarbonate	mg/l	265.35	APHA 2320B
29	Calcium*	mg/l	580.74	APHA 3500B
30	Conductivity	µS/cm	20550	Conductivity Meter
31	Magnesium*	mg/l	485.89	APHA 3500B
32	Potassium	mg/l	510	AAS-APHA 3030E
33	Sulphate*	mg/l	1100	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	23	Hach Method 8006
36	Ammonia	mg/l	2.51	Hach Method 8038
37	Sodium	mg/l	5567	AAS-APHA 3030E
38	Phosphate	mg/l	1.13	Hach Method 8048
39	SAR Iodine (I)		0.21	ASTM D4785
40	Iodine	ppm	0.09	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
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TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-C/32920/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 03)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	01	HACH 8014
5	Boron	mg/l	0.39	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	4594.72	APHA 4500 CL C
8	Chromium	mg/l	0.074	AAS-APHA 3030E
9	Colour	PtCo	05	Physical
10	Copper*	mg/l	<0.005	AAS-APHA 3030E
11	Cyanide	mg/l	0.147	Merck Test (1.14561)
12	Fluoride*	mg/l	0.91	Hach Method 8029
13	Lead*	mg/l	0.068	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	2.7	Hach Method 8171
18	Nitrite	mg/l	0.010	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	6.89	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	11180	APHA 2540 C
24	Total Hardness*	mg/l	2464.4	APHA 2340 C
25	Turbidity	NTU	15	Merck Method (077)
26	Zinc	mg/l	0.077	AAS-APHA 3030E
27	Iron*	mg/l	0.913	AAS-APHA 3030E
28	Bicarbonate	mg/l	216.55	APHA 2320B
29	Calcium*	mg/l	398.62	APHA 3500B
30	Conductivity	µS/cm	13920	Conductivity Meter
31	Magnesium*	mg/l	357.05	APHA 3500B
32	Potassium	mg/l	398	AAS-APHA 3030E
33	Sulphate*	mg/l	720	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	24	Hach Method 8006
36	Ammonia	mg/l	3.21	Hach Method 8038
37	Sodium	mg/l	2950	AAS-APHA 3030E
38	Phosphate	mg/l	1.21	Hach Method 8048
39	SAR Iodine (I)		0.37	ASTM D4785
40	Iodine	ppm	0.10	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
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PNAC Pakistan National Accreditation Council | LAB 074 17025

TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-D/32921/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 04)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	02	HACH 8014
5	Boron	mg/l	0.21	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	8260.72	APHA 4500 CL C
8	Chromium	mg/l	0.099	AAS-APHA 3030E
9	Colour	PtCo	04	Physical
10	Copper*	mg/l	0.013	AAS-APHA 3030E
11	Cyanide	mg/l	0.129	Merck Test (1.14561)
12	Fluoride*	mg/l	1.56	Hach Method 8029
13	Lead*	mg/l	0.055	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	2.2	Hach Method 8171
18	Nitrite	mg/l	1.13	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	6.68	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	19980	APHA 2540 C
24	Total Hardness*	mg/l	3408.75	APHA 2340 C
25	Turbidity	NTU	12	Merck Method (077)
26	Zinc	mg/l	0.067	AAS-APHA 3030E
27	Iron*	mg/l	2.716	AAS-APHA 3030E
28	Bicarbonate	mg/l	362.95	APHA 2320B
29	Calcium*	mg/l	576.69	APHA 3500B
30	Conductivity	µS/cm	20770	Conductivity Meter
31	Magnesium*	mg/l	476.53	APHA 3500B
32	Potassium	mg/l	472	AAS-APHA 3030E
33	Sulphate*	mg/l	1010	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	20	Hach Method 8006
36	Ammonia	mg/l	5.71	Hach Method 8038
37	Sodium	mg/l	5340	AAS-APHA 3030E
38	Phosphate	mg/l	1.49	Hach Method 8048
39	SAR Iodine (I)		0.41	ASTM D4785
40	Iodine	ppm	0.08	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
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UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
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TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-E/32904/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 05)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	0.021	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	04	HACH 8014
5	Boron	mg/l	0.26	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	3468.5	APHA 4500 CL C
8	Chromium	mg/l	0.041	AAS-APHA 3030E
9	Colour	PtCo	<1	Physical
10	Copper*	mg/l	0.029	AAS-APHA 3030E
11	Cyanide	mg/l	<0.010	Merck Test (1.14561)
12	Fluoride*	mg/l	1.37	Hach Method 8029
13	Lead*	mg/l	0.035	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	11.2	Hach Method 8171
18	Nitrite	mg/l	1.132	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	6.52	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	12880	APHA 2540 C
24	Total Hardness*	mg/l	3378.45	APHA 2340 C
25	Turbidity	NTU	09	Merck Method (077)
26	Zinc	mg/l	0.043	AAS-APHA 3030E
27	Iron*	mg/l	1.066	AAS-APHA 3030E
28	Bicarbonate	mg/l	265.35	APHA 2320B
29	Calcium*	mg/l	582.76	APHA 3500B
30	Conductivity	µS/cm	19340	Conductivity Meter
31	Magnesium*	mg/l	467.48	APHA 3500B
32	Potassium	mg/l	415.277	AAS-APHA 3030E
33	Sulphate*	mg/l	980	Hach Method 8051
34	Temperature	°C	28	Thermometer
35	Total Suspended Solid	mg/l	<1	Hach Method 8006
36	Ammonia	mg/l	4.7	Hach Method 8038
37	Sodium	mg/l	2053.46	AAS-APHA 3030E
38	Phosphate	mg/l	0.09	Hach Method 8048
39	SAR Iodine (I)		0.08	ASTM D4785
40	Iodine	ppm	0.04	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

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AAS=Atomic Absorption Spectrophotometry
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UCM = Uncertainty measurement
N/O = Non Objectionable
The result are related only to the sample tested
Statement of conformity : on demand
Opinions and interpretation; on demand

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G.M. Lab

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TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-F/32905/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 06)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	03	HACH 8014
5	Boron	mg/l	0.18	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	7478.64	APHA 4500 CL C
8	Chromium	mg/l	0.039	AAS-APHA 3030E
9	Colour	PtCo	<1	Physical
10	Copper*	mg/l	0.027	AAS-APHA 3030E
11	Cyanide	mg/l	<0.010	Merck Test (1.14561)
12	Fluoride*	mg/l	0.97	Hach Method 8029
13	Lead*	mg/l	<0.005	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	2.8	Hach Method 8171
18	Nitrite	mg/l	0.022	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	6.77	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	12425	APHA 2540 C
24	Total Hardness*	mg/l	3090.6	APHA 2340 C
25	Turbidity	NTU	06	Merck Method (077)
26	Zinc	mg/l	0.048	AAS-APHA 3030E
27	Iron*	mg/l	1.053	AAS-APHA 3030E
28	Bicarbonate	mg/l	222.65	APHA 2320B
29	Calcium*	mg/l	546.34	APHA 3500B
30	Conductivity	µS/cm	18860	Conductivity Meter
31	Magnesium*	mg/l	375.46	APHA 3500B
32	Potassium	mg/l	382.466	AAS-APHA 3030E
33	Sulphate*	mg/l	860	Hach Method 8051
34	Temperature	°C	28	Thermometer
35	Total Suspended Solid	mg/l	11	Hach Method 8006
36	Ammonia	mg/l	3.3	Hach Method 8038
37	Sodium	mg/l	1992.38	AAS-APHA 3030E
38	Phosphate	mg/l	0.08	Hach Method 8048
39	SAR Iodine (I)		0.06	ASTM D4785
40	Iodine	ppm	0.03	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
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UCM = Uncertainty measurement
N/O = Non Objectionable
The result are related only to the sample tested
Statement of conformity : on demand
Opinions and interpretation; on demand

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G.M. Lab

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TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-G/32906/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 07)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	05	HACH 8014
5	Boron	mg/l	0.17	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	8006.54	APHA 4500 CL C
8	Chromium	mg/l	0.046	AAS-APHA 3030E
9	Colour	PtCo	<1	Physical
10	Copper*	mg/l	0.039	AAS-APHA 3030E
11	Cyanide	mg/l	<0.010	Merck Test (1.14561)
12	Fluoride*	mg/l	1.13	Hach Method 8029
13	Lead*	mg/l	0.025	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	6.7	Hach Method 8171
18	Nitrite	mg/l	0.033	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	6.70	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	13076	APHA 2540 C
24	Total Hardness*	mg/l	3196.65	APHA 2340 C
25	Turbidity	NTU	05	Merck Method (077)
26	Zinc	mg/l	0.062	AAS-APHA 3030E
27	Iron*	mg/l	2.321	AAS-APHA 3030E
28	Bicarbonate	mg/l	225.7	APHA 2320B
29	Calcium*	mg/l	562.53	APHA 3500B
30	Conductivity	µS/cm	18720	Conductivity Meter
31	Magnesium*	mg/l	390.18	APHA 3500B
32	Potassium	mg/l	397.66	AAS-APHA 3030E
33	Sulphate*	mg/l	920	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	07	Hach Method 8006
36	Ammonia	mg/l	3.8	Hach Method 8038
37	Sodium	mg/l	2437.66	AAS-APHA 3030E
38	Phosphate	mg/l	0.07	Hach Method 8048
39	SAR Iodine (I)		0.09	ASTM D4785
40	Iodine	ppm	0.06	8031

Temperature: 25 ℃ ± 3 Humidity: N/A UCM: N/A

*=Accredited
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UCM = Uncertainty measurement
N/O = Non Objectionable
The result are related only to the sample tested
Statement of conformity : on demand
Opinions and interpretation; on demand

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G.M. Lab

End of the Report

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GEL Pvt Ltd

TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-F/32924/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 06)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	03	HACH 8014
5	Boron	mg/l	0.20	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	953.18	APHA 4500 CL C
8	Chromium	mg/l	0.039	AAS-APHA 3030E
9	Colour	PtCo	03	Physical
10	Copper*	mg/l	0.027	AAS-APHA 3030E
11	Cyanide	mg/l	<0.010	Merck Test (1.14561)
12	Fluoride*	mg/l	0.4	Hach Method 8029
13	Lead*	mg/l	0.025	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	1.1	Hach Method 8171
18	Nitrite	mg/l	0.015	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	7.15	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	3280	APHA 2540 C
24	Total Hardness*	mg/l	587.82	APHA 2340 C
25	Turbidity	NTU	04	Merck Method (077)
26	Zinc	mg/l	0.049	AAS-APHA 3030E
27	Iron*	mg/l	0.849	AAS-APHA 3030E
28	Bicarbonate	mg/l	452.62	APHA 2320B
29	Calcium*	mg/l	137.59	APHA 3500B
30	Conductivity	µS/cm	4420	Conductivity Meter
31	Magnesium*	mg/l	59.38	APHA 3500B
32	Potassium	mg/l	157	AAS-APHA 3030E
33	Sulphate*	mg/l	440	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	13	Hach Method 8006
36	Ammonia	mg/l	0.15	Hach Method 8038
37	Sodium	mg/l	610.54	AAS-APHA 3030E
38	Phosphate	mg/l	0.41	Hach Method 8048
39	SAR Iodine (I)		0.26	ASTM D4785
40	Iodine	ppm	0.03	8031

Temperature: 25 °C ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
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TEST REPORTS	GEL/QMR/FF/708/01 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31919-G/32925/0323 Reporting Date: 25/03/2023

Department : Chemical Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water (W.B.H 07)

Date of Sample Collection/Received : 17/02/2023

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Result	Method
1	Aluminium	mg/l	<0.02	Hach Method 8012
2	Antimony	mg/l	<0.005	Vogel III
3	Arsenic	mg/l	<0.005	Merck Test (1.17927)
4	Barium	mg/l	01	HACH 8014
5	Boron	mg/l	0.21	Merck 1-00826
6	Cadmium*	mg/l	<0.003	AAS-APHA 3030E
7	Chloride	mg/l	1075.36	APHA 4500 CL C
8	Chromium	mg/l	0.016	AAS-APHA 3030E
9	Colour	PtCo	03	Physical
10	Copper*	mg/l	0.039	AAS-APHA 3030E
11	Cyanide	mg/l	<0.010	Merck Test (1.14561)
12	Fluoride*	mg/l	0.51	Hach Method 8029
13	Lead*	mg/l	0.011	AAS-APHA 3030E
14	Manganese	mg/l	<0.005	AAS-APHA 3030E
15	Mercury	mg/l	<0.001	Boris's Mercury Check
16	Nickel *	mg/l	<0.005	AAS-APHA 3030E
17	Nitrate	mg/l	1.5	Hach Method 8171
18	Nitrite	mg/l	0.025	Hach Method 8507
19	Odour	.....	N/O	Physical
20	pH Value *	.....	7.40	APHA 4500H+ B
21	Selenium	mg/l	<0.005	Vogal (III, 62-C)
22	Taste	.....	Objectionable	physical
23	Total Dissolved Solids	mg/l	3290	APHA 2540 C
24	Total Hardness*	mg/l	627.21	APHA 2340 C
25	Turbidity	NTU	05	Merck Method (077)
26	Zinc	mg/l	0.062	AAS-APHA 3030E
27	Iron*	mg/l	1.415	AAS-APHA 3030E
28	Bicarbonate	mg/l	402.60	APHA 2320B
29	Calcium*	mg/l	146.09	APHA 3500B
30	Conductivity	µS/cm	4195	Conductivity Meter
31	Magnesium*	mg/l	63.80	APHA 3500B
32	Potassium	mg/l	173	AAS-APHA 3030E
33	Sulphate*	mg/l	410	Hach Method 8051
34	Temperature	°C	27	Thermometer
35	Total Suspended Solid	mg/l	16	Hach Method 8006
36	Ammonia	mg/l	0.17	Hach Method 8038
37	Sodium	mg/l	690.712	AAS-APHA 3030E
38	Phosphate	mg/l	0.56	Hach Method 8048
39	SAR Iodine (I)		0.09	ASTM D4785
40	Iodine	ppm	0.06	8031

Temperature: 25 °C ± 3 Humidity: N/A UCM: N/A

*=Accredited
AAS=Atomic Absorption Spectrophotometry
N/O = Non Objectionable
UCM = Uncertainty measurement
Opinions and interpretation; on demand
Statement of conformity : on demand
The result are related only to the sample tested
This report is not valid for any negotiations

for GEL

Approved By
G.M. Lab

End of the Report

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TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-A/32907/0323

Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side

Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 01)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	15	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 °C ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found beyond mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
Ph: (92-21) 35113804-5 Fax: (92-21) 35113806 Email:info@gel.com.pk

TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-B/32908/0323
Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side
Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 02)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	0	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found within mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
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TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-C/32909/0323
Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side
Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 03)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	54	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found beyond mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
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TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-D/32910/0323 Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 04)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	42	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found beyond mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
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TEST REPORTS

GEL/QMR/FF/708/03
Revision #: 00
ISSUE #: 01
ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-E/32911/0323
Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side
Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 05)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	0	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found within mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
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GEL Pvt Ltd

TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-F/32912/0323

Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side

Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 06)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	21	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 ℃ ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found beyond mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
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TEST REPORTS	GEL/QMR/FF/708/03 Revision #: 00 ISSUE #: 01 ISSUE DATE:01.04.2019

Report Reference No: GEL/LAB/31920-G/32913/0323 Reporting Date: 25/03/2023

Department : Microbiological Lab

Name of Customer : Solid Waste Emergency & Efficiency Project (SWEEP)

Address : Jam Chakro Landfill Side Grab/Composite: Grab

Nature of Sample : Ground Water(W.B.H 07)

Date of Sample Collection/Received : 17/02/2023

Sample Appearance : Satisfactory

Sample Collected/Provided By: GEL

Date of Completion of Analysis: 25/03/2023

S.No	Parameter	Unit	Recommended Value	Result	Method
1	Faecal Coliform	cfu/100ml	0	0	Membrane Filtration Method
2	Total Coliform	cfu/100ml	0	33	Membrane Filtration Method
3	E. Coli	cfu/100ml	0	0	Membrane Filtration Method

Temperature: 25 °C ± 1 Humidity: N/A UCM: N/A

UCM = Uncertainty measurement
The result are related only to the sample tested
Statement of conformity : on demand
Recommended Values as per WHO/USEPA Guidelines for Tap/Bore Water.

Remarks
Bacteriological Analysis of submitted sample found beyond mentioned limits.

Approved By
G.M. Lab

End of the Report

Global Environmental Lab (Pvt) Ltd
2nd Floor, Aiwan-e-Sanat, ST-4/2, Sector-23, Korangi Industrial Area, Karachi.
Ph: (92-21) 35113804-5 Fax: (92-21) 35113806 Email:info@gel.com.pk

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-1

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (°C)	Humidity (%)
02/03/2023	17:00	2.85	5.64	148.51	34.27	4.37						2.49	1056	109	32.0	21.3
02/03/2023	18:00	2.56	4.52	78.92	47.03	3.85						2.65	1092	47	32.2	2152
02/03/2023	19:00	1.52	3.32	119.55	30.25	4.52						1.20	1024	41	30.2	26.2
02/03/2023	20:00	2.45	16.03	162.30	19.16	2.56						4.34	1026	76	28.3	33.4
02/03/2023	21:00	5.92	48.72	168.51	17.12	3.34						3.13	1023	59	27.4	35.2
02/03/2023	22:00	11.49	71.47	153.15	12.24	3.23						0.00	1029	292	27.1	42.7
02/03/2023	23:00	14.62	64.61	129.27	11.46	3.57						1.12	1021	287	24.5	46.2
03/03/2023	0:00	13.62	62.31	119.62	19.34	3.24						1.62	1036	308	24.5	53.2
03/03/2023	1:00	14.89	65.09	89.52	23.62	3.50						1.82	1036	302	24.3	52.4
03/03/2023	2:00	10.21	42.33	91.62	14.84	3.74						2.42	1036	275	24.6	51.3
03/03/2023	3:00	11.58	67.56	85.60	16.28	3.20						3.48	1036	283	24.4	51.9
03/03/2023	4:00	11.92	61.23	89.21	15.25	2.65	0.147	7	69	171	468.27	3.30	1036	282	24.1	49.2
03/03/2023	5:00	13.64	55.62	79.58	12.36	2.75						4.71	1036	287	24.3	48.5
03/03/2023	6:00	15.45	45.24	92.17	13.71	3.85						7.63	1034	318	24.2	49.1
03/03/2023	7:00	27.82	68.57	96.81	18.83	4.57						4.42	1034	288	22.9	48.3
03/03/2023	8:00	14.12	53.51	81.16	17.82	6.68						4.56	1035	289	25.6	45.4
03/03/2023	9:00	3.31	6.08	39.75	15.62	4.08						3.30	1035	281	25.2	44.3
03/03/2023	10:00	2.48	4.51	31.23	14.34	3.19						5.98	1033	312	27.3	43.7
03/03/2023	11:00	5.31	2.43	45.52	17.52	2.81						6.75	1033	397	28.5	39.7
03/03/2023	12:00	4.51	2.42	49.20	21.0	3.46						3.63	1031	338	30.6	34.3
03/03/2023	13:00	4.94	3.75	39.56	26.85	1.32						4.09	1031	316	30.4	31.8
03/03/2023	14:00	3.21	2.19	24.24	33.52	1.42						3.52	1035	333	33.2	26.3
03/03/2023	15:00	3.87	3.58	31.14	28.19	2.52						2.81	1035	344	33.6	25.3
03/03/2023	16:00	2.74	3.98	36.27	32.42	3.60						1.13	1029	33	-35.5	1.6

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-2

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^oC)	Humidity (%)
03/03/2023	17:00	0.39	11.23	53.54	18.92	1.65						0.00	1029	26	35.4	1.5
03/03/2023	18:00	1.29	11.41	80.13	16.3	1.32						0.97	1029	59	32.3	14.2
03/03/2023	19:00	1.87	14.29	62.42	13.2	1.56						2.50	1029	54	32.2	21.3
03/03/2023	20:00	1.91	14.45	72.21	13.52	0.36						2.52	1027	49	30.1	21.8
03/03/2023	21:00	5.31	15.37	71.53	11.62	0.51						3.39	1027	62	29.6	31.2
03/03/2023	22:00	6.51	15.95	76.72	9.3	0.34						2.61	1025	59	26.2	36.9
03/03/2023	23:00	4.13	12.59	75.13	7.84	0.86						0.17	1025	229	22.5	41.4
03/03/2023	0:00	4.21	24.23	121.21	6.53	1.31						0.00	1025	224	22.9	45.3
04/03/2023	1:00	4.9	24.32	115.2	8.2	0.45						0.00	1026	198	23.1	52.6
04/03/2023	2:00	3.21	12.59	86.21	9.03	0.37						0.98	1026	292	22.5	53.2
04/03/2023	3:00	3 .20	8.42	86.01	10.18	1.02						0.41	1026	261	21.8	57.6
04/03/2023	4:00	1.72	8.8	70.13	12.15	1.08						2.37	1027	212	21.4	56.3
04/03/2023	5:00	0.85	6.22	31.96	15.3	1.35	0.123	6	28.37	79.1	381.34	2.43	1027	212	22.2	55.8
04/03/2023	5:00	0.85	6.22	31.96	15.3	1.35						2.43	1027	212	22.2	55.8
04/03/2023	6:00	0.83	8.32	50.34	17.02	1.43						1.34	1027	123	22.3	57.7
04/03/2023	7:00	3.57	24.3	81.31	19.16	0.99						0.09	1026	227	21.7	63.7
04/03/2023	8:00	3.12	31.04	145.31	17.67	0.36						0.37	1026	195	20.0	61.2
04/03/2023	9:00	1.59	4.31	65.17	22.73	0.37						3.61	1024	111	23.2	53.3
04/03/2023	10:00	0.36	1.23	35.35	31.4	0.13						4.89	1024	52	27.3	37.2
04/03/2023	11:00	1.28	1.51	51.33	36.53	0.24						5.46	1027	21	31.2	33.3
04/03/2023	12:00	1.92	5.24	58.12	34.28	0.17						4.03	1027	91	32.3	25.3
04/03/2023	13:00	1.81	7.31	94.36	35.19	0.23						1.86	1028	131	31.8	21.0
04/03/2023	14:00	1.9	6.75	76.52	21.23	0.58						1.36	1028	42	34.2	12.5
04/03/2023	15:00	1.71	6.53	131.8	24.58	0.33						1.61	1025	139	34.4	17.1
04/03/2023	16:00	1.41	5.14	85.22	33.15	0.64						1.32	1025	96	36.2	14.2

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-3

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^0C)	Humidity (%)
04/03/2023	17:00	2.26	5.33	115.23	38.23	0.18	0.251	8	51.11	261.43	465.24	1.18	1034	113	33.3	24.3
04/03/2023	18:00	2.50	5.11	79.69	31.42	0.62						1.52	1035	345	33.2	25.3
04/03/2023	19:00	1.24	6.32	119.23	33.23	6.24						1.32	1025	116	33.2	22.3
04/03/2023	20:00	1.36	7.45	95.28	32.11	0.35						2.62	1025	55	31.5	22.8
04/03/2023	21:00	1.12	7.23	85.23	24.56	0.52						2.81	1025	51	32.1	21.4
04/03/2023	22:00	1.26	3.56	69.23	26.12	1.84						3.64	1026	65	31.7	23.0
04/03/2023	23:00	2.32	3.28	109.11	30.15	0.64						3.95	1026	58	30.5	29.3
04/03/2023	0:00	3.35	11.56	129.32	16.12	4.52						2.45	1026	61	25.8	31.3
04/03/2023	1:00	5.62	28.62	123.61	21.74	3.51						2.62	1026	351	27.6	42.3
04/03/2023	2:00	4.25	6.85	105.21	41.30	1.52						1.31	1024	262	24.6	45.2
05/03/2023	3:00	6.12	27.23	125.23	10.12	4.21						1.35	1027	26	22.8	57.4
05/03/2023	4:00	7.33	11.28	110.25	10.53	4.82						1.00	1027	331	23.8	52.6
05/03/2023	5:00	3.81	13.75	95.25	10.28	3.62						1.32	1027	273	21.3	53.7
05/03/2023	6:00	4.51	6.25	72.93	9.23	3.15						3.57	1027	352	21.6	52.7
05/03/2023	7:00	3.13	13.52	73.52	9.35	1.92						3.62	1025	5	22.4	54.1
05/03/2023	8:00	2.21	9.68	69.52	9.38	4.15						2.32	1025	13	21.8	57.8
05/03/2023	9:00	3.52	5.21	61.17	10.52	8.52						0.00	1027	344	21.6	61.2
05/03/2023	10:00	3.89	5.15	69.53	10.35	3.75						1.09	1027	353	22.6	64.1
05/03/2023	11:00	1.45	4.62	62.42	15.45	3.23						3.12	1027	138	24.0	56.1
05/03/2023	12:00	1.27	3.78	46.82	31.40	4.85						5.32	1029	67	26.2	42.1
05/03/2023	13:00	1.6	3.71	33.21	33.29	4.42						2.05	1029	39	31.6	34.3
05/03/2023	14:00	1.19	1.32	30.51	34.78	2.32						3.32	1029	30	31.3	29.8
05/03/2023	15:00	2.87	1.51	31.51	32.51	1.85						2.51	1027	301	33.2	24.4
05/03/2023	16:00	1.33	2.42	29.75	31.21	1.62						2.32	1027	15	33.8	22.7

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID / Name: Jam chakro-4

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	PM $_{2.5}$ ($\mu g/m^3$)	PM $_{10}$ ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^0C)	Humidity (%)
05/03/2023	17:00	4.15	8.61	132.19	26.44	3.69				1.55	1026	34	32.9	19.1
05/03/2023	18:00	6.46	8.07	132.57	35.91	4.68				0.00	1024	23	33.5	19.6
05/03/2023	19:00	5.59	8.27	114.59	38.59	3.14				0.02	1024	71	32.7	20.3
05/03/2023	20:00	8.35	11.14	129.99	26.24	3.26				3.34	1024	31	31.5	23.0
05/03/2023	21:00	14.51	19.43	144.49	19.91	3.12				0.70	1024	49	30.6	27.1
05/03/2023	22:00	13.46	11.3	102.71	20.67	3.1				3.12	1026	51	29.2	31.5
05/03/2023	23:00	19.87	22.34	118.79	10.03	3.11				2.73	1026	68	27.3	38.2
05/03/2023	0:00	18.69	23.29	103.54	8.97	3.1				0.00	1026	280	24.1	45.8
05/03/2023	1:00	7.94	19.05	89.05	7.94	3.08				0.00	1026	80	22.9	49.6
06/03/2023	2:00	7.03	26.4	93.94	7.75	3.27				2.18	1025	334	24.1	49.1
06/03/2023	3:00	5	24.46	82.46	7.77	2.86				1.69	1025	5	22.4	57.5
06/03/2023	4:00	6.43	48.99	81.94	6.41	3.65				3.22	1025	26	23.6	55.0
06/03/2023	5:00	7.42	24.72	94.43	6.74	3.57	114.90	199.58	489.10	3.98	1025	25	23.3	57.1
06/03/2023	6:00	7.63	41.04	86.4	5.24	3.9				1.02	1026	5	21.7	62.4
06/03/2023	7:00	5.22	27.82	73.54	7.17	3.89				0.00	1027	308	20.3	68.4
06/03/2023	8:00	3.67	45.71	64.32	7.45	3.89				1.24	1027	282	23.6	58.3
06/03/2023	9:00	5.99	132.9	85.86	6.83	4.94				6.51	1028	1	27.3	42.7
06/03/2023	10:00	7.99	79.38	93.3	7.33	5.56				2.88	1029	28	29.0	36.3
06/03/2023	11:00	6.28	22.33	83.84	9.19	4.73				3.90	1028	9	31.1	29.5
06/03/2023	12:00	2.88	5.36	63.54	18.75	4.1				1.73	1027	5	32.4	24.3
06/03/2023	13:00	2.17	7.01	56.96	26.84	3.88				4.71	1026	57	33.6	20.8
06/03/2023	14:00	3.7	7.4	67.73	21.68	3.29				0.06	1024	214	33.9	20.4
06/03/2023	15:00	2.36	5.72	55.96	29.65	2.51				0.55	1025	68	34.6	20.0
06/03/2023	16:00	2.73	4.9	59.73	51.83	3.13				1.66	1025	119	35.0	19.6

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-5

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^oC)	Humidity (%)
05/03/2023	17:00	5.21	9.51	135.24	25.14	4.26						1.61	1025	39	33.5	18.2
05/03/2023	18:00	7.21	9.62	134.82	33.15	5.61						0.05	1026	21	33.2	19.8
05/03/2023	19:00	6.26	7.31	119.75	36.25	4.31						0.04	1023	69	32.3	21.4
05/03/2023	20:00	7.31	10.52	131.51	25.13	4.16						2.91	1023	35	32.7	22.8
05/03/2023	21:00	15.61	15.31	151.25	20.31	4.61						0.80	1025	44	31.2	26.2
05/03/2023	22:00	14.82	14.1	115.27	21.75	3.19						2.73	1028	58	30.4	34.7
05/03/2023	23:00	20.25	24.25	121.31	11.03	3.81						3.52	1025	63	28.5	35.5
05/03/2023	0:00	17.34	25.34	109.32	9.95	3.12						0.00	1025	291	26.5	46.7
05/03/2023	1:00	8.41	20.09	90.06	8.93	3.73						0.00	1026	85	25.8	41.2
06/03/2023	2:00	7.51	28.5	95.24	8.52	2.87						2.61	1025	345	25.6	44.3
06/03/2023	3:00	6.21	23.52	80.31	7.37	2.51						1.62	1025	8	23.5	54.2
06/03/2023	4:00	7.32	42.78	80.75	6.52	2.61						2.62	1025	23	21.2	57.3
06/03/2023	5:00	6.82	25.62	96.73	5.67	4.58	0.361	9	121.81	192.72	472.30	2.99	1025	28	22.7	56.7
06/03/2023	6:00	5.53	40.82	90.7	6.82	4.8						2.01	1026	7	23.2	61.2
06/03/2023	7:00	2.61	24.25	79.25	7.25	3.19						0.09	1026	315	21.5	65.3
06/03/2023	8:00	2.84	51.31	84.32	5.75	4.34						1.18	1026	292	22.7	60.2
06/03/2023	9:00	6.88	126.2	81.75	6.19	5.62						6.21	1028	3	25.5	45.2
06/03/2023	10:00	7.19	81.75	92.4	8.51	3.51						2.18	1028	30	28.2	35.2
06/03/2023	11:00	6.15	23.51	85.31	10.20	4.71						2.92	1027	5	33.2	25.3
06/03/2023	12:00	3.51	7.52	61.35	17.44	3.38						1.62	1027	3	34.5	23.8
06/03/2023	13:00	3.51	8.15	58.61	25.82	3.88						2.84	1025	67	32.7	21.3
06/03/2023	14:00	4.3	6.3	69.52	23.81	2.33						0.02	1028	26	33.7	21.6
06/03/2023	15:00	3.52	4.84	51.85	22.31	2.11						0.31	1024	69	33.4	20.3
06/03/2023	16:00	3.23	5.8	55.17	49.82	2.14						1.27	1026	121	34.1	20.2

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-6

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^oC)	Humidity (%)
06/03/2023	17:00	1.21	3.12	61.35	42.32	3.52						3.17	1026	151	34.2	17.2
06/03/2023	18:00	1.85	6.52	75.15	40.66	3.41						2.25	1028	244	32.4	22.4
06/03/2023	19:00	1.26	6.17	122.52	31.42	3.16						0.65	1028	231	31.2	22.7
06/03/2023	20:00	1.15	9.34	145.23	19.26	3.92						0.00	1028	183	31.6	26.1
06/03/2023	21:00	1.31	9.45	133.52	15.31	4.58						0.00	1031	172	30.8	26.3
06/03/2023	22:00	1.25	18.62	111.60	18.62	4.85						0.00	1031	159	28.6	30.5
06/03/2023	23:00	4.59	31.25	126.41	11.23	4.75						0.00	1031	305	25.2	40.2
06/03/2023	0:00	3.61	30.37	110.60	7.28	5.64						0.00	1028	361	25.7	41.1
07/03/2023	1:00	4.85	68.85	105.15	13.35	5.34						0.00	1028	245	23.2	40.8
07/03/2023	2:00	7.52	89.52	97.24	18.38	5.74						0.00	1028	315	26.9	31.7
07/03/2023	3:00	7.61	79.13	87.14	9.51	6.27						0.00	1030	355	25.1	37.2
07/03/2023	4:00	6.53	68.34	89.05	6.32	6.34						0.03	1031	361	25.2	31.3
07/03/2023	5:00	5.16	76.18	79.34	6.72	6.87	0.456	7	51.92	280.51	458.42	0.00	1031	368	23.0	21.4
07/03/2023	6:00	2.65	51.85	86.49	7.15	6.34						0.05	1031	292	23.2	20.8
07/03/2023	7:00	3.85	22.36	79.31	7.37	6.51						0.00	1031	343	22.4	15.1
07/03/2023	8:00	2.65	70.20	142.21	5.92	5.89						1.45	1030	12	22.7	13.8
07/03/2023	9:00	5.14	72.42	90.42	6.75	5.81						0.16	1032	213	25.3	11.7
07/03/2023	10:00	5.58	18.18	82.58	10.11	5.66						0.32	1030	261	25.2	11.6
07/03/2023	11:00	3.90	11.51	70.26	15.39	5.32						2.05	1028	234	28.1	11.4
07/03/2023	12:00	2.34	3.92	63.52	21.35	5.21						2.56	1028	209	30.2	13.2
07/03/2023	13:00	1.06	4.35	81.84	21.10	2.45						2.92	1028	319	32.4	14.5
07/03/2023	14:00	1.31	2.52	40.15	27.77	1.32						1.32	1028	279	33.9	10.9
07/03/2023	15:00	1.28	2.01	51.61	31.28	1.71						1.13	1029	285	34.7	13.2
07/03/2023	16:00	1.39	1.34	39.75	40.82	0.85						1.45	1028	279	35.2	12.9

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-7

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^oC)	Humidity (%)
05/03/2023	17:00	5.56	9.52	133.20	28.51	4.92						0.55	1024	29	33.2	20.2
05/03/2023	18:00	5.61	8.05	131.31	36.95	5.42						0.00	1024	26	34.6	21.2
05/03/2023	19:00	6.52	7.62	118.75	33.75	2.34						0.00	1024	69	31.8	20.7
05/03/2023	20:00	7.85	10.15	130.84	22.13	2.52						2.52	1024	36	32.3	22.3
05/03/2023	21:00	16.62	17.62	145.29	20.90	3.75						0.30	1026	52	30.6	24.8
05/03/2023	22:00	15.62	9.32	107.41	20.73	3.12						2.52	1026	56	30.1	30.3
05/03/2023	23:00	20.54	20.51	121.49	11.61	3.10						2.61	1026	70	28.3	35.1
05/03/2023	0:00	21.28	22.31	107.71	9.52	3.19						0.00	1026	284	26.8	42.5
05/03/2023	1:00	8.84	17.06	90.07	8.56	3.34						0.00	1025	86	23.7	48.2
06/03/2023	2:00	8.27	25.3	98.37	8.34	1.51						2.02	1025	341	25.6	47.8
06/03/2023	3:00	6.23	22.7	80.15	8.92	2.67						1.84	1025	12	24.2	52.1
06/03/2023	4:00	7.40	50.80	81.51	7.11	3.92						3.64	1025	29	24.8	53.8
06/03/2023	5:00	6.75	25.32	92.31	7.32	3.57	0.133	6	138.72	201.34	473.64	1.82	1026	32	23.4	53.5
06/03/2023	6:00	7.15	42.56	82.6	6.34	3.93						1.54	1026	8	22.8	61.8
06/03/2023	7:00	6.51	26.74	71.51	6.92	3.58						0.00	1026	315	22.5	61.2
06/03/2023	8:00	4.75	48.51	61.85	6.54	4.24						0.00	1027	283	22.1	60.4
06/03/2023	9:00	6.85	139.7	84.60	5.72	3.82						7.31	1028	3	28.3	40.5
06/03/2023	10:00	6.51	80.24	91.8	5.16	4.35						2.82	1028	30	30.3	38.1
06/03/2023	11:00	5.75	26.51	80.64	10.24	4.51						3.24	1027	11	33.7	29.2
06/03/2023	12:00	1.62	7.82	61.75	19.88	5.3						1.79	1027	8	35.8	26.8
06/03/2023	13:00	2.52	6.2	52.84	21.36	3.25						4.34	1025	60	34.5	21.1
06/03/2023	14:00	3.6	8.4	70.34	25.37	3.82						0.02	1025	225	31.8	21.9
06/03/2023	15:00	2.62	6.72	59.75	30.42	2.51						0.45	1026	72	35.2	21.1
06/03/2023	16:00	2.69	3.9	60.61	40.57	3.37						1.84	1026	125	36.2	20.5

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP)

Site ID Name: Jam chakro-8

Date	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Lead (ppm)	VOC (ppb)	PM 2.5 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Wind speed (m/s)	Pressure (mbar)	Direction (degree)	Air Temperature (^oC)	Humidity (%)
06/03/2023	17:00	2.06	3.08	57.34	47.62	3.34						2.30	1026	118	33.2	18.2
06/03/2023	18:00	2.42	6.35	78.30	43.09	3.31						1.75	1026	241	32.9	20.2
06/03/2023	19:00	3.62	6.18	126.98	30.18	4.50						0.62	1026	253	31.5	21.6
06/03/2023	20:00	3.85	6.52	147.38	20.08	3.94						0.16	1026	182	31.7	24.3
06/03/2023	21:00	1.51	8.34	136.57	19.36	3.68						0.00	1025	161	32.5	24.2
06/03/2023	22:00	1.63	15.57	120.36	15.20	4.79						0.00	10325	179	28.2	25.8
06/03/2023	23:00	2.34	32.38	187.34	11.65	4.94						0.00	1025	294	25.2	40.7
06/03/2023	0:00	5.21	30.87	112.60	6.42	5.66						0.00	1028	328	24.1	37.6
07/03/2023	1:00	3.81	68.34	108.54	13.06	5.48						0.00	1028	291	24.6	41.9
07/03/2023	2:00	7.45	84.02	96.87	18.09	5.49						0.00	1028	316	25.2	31.3
07/03/2023	3:00	5.67	75.34	89.33	9.85	6.26						0.00	1028	351	25.7	40.3
07/03/2023	4:00	5.34	65.37	89.40	6.52	6.21	0.129	5	52.96	286.17	448.26	0.00	1029	362	24.4	31.8
07/03/2023	5:00	6.18	76.25	86.76	6.37	6.01						0.98	1029	359	24.3	21.8
07/03/2023	6:00	2.68	62.09	83.16	6.03	6.24						0.08	1031	292	23.2	22.3
07/03/2023	7:00	3.81	23.82	83.52	6.08	6.59						1.60	1031	339	21.3	16.5
07/03/2023	8:00	5.26	80.34	138.05	7.63	6.66						1.81	1032	19	23.7	14.7
07/03/2023	9:00	3.57	72.61	97.82	9.42	5.80						0.37	1030	216	26.6	12.3
07/03/2023	10:00	4.16	14.81	83.67	13.05	5.99						0.62	1030	262	27.5	12.1
07/03/2023	11:00	4.37	11.13	73.82	16.08	5.64						1.02	1029	222	28.3	12.5
07/03/2023	12:00	3.82	5.87	67.19	22.35	5.51						3.42	1029	216	32.1	12.3
07/03/2023	13:00	1.12	5.03	79.37	23.09	2.75						2.37	1028	332	33.8	13.6
07/03/2023	14:00	1.34	3.78	56.82	27.85	1.12						1.98	1028	290	33.7	10.7
07/03/2023	15:00	1.56	3.34	49.35	37.16	0.81						3.05	1028	287	33.2	11.6
07/03/2023	16:00	1.08	2.17	42.16	36.75	0.75						2.25	1029	281	36.2	10.3

Global Environmental Lab Private Limited

Client Name: Solid Waste Emergency & Efficiency Project (SWEEP) **Site ID / Name:** Jam Chakro 09

Date	Time	CO	NO	NO2	SO2	O3	Lead	VOC	PM2.5	PM10	TSP	Rainfall	Wind speed	Pressure (mbar)	Direction (degree)	Air Temp	Humidity (%)
23/3/2023	18:00	2.76	5.85	67.95	3.19	21.29	0.172	7	66.6	138.56	418.56	0	2.55	1028	49.2	35.9	18.1
23/3/2023	19:00	3.41	5.56	72.16	3.35	34.79						0	2.845	1028	51.2	34.5	24.3
23/3/2023	20:00	3.04	7.53	62.26	3.92	30.89						0	0.95	1028	68.4	33.5	27.2
23/3/2023	21:00	5.92	15.19	76.52	4.35	15.89						0	2.17	1028	279.8	32.5	30.4
23/3/2023	22:00	2.83	7.04	55.02	3.61	19.73						0	0.14	1029	80.05	31.6	29.9
23/3/2023	23:00	3.23	8.56	55.53	2.97	18.14						0	0.83	1029	334.4	30.4	33.4
24/3/2023	0:00	1.05	11.73	116.05	3.08	10.62						0	0.39	1029	5.24	27	52.09
24/3/2023	1:00	1.1	2.72	71.24	4.64	4.67						0	0.34	1028	25.92	26.86	47.4
24/3/2023	2:00	0.73	9.77	102.75	3.25	9.76						0	0.30	1027	274.99	24.99	49.3
24/3/2023	3:00	0.74	7.99	100.74	2.2	5.46						0	0.25	1028	263.16	25.7	41.6
24/3/2023	4:00	0.79	10.17	107.02	1.04	10.6						0	0.20	1029	283.39	24.3	47.3
24/3/2023	5:00	0.83	5.25	98.55	1.61	2.76						0	0.154	1030	294.73	24.3	37.07
24/3/2023	6:00	0.78	0.91	53.22	2.18	5.48						0	0.41	1031	269.23	24.2	25.2
24/3/2023	7:00	1.04	-2.05	58.39	2.54	7.71						0	0.02	1031	241.05	23.5	23.7
24/3/2023	8:00	1.43	14.26	111.98	5.42	7.32						0	0	1031	196.85	23.4	15.4
24/3/2023	9:00	2.36	19.68	67.19	3.33	5.07						0	2.55	1031	247.86	24.0	13.6
24/3/2023	10:00	2.46	15.95	67.13	1.66	5.67						0	0.16	1031	326.85	26.6	12.2
24/3/2023	11:00	1.88	10.45	59.45	1.61	6.62						0	0.16	1030	296.82	28.2	12.08
24/3/2023	12:00	2.92	22.39	66.52	3.48	8.05						0	1.43	1029	278.38	30.1	11.6
24/3/2023	13:00	2.16	11.32	66.81	3.4	5.07						0	4.32	1028	220.23	32.7	17.7
24/3/2023	14:00	2.6	24.38	76.5	3.26	7.48						0	4.36	1028	280.11	34.05	21.5
24/3/2023	15:00	2.63	21.39	100.75	3.41	9.13						0	2.52	1027	193.89	34.8	18.1
24/3/2023	16:00	3.18	31.31	97.31	3.58	10.54						0	3.72	1027	216.84	35.5	18.5
24/3/2023	17:00	3.42	10.76	83.43	3.48	22.96						0	2.08	1027	271.51	36.8	21.0

ANNEX VI- Livelihood Restoration Plan

SWEEP
Solid Waste Emergency and Efficiency Project

SSWMB
Sindh Solid Waste Management Board



September 2023

Vol. I - Report

Livelihood Restoration Plan for Development of New Landfill Cell at Jam Chakro and Five Garbage Transfer Stations in Karachi



ACRONYMS

APs	Affected Persons
D&SC	Design and Supervision Consultant
ESIA	Environmental and Social Impact Assessment
FGDs	Focus Group Discussions
GoS	Government of Sindh
GTS	Garbage Transfer Stations
IMC	Independent Monitoring Consultant
LRP	Livelihood Restoration Plan
LRPIF	Livelihood Restoration Plan Implementing Firm
LFS	Landfill Site
NGO	Non-Governmental Organization
PIU	Project Implementing Unit
PPEs	Personal Protective Equipment
PoR	Proof of Registration
SSWMB	Sindh Solid Waste Management Board
SWEEP	Solid Waste Emergency and Efficiency Project
TNA	Training Need Assessment

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EXECUTIVE SUMMARY

Introduction

Karachi faces a significant waste management issue, with a daily production of 10,000–12,000 metric tons of solid waste. Waste pickers, who are crucial in tackling this challenge, earn their livelihoods by collecting recyclable materials. However, the proposed Solid Waste Emergency and Efficiency Project (SWEEP) will impact their livelihoods. SWEEP aims to enhance waste management services and address flooding and COVID-19 emergencies. This involves establishing landfill sites, garbage transfer stations, and improving waste management infrastructure. To mitigate the impact on waste pickers, a Livelihood Restoration Plan (LRP) has been developed, focusing on restoring and improving their livelihoods through impact analysis, exploring options, enhancing income, and monitoring effectiveness. The aim was to create a safer working environment and improve the livelihoods of waste pickers.

Applicable Policies and Legal Framework

The Livelihood Restoration Plan (LRP) is formulated based on the World Bank's Environmental and Social Framework (ESF), and relevant provincial regulation. While Pakistan's law does not mandate livelihood restoration, the ESS1 recognizes the need for it when projects negatively impact people's means of making a living. The Sindh Resettlement and Rehabilitation (R&R) Policy 2022 and subsequent revised version 30th Jan 2023 addresses displacement caused by development projects, providing guidelines for compensation and rehabilitation. The LRP aims to restore the economic and social status of vulnerable households affected by SWEEP, with principles including minimizing adverse impacts, consulting affected persons, assisting vulnerable groups, providing skill enhancement and education opportunities for children, and monitoring livelihood restoration activities.

Range of Livelihood Impacts from Subprojects under Preparation

This LRP covers the subprojects currently being prepared, (specifically sub-components 2.2, & 2.3) including the development of a sanitary landfill at Jam Chakro and the upgradation of five transfer stations in Karachi.

The Jam Chakro waste disposal site covers 500 acres and includes two informal settlements. Waste disposal operations at this site will undergo improvements through the construction of new sanitary landfill cells within the boundaries of the disposal site. While this upgrade enhances the safety and living conditions for waste pickers in the area, it adversely affects 660 households, comprising 1,067 individuals who depend on waste picking for their livelihoods.

Similarly, operations are already underway at the GTS sites in consideration, where they currently exist as open dumping sites where waste from nearby areas is temporarily placed before being hauled away to the landfill sites. Being open sites, waste pickers are able to easily access these sites and pick recyclable materials for sale.

There are social risks associated with the development of the GTS' and Jam Chakro sites. These include potential conflicts over resources, restricted mobility in the area, potential community health and safety risks, traffic congestion, and social and cultural issues. At Jam Chakro, the livelihoods of waste pickers operating at the dumpsite may get impacted upon the start of landfilling operation. At transfer station sites, there also exists the potential of discrimination in the case of Afghan refugees who are generally wary about interacting with government administration.

To mitigate these impacts and particularly their relation to the Affected Persons (APs) ability to continue their livelihood practices, this LRP has been developed, encompassing training, resource allocation, and facilitating formal employment opportunities. The project also aims to enhance efficiency in waste management operations by constructing and upgrading garbage transfer stations, while ensuring waste pickers continue to have uninterrupted access to designated areas for material recovery. Personal protective equipment (PPE) and required amenities such as washing areas will be provided at the transfer stations to ensure the safety of waste pickers.

Baseline Socioeconomic Profile of APs

Waste pickers at the Jam Chakro disposal site in Karachi come from diverse backgrounds, including lower socioeconomic strata, religious minorities, and marginalized communities. A census survey revealed that out of the 3,448 residents, 1,067 individuals (31%) engage in waste picking as their primary source of livelihood. These waste pickers represent various ethnicities and include people with disabilities and children. The community faces economic challenges as all households fall below the poverty line. Waste pickers salvage recyclables from fresh waste deposited at the site, contributing to waste management and recycling efforts.

A socioeconomic survey examined waste pickers at garbage transfer station (GTS) sites in Karachi. Waste picking is a common occupation among the lowest socioeconomic groups, which include Afghan refugees. The survey observed waste pickers at three GTS sites over a two-week period and provided insights into their socioeconomic conditions. Some waste pickers were unwilling to participate in the survey, due to concerns around privacy, and wariness about authorities and law enforcement agencies in the case of Afghan waste pickers.

Consultations with Stakeholders

Stakeholder engagement and inclusive consultations were undertaken for the subprojects. The objectives of these consultations include addressing stakeholders' concerns, informing them about the project, maximizing benefits, involving the public in decision-making, promoting transparency, and ensuring sustainability. Stakeholders identified include affected communities, waste pickers, vocational training institutes, and NGOs. Public consultations with affected parties were conducted to gather feedback and ensure the inclusion of vulnerable groups.

Consultation meetings with NGOs and institutions aimed to learn about their prior experience of working with vulnerable groups/communities and establish linkages and partnerships for the restoration of livelihoods in Jam Chakro and GTS sites. Discussions included customized vocational training program development, capacity assessment of NGOs and training institutes, policy advocacy, and strategies for social mobilization, stakeholder engagement and inclusiveness in addressing societal needs.

Livelihood Restoration Measures

The strategies proposed to restore livelihoods for those affected by the LFS, including training, capacity-building, and alternative employment options. A collaborative approach involving affected waste pickers ensures their inputs and aspirations are considered. The Training Needs Assessment (TNA) identified required skills, preferences, and vulnerabilities to plan effective measures. By addressing these needs, the aim is to enhance economic independence, improve quality of life, and prevent gender-based violence.

The TNA revealed that 90% of females preferred tailoring, while males showed interest in construction and driving. Socio-cultural factors influenced these choices, with women favoring

traditional roles and men seeking immediate income. Poverty also influenced decisions, deterring entrepreneurial pursuits. Contextual factors played a significant role in occupation preferences. Contextual factors like societal norms and economic conditions influenced their choices.

Eligibility and Entitlement

Compensation eligibility for APs of LFS is determined by a cut-off date, and all affected waste pickers are issued unique identification numbers. TNA data categorizes waste pickers, and entitlements include training, education assistance, income support for vulnerable groups, and assisting in registration in social protection programs. Vocational institutes will customize training programs to considering illiteracy and age factors. Assistance for waste pickers at GTS sites includes providing PPE, establishing linkages for recycling and upcycling, and advocating for inclusive policies. Collaboration with stakeholders ensures comprehensive support and policy engagement for waste-picking refugees.

Grievance Redressal for Livelihood Restoration

The Grievance Redress Mechanism (GRM) is an essential part of SWEEP, ensuring effective handling of concerns and complaints. A project specific GRM has been established, and all grievances will be documented and recorded. A web-based platform will be linked with already existing system of Sindh Solid Waste Management Board for convenient complaint lodging. Complaints will be addressed within the project's framework, and further escalation options are available if needed. Procedural components related to livelihood restoration are outlined in the main GRM document. Detailed information is provided in the SWEEP GRM document.

Implementation of the LRP

The implementation of the LRP involves various key actors and responsibilities. The SWEEP Implementation Unit (PIU) and the PIU-E&S team are responsible for compliance, coordination, grievance redressal, training programs, and liaison with waste pickers. An LRP implementing firm (LRPIF) and an NGO will be engaged to coordinate with the PIU and carry out the LRP. The implementation schedule of the LRP is contingent on clearance from the World Bank, and activities will be aligned with project goals and timelines. Collaboration between SWEEP and the LRP implementing firm will be facilitated through a dedicated database for transparency and monitoring.

LRP Budget

The cost of preparation and implementation of LRP, including the cost of vocational training, IEC material logistics, provision of toolkits and administration, will be part of the overall budget of the Project. SWEEP will be responsible for securing the project-related financing. The overall budget for the LRP implementation is estimated PKR 247.51 million.

Monitoring and Evaluation

Monitoring and evaluation are crucial for assessing the achievements of livelihood restoration objectives. Internal monitoring, carried out by the project's Social Safeguard Staff, includes administrative, socio-economic, and impact evaluation monitoring to assess progress and adjust the work program. External monitoring is conducted by an Independent Monitoring Consultant (IMC) to review LRP implementation, evaluate objective achievement, identify gaps, and propose remedial measures. The monitoring activities ensure compliance, effectiveness of mitigation measures, and adherence to social and livelihood restoration requirements.

1 INTRODUCTION

Context

1. In Karachi, waste management is a pressing issue, with the city generating more than 10,000 metric tons of solid waste daily. The Sindh Solid Waste Management Board (SSWMB) has engaged contractors for the collection of solid waste across the city. This includes door-to-door collection from the majority of households, lifting of waste from designated primary collection points, and street sweeping and cleaning operations. The waste collected is transported to designated GTSs in Karachi, from where it is further moved to the Jam Chakro and Gondpass open dumping sites.

2. The informal sector plays a significant role in waste value chains, particularly through the involvement of waste pickers who collect and sort recyclable materials. Karachi's informal sector is substantial, accounting for a large portion of the city's workforce. Within this sector, waste picking provides a source of livelihood for many individuals. The involvement of waste pickers in the informal waste management sector is intertwined with their livelihood restoration. Through waste picking, they earn an income to support themselves and their families. However, the proposed improvement of the solid waste management system will affect the livelihood of some waste pickers. It is imperative to implement measures that simultaneously address the city's waste management challenges and restore the livelihoods of any waste pickers affected.

Subproject Description

3. The government of Sindh (GoS), through the SSWMB, initiated a four-year project (2021-2025), the Solid Waste Emergency and Efficiency Project (SWEEP) for Karachi. The primary focus under the project is the improvement of backbone infrastructure for waste management in the city. A Project Implementation Unit (SWEEP-PIU) has been established to execute these sub-projects.

4. The first phase of subprojects under SWEEP are being prepared and these works are expected to be tendered out in 2023. The investments under the first phase will include: Construction of a Landfill Site (LFS) at Jam Chakro along with five Garbage Transfer Stations (GTS). Further subprojects under SWEEP, including a new landfill facility and waste management infrastructure for non-municipal waste, will be prepared and implemented later. This LRP is developed for the LFS at Jam Chakro and GTS sites mentioned above.

5. The Jam Chakro disposal site is in Bund Murad, Mangho Pir, District Council Gadap Town, District Karachi West. There are five sites identified for GTSs, near Sharafi Goth, Dinga Morr, Imtiaz Store, Gutter Baghicha, and Sohrab Goth. The proposed GTS sites are already in use for interim storage and transportation of waste except Sohrab Goth. Three of the sites have open access and are accessed by informal waste pickers who sort and collect valuables from the waste.

6. The subprojects may cause livelihood impacts on the community of waste-pickers settled at the Jam Chakro disposal site as well as the livelihood implications for waste pickers who currently earn their income from the existing transfer stations in the city.

7. No land will be acquired since it is already owned by the Sindh government. There have been no recent anti-encroachment operations at any of the proposed sites and no removal of encroachment is envisaged.

Objectives of LRP

8. The overall objective of LRP is to provide a comprehensive plan for restoration of livelihood for the people affected due to subproject interventions at Jam Chakro LFS and GTSs sites to restore and improve their livelihoods to pre-project levels. The specific objectives of this LRP are to:

- Analyze livelihoods impacts/risks and explore livelihoods options in consultations with Affected Person (APs.)
- Enhance/increase income level of APs including vulnerable groups with particular focus on women
- Strategize and recommend livelihood restoration measures for the APs and prepare an livelihoods restoration plan implementable plan.

9. This involves identifying and assessing potential social impacts on vulnerable and marginalized groups, engaging with affected communities and stakeholders to understand their needs and concerns, designing and implementing measures to manage and mitigate negative impacts, promoting positive social outcomes, and monitoring and evaluating the plan's effectiveness in meeting the needs of affected communities.

10. The document is prepared in line with principles and requirements reflected in the Environmental and Social Standard of World Bank and Sindh Resettlement & Rehabilitation Policy, 2022 Revised Version 30th January 2023, and to consummate the contractual obligation between the world bank and SSWMB.

Rationale for LRP

11. In accordance with ESF, a Livelihood Restoration Plan (LRP) is required for the subproject involving economic displacement through loss of income irrespective of scale and magnitude of impacts. ESF recognizes that project-related interventions can have adverse impacts on communities and persons. Project-related interventions may cause economic displacement, leading to loss of income sources.

12. The LRP will cover economic losses that result from the subproject and establish the detailed compensation and administration budgets, as well as an implementation schedule linking rehabilitation tasks to the inception of civil works. The LRP has been prepared in accordance with the principles included in this World Bank, ESF.

13. The SSWMB, as the Executing Agency (EA) through SWEEP, is committed to compensate project social impacts, to improve or at least restore livelihoods of APs and to minimize or mitigate other negative social impacts. This document identifies the principles, measures and procedures that will be used to fulfill this commitment. The LRP starts during planning, continues during construction and extends throughout operation of the project. This document incorporates findings from a series of assessments. The LRP has been prepared through intensive consultation with waste pickers and local residents.

14. This LRP was prepared by the ESIA Consultant in coordination with PIU-SWEEP and is designed in accordance with the World Bank's ESF and applicable laws and regulations of Pakistan and the Sindh Province. This LRP has been developed for subprojects that entail impact on livelihoods. Apart from meeting World Bank requirements, the LRP defines the legal and policy framework, eligibility criteria and entitlements for project affected persons (APs) and, as required, to ensure livelihood restoration, and rehabilitation. In particular, the eligibility criteria

for APs, entitlements, modes of compensation and rehabilitation, participation and consultation procedures and grievance redress mechanisms are defined.

Methodology and Approach

15. The data collection approach for preparing this LRP employed a combination of qualitative and quantitative methods. This involved reviewing project documents, assessing the current livelihood situation of APs, conducting focus group discussions, socio-economic and census surveys, creating an entitlement matrix, and identifying the capacity needs of waste pickers. The purpose of these measures was to gain valuable insights into the impact of the project on APs, aiming to restore their livelihoods and enhance their income-earning potential. The ultimate goal of the LRP was to transition waste pickers to a healthier and safer working environment that would afford them dignity, thereby facilitating a positive change for APs.

2 APPLICABLE POLICIES AND LEGAL FRAMEWORK

16. According to the World Bank's Environmental and Social Framework (ESF), it is necessary to consider livelihood restoration measures when project activities have a detrimental impact on people's means of making a living. Consequently, following a comprehensive social impact assessment and extensive consultations with APs and other stakeholders, a LRP has been formulated to ensure the sustainable restoration of livelihoods for the vulnerable APs.

17. The ESF aims to help APs enhance or restore their previous living standards, income, and production levels. While the restoration of livelihoods is not mandated by Pakistan's law, the Sindh Resettlement and Rehabilitation (R&R) Policy 2022 introduced by the Government of Sindh in Pakistan aims to address displacement caused by development projects, natural disasters, and eviction drives. The policy provides guidelines for minimizing displacement, providing compensation, and facilitating rehabilitation for affected populations. Its key objective is to minimize displacement by exploring alternative options and providing compensation at replacement cost for acquired or affected assets. Special attention is given to vulnerable groups. It fills gaps in existing laws, emphasizing consultation, participation, transparency, and grievance redressal mechanisms.

18. The Sindh Prohibition of Employment of Children Act, 2017, prohibits the employment of children in hazardous work listed in the Act's Schedule. This includes all forms of scavenging, including hospital waste, as stated in sections 3(1) and 3(2) of the Act. Consequently, children under the age of 15 are classified separately and will not receive livelihood assistance or training. Instead, they will be provided with education assistance through projects and other interventions.

19. The following rehabilitation policy was developed for the SWEEP subprojects.

The Project Livelihood Restoration Policy

20. SWEEP's LRP is developed with reference to World Bank's standards and provincial regulations. The basic objective of income and livelihood restoration and improvement activities is to restore the economic and social status of the economically displaced vulnerable households to at least pre-project level or better, in line with the requirements of WB ESF.

21. The Project's guiding principles for livelihood restoration are as follows:

- LRP is designed to minimize adverse impacts on livelihood;
- Support for alternative livelihoods that describes feasible arrangements for obtaining employment including provision of relevant supplemental assistance including skills training.
- Special assistance to female headed households, minorities, the elderly, or persons with disabilities to ensure their participation in livelihoods restoration interventions.
- Consideration of economic development opportunities which may include preferential employment arrangements during construction and operational phase.
- LRP provides transitional support to those whose livelihoods is disrupted
- Children will be provided skill enhancement and education opportunities; and
- Livelihood restoration activities will be monitored during Project implementation.

3 PROJECT SOCIAL IMPACTS

Subproject Locations and Impacts

Jam Chakro LFS

22. The Jam Chakro disposal site is located in Bund Murad, Mangho Pir, District Council Gadap Town, covers a total land area of 500 acres and includes two settlements, Umar Goth and Ibrahim Goth. The project does not include or anticipate private land acquisition as the proposed infrastructure will be constructed on public land. However, there are livelihood impacts on, encroachers as new sanitary landfill cells are planned to be constructed within the Jam Chakro disposal site. The purpose of this construction is to enhance safety measures at the dumpsite, rehabilitate areas that have reached their capacity, and improve living conditions and livelihoods for the waste pickers community residing nearby.

23. According to the socioeconomic and census surveys conducted in August 2022 and revised in November 2022 where cutoff date was announced, the Jam Chakro community comprises 3,448 residents who reside in 723 makeshift houses. Among this population, 660 households (HHs) comprising of 1,067 individuals (31%) rely on waste picking as their primary source of livelihood and core skill. These families have also involved their children in waste picking activities. Out of the 1,067 waste pickers, 12 are differently-abled, 107 are children, 841 are male, and 226 are female.

24. The large haulers deposit waste at Jam Chakro, majority of which is transferred from the GTS sites in the city. Waste pickers at Jam Chakro salvage recyclable items from waste, carrying out their essential role although very limited, in the waste management process. Unfortunately, these waste pickers encounter notable obstacles and vulnerabilities in their efforts to earn a living through waste collection.

25. The LRP has been developed to mitigate the livelihood impact on residents of the Jam Chakro disposal site. The LRP encompasses measures to mitigate the impacts and give alternative opportunities to garbage pickers at the Jam Chakro.

26. The closure of the existing dumping area in Jam Chakro is scheduled to begin around 2025, aligning with the construction period. Presently, the existing dumping site serves as a means of livelihood for 1,067 APs who engage in waste picking. Although the new landfill cells will be inaccessible to waste pickers due to health and safety considerations, provisions will be made to enable them to recover recyclables from the dumpsite during the transition phase which is expected to be one a half year. Moreover, comprehensive support will be provided to the waste pickers through training, allocation of resources, and facilitation of formal employment opportunities.

Garbage Transfer Stations (GTSs)

27. The project will focus on constructing transfer stations to enhance the efficiency of waste management services and facilitate waste transportation. The project financing will support the implementation of these initiatives, leading to a cleaner and more sustainable environment. The following GTSs are planned to be constructed with the project financing.

i. GTS Dinga Morr – Gulberg Zone – District Central
ii. GTS Gutter Baghicha – SITE Zone – District West
iii. GTS Imtiaz – Korangi Zone – District Korangi

iv. GTS Sharafi Goth – Landhi Zone – District Malir
v. GTS Sohrab Goth – Gulshan Zone – District East

28. Out of the five GTSs, four are currently operational: Imtiaz, Sharafi Goth, Gutter Baghicha, and Dinga Morr. However, Sohrab Goth is currently non-operational. Among these five operational GTS, waste picking activities are carried out only at three of them.

29. These GTSs are owned by the government and do not require land acquisition or resettlement. Waste pickers will have uninterrupted access to recover and sort waste, even during construction and afterwards in the designated areas of the GTSs. To ensure the health and safety of waste pickers and smooth operation of the transfer stations, they will be provided with appropriate personal protective equipment (PPE). This initiative aims to improve occupational safety standards and ensure uninterrupted functioning of the transfer stations.

4 BASELINE SOCIO-ECONOMIC PROFILE OF APS

30. A complete census survey and TNA of Jam Chakro was conducted. The socioeconomic profile of waste pickers was also conducted at GTS sites. These surveys served as valuable tools for gathering crucial information about the waste pickers, covering their demographic characteristics, living conditions, income levels, skills, and other relevant factors. These surveys provided insights into the specific needs and obstacles faced by waste pickers, and helped to develop targeted interventions and strategies aimed at enhancing their socioeconomic well-being.

Jam Chakro LFS

31. Waste pickers at Jam Chakro disposal site come from diverse socioeconomic and ethnic backgrounds. This occupation tends to attract individuals from lower socioeconomic strata - Sindhis, Balochis and Brohi communities including religious minorities, such as Hindus including Kolhi, Kachi, and Jogi are living in the area. Factors such as poverty, limited employment options, and displacement often lead individuals to engage in waste picking as a means of survival.

32. The survey unveiled that Jam Chakro is home to 3,448 residents, residing in 723 makeshift/thatched houses in the vicinity. Among the total, 1067 individuals from 660 households were interviewed, who are directly involved in waste picking activities at the Jam Chakro Site, while the remaining residents are engaged in various occupations such as house jobs, trading/business, labor work, contractual jobs, driving, and others. Waste picking is not only their primary source of livelihood but also the skill they possess. Additionally, these families have also included their children in waste picking activities. The Master Data Sheet prepared from the census survey is provided as **Annex I.**

33. Out of the total 1,067 waste pickers, there are 12 individuals with disabilities, 107 children, 841 males, and 226 females. This breakdown underscores the diverse composition of waste pickers within the community. Following are the significant economic challenges faced by the residents.

34. The socioeconomic details of waste pickers around Jam Chakro are provided below.

Demographic Profile of HHs

Table 4.1: Population and Family Size

Family Size	No. of HH	Total Members
1	421	421
2	142	284
3	57	171
4	20	80
5	13	65
6	5	30
8	2	16
Total	**660**	**1,067**

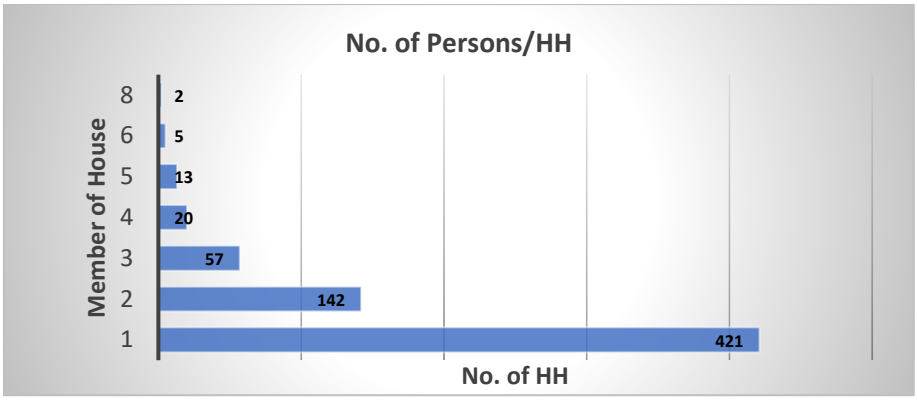


Figure 4.1: Family Size and Houses

35. The data implies a skewed distribution of family sizes, with a larger number of smaller households and fewer larger households. This suggests that a significant portion of the population lives alone or in smaller family units.

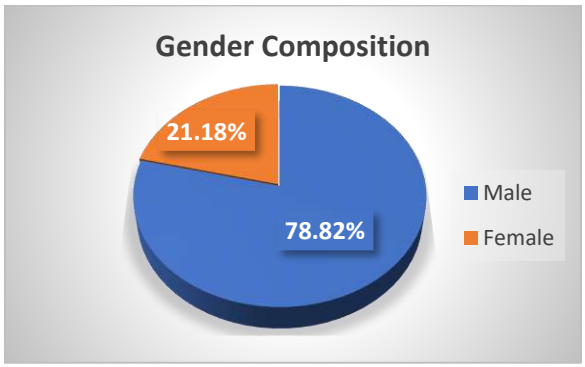


Figure 4.2: Gender Composition

Characteristics of the Heads of HHs

36. Regarding age distribution, majority of the family heads was in active age group, as shown in Figure 4.3.

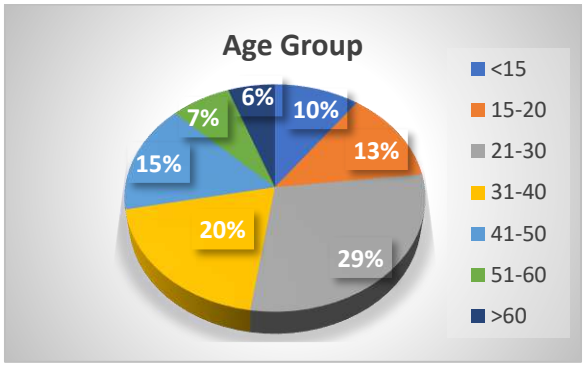


Figure 4.3: Age Group

Table 4.2: Literacy Rate

Education Level	Details	
	No.	Percentage
Intermediate	2	0.19%
Secondary	5	0.47%
Middle	18	1.69%

Primary	35	3.28%
Illiterate	1,007	94.38%
Total	**1,067**	**100.00%**

37. The above table highlights a significant prevalence of illiteracy within the population, with a small percentage of individuals having completed primary education and an even smaller percentage attaining higher education levels.

Table 4.3: Summary of Waste Pickers around Jam Chakro Dumpsite

Category APs	Total	Male	Female
Waste Pickers (total)	1067	841	226
Age < 15 years (children)	107	72	35
Differently Abled	12	10	2
Waste Dealers	14	14	-

Household Income

38. Out of 1,067 of waste pickers at Jam Chakro, the majority of the individuals in the area have a very low-income level with 95% of waste pickers reporting having a monthly income up to PKR. 15,000 while only 5% reported having an income above PKR 15,000. Many waste pickers reported that monthly expenditure slightly exceeds the PKR, 15,000. Most of the monthly waste pickers expenditure is spent mostly on food, health services and medicines.

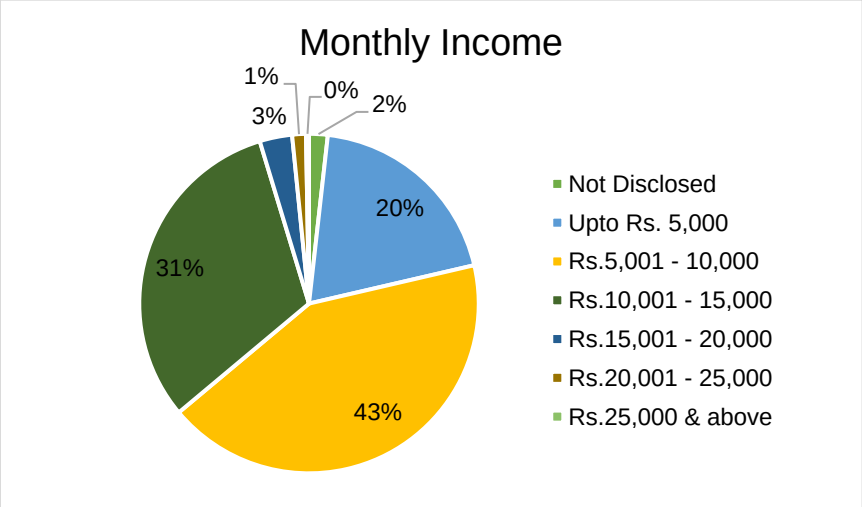


Figure 4.4: Monthly Income of Waste Pickers

39. The household surveys suggests that 100% local residents have access to the schools run by Idara Al-Khair, whereas in addition, 1% send their children to religious, government schools and vocational institutes. The area people are very poor so they cannot afford the expenses of private schools and prefer to send their children to Idara Al-Khair school.

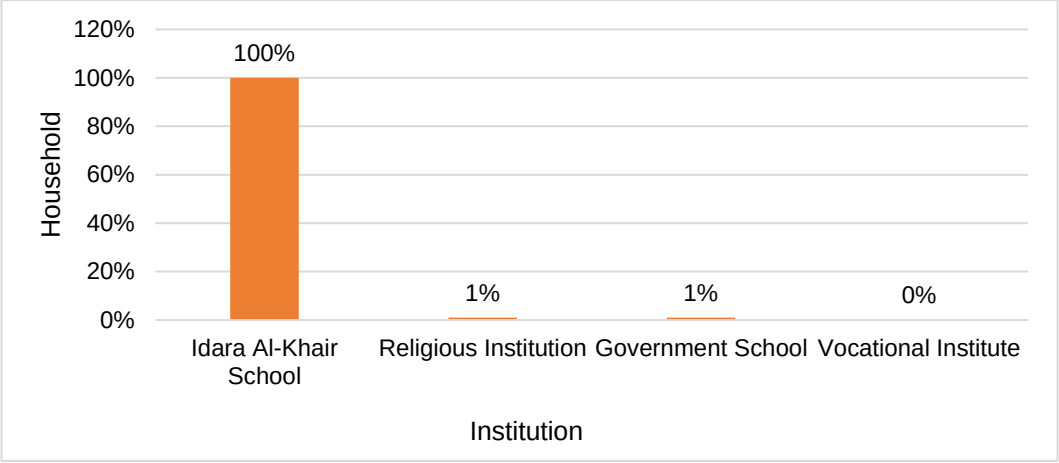


Figure 4.5: Access to Primary Education

40. Out of 1,067 waste pickers, aged 15 years old and above, the majority of the Individuals (85%) are not educated, with 94.38% illiterate. The highest level of education was found as Secondary which was found at 0.47% in the waste pickers. Only 3.28% got primary education while 1.69% got middle education. Several reasons were reported for not attending school by respondents; most people cited an inability to afford education expenses. Other reasons mentioned, included seasonal and weather-related migration time-to-time, poverty and lack of school facilities and schools being at far distance.

41. Around 1% of the surveyed waste pickers reported having physical disabilities like deaf and dumb. This group was considered most vulnerable in the village. Some of them are head of households and supported financially and are bread earners for family.

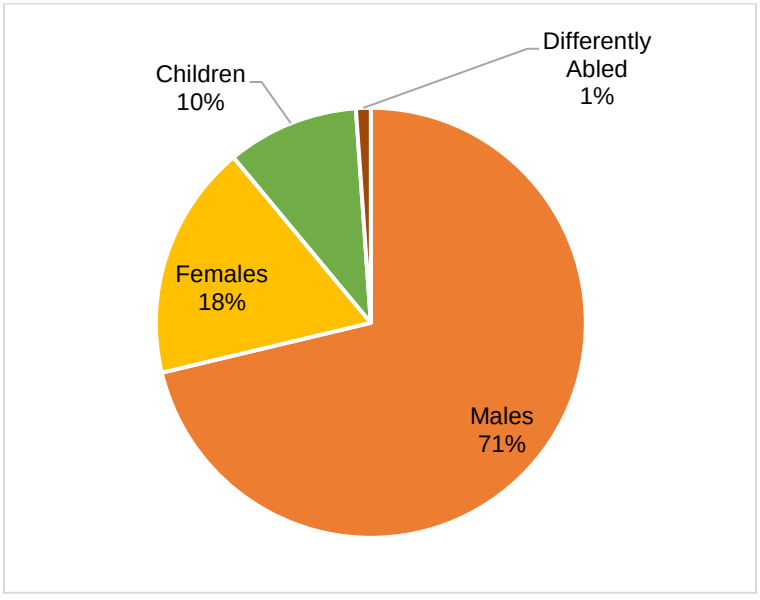


Figure 4.6: Breakdown of AP Groups

42. There are no formal organizations present in the Jam Chakro disposal site or any of the GTS site, representing waste pickers.

Garbage Transfer Stations

43. A Socioeconomic Survey was conducted to examine the current economic conditions of waste pickers at the GTS sites. The majority of these waste pickers are Afghan citizens without legal rights or citizenship in Pakistan. However, they are registered with the Government of Pakistan and possess Afghan Citizen Identity Cards. These scavengers typically work independently and lack protection from both contractors and the state. They lack representation through trade unions or a common platform. Due to the fear of repatriation and involvement in such activities, many waste pickers in Karachi do not possess Afghan Citizen Identity Cards.

44. A survey was conducted at three open-air garbage transfer station (GTS) sites in Karachi: Dinga Morr, Gutter Baghicha, and Imtiaz. These sites are frequently visited by waste pickers. The survey observed the number of waste pickers present at each site throughout different parts of the day over a two-week period.

45. During the socioeconomic survey only 89 waste pickers who voluntarily participated in the survey. The findings of the survey provide insights into their socioeconomic conditions. The questionnaire used in the survey is provided as **Annex II**.

46. It is worth noting that waste pickers of Afghan origin, face harassment from the police due to suspicions of involvement in street crimes. Consequently, many of them were reluctant to share their personal data during the survey, leading to a non-responsive status for some participants.

47. Upon engaging with the waste pickers who were willing to share information, additional details were gathered to gain a deeper understanding of their activities and the link between their livelihoods and the GTS sites. The obtained data is presented as follows:

Table 4.4: Estimated Number of Waste Pickers at Project Sites

GTS Site	No. Of Pickers Identified	No. of Pickers Responsive to Survey
Dinga Morr	23	06
Imtiaz	225	58
Gutter Baghicha	38	25
Total	**286**	**89**

Table 4.5: Age of Waste Pickers

Age	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	89	**100%**	**6**	**100%**	**25**	**100%**	**58**	**100%**
07-14	17	17%	4	67%	3	12%	10	17%
15-25	48	53%	1	17%	15	60%	32	55%
26-35	18	25%	1	17%	5	20%	12	21%
36-45	3	3%	0	0%	0	0%	3	5%
46 & above	3	3%	0	0%	2	8%	1	2%

48. The data shows that 53% of the waste pickers belong to the age group of 15-25, while 28% belong to 26-45 age group and 03 % belong to the age group 46 and above years old. It is clear that the majority of the waste pickers, 75%, are below 25 years old. Child labor (17%) was engaged in the waste picking activities.

49. This distribution show that most of the respondents belonged to school going age class of the society.

Table 4.6: Literacy Rates of Waste Pickers

Education	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
Total	**89**	**100%**	**6**	**100%**	**25**	**100%**	**58**	**100%**
Illiterate	67	76%	6	100%	23	92%	38	66%
Primary	15	16%	0	0%	2	8%	13	22%
Matric	4	5%	0	0%	0	0%	4	7%
Intermediate	1	1%	0	0%	0	0%	1	2%
Graduate	1	1%	0	0%	0	0%	1	2%
Can read Quran	1	1%	0	0%	0	0%	1	2%

50. Out of 89 individuals, majority of (76%) were not educated, with highest literacy in Gutter Baghicha 92%. GTS Imtiaz site scavengers received no education at all from primary to graduate, whereas Dinga Morr, literacy rate is zero (0%), Gutter Baghicha respondent got only (8%) primary level education rest the others level in zero.

51. Several reasons were reported for not attending the school by respondents; majority people mentioned registration issues in national identification certificate and birth certificate.

Table 4.7: No. of Dependents in the Family of Waste Pickers

Dependents	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	89	**100%**	**6**	**100%**	**25**	**100%**	**58**	**100%**
01-03	11	11%	0	0%	3	12%	8	14%
04-06	20	24%	0	0%	6	24%	14	24%
07-10	34	37%	1	17%	7	28%	26	45%
11-15	20	20%	5	83%	8	32%	7	12%
16 & above	4	9%	0	0%	1	4%	3	5%

52. 11% of the waste pickers have 1-3 depends members in the family, 24% of the waste pickers have 4-6 depends members in the family, (37%) of the waste pickers have 7-10 depends members in the family, 20% of the waste pickers have 11-15 depends members in the family, while % have 16 & above depends members in the family.

Table 4.8: Key Expenses for Waste Pickers

Expenditure Heads	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	89	**100%**	**6**	**100%**	**25**	**100%**	**58**	**100%**
Grocery/Food	89	100%	6	100%	25	100%	58	100%
House Rent	65	72%	6	100%	11	44%	48	83%
Transportation	34	39%	0	0%	12	48%	22	38%
Utilities	28	33%	6	100%	1	4%	21	36%
Clothing	22	29%	0	0%	8	32%	14	24%
Health/ Medicines	10	14%	0	0%	6	24%	4	7%
Drinking water	4	5%	0	0%	0	0%	4	7%
Education	1	1%	0	0%	0	0%	1	2%

*Note: pickers answered affirmatively to more than 1 item.

53. The expenditure patterns of waste pickers reveal that their priorities are primarily focused on basic needs. Food and groceries make up 100% of their expenses, followed by house rent at 72%, transportation at 39%, and utilities at 33%. A smaller percentage is allocated to clothing, health/medicines, and drinking water. Unfortunately, education receives only 1% of their

expenditure, suggesting a lack of emphasis on educational opportunities. However, it is crucial to address this issue and provide access to education as it plays a crucial role in breaking the cycle of poverty and empowering waste pickers for a better future.

Table 4.9: Waste Pickers Average Monthly Expenditure

Expenditure Amount	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	89	**100%**	**6**	**100%**	**25**	**100%**	**58**	**100%**
Up to 15,000	7	7%	0	0%	5	20%	2	3%
15,001 - 25,000	29	30%	0	0%	9	36%	20	34%
25,001 - 35,000	27	29%	3	50%	7	28%	17	29%
35,001 - 50,000	13	18%	3	50%	2	8%	8	14%
50,000 +	13	16%	0	0%	2	8%	11	19%

54. Out of 89, very few (7%) households in the area have monthly expenses up to 15000, (30%) of the waste pickers have monthly expenses between 15,000-25,000, 29% of the waste pickers have monthly expenses between 25,001-35,000,18% of the waste pickers have monthly expenses between 35,001-50,000, while (16%) of the waster pickers have monthly expenses of 50,000 or above it.

Table 4.10: Alternate Jobs Held by Waste Pickers

Type of Other Work	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	6	100%	0	0%	1	100%	5	100%
Driver	3	50%	0	0%	1	100%	2	40%
Daily wages work	1	17%	0	0%	0	0%	1	20%
Packing/ Cutting work in factory	1	17%	0	0%	0	0%	1	20%
Samosa seller	1	17%	0	0%	0	0%	1	20%

55. Only (6%) waste pickers used to work as an employee in factory, skilled work like driver and another one waste picker used to work in daily wages, while (94%) were depended only on waste collecting from the sites. It clears that almost all the waste pickers have been engaged in waste picking activity as their main work/job from the start for obtaining their earning. Their opinion is that they preferred waste picking because of good earning compared to their previous jobs and less hard work.

Table 4.11: Monthly Income from Selling of Recyclables

Earning Amount	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	89	100%	6	100%	25	100%	58	100%
10,000 - 15,000	18	18%	3	50%	8	32%	7	12%
15,001 - 20,000	14	16%	0	0%	7	28%	7	12%
21,000 - 25,000	25	33%	2	33%	7	28%	16	28%
26,000 - 30,000	23	25%	1	17%	2	8%	20	34%
>30,000	9	9%	0	0%	1	4%	8	14%

56. The monthly income of 89 waste pickers, the income level ranges from the lowest at 10,000 Rs to 15,000 Rs. An average income of waste picker is computed at 30,000 Rs. per person per month.

Table 4.12: Number of Working Family Members of Waste Pickers

Number of Working Members in the Family	Total Respondents		GTS					
			Dinga Morr		Gutter Baghicha		Imtiaz	
	Count	%	Count	%	Count	%	Count	%
	89	**100%**	**6**	**100%**	**25**	**100%**	**58**	**100%**
One	22	45%	1	20%	9	82%	12	38%
Two	16	31%	3	60%	1	9%	12	38%
Three	6	17%	0	0%	0	0%	6	19%
Four	1	2%	0	0%	0	0%	1	3%
Five	2	3%	1	20%	0	0%	1	3%
Six	1	2%	0	0%	1	9%	0	0%

57. According to the data, a significant percentage of waste picker families rely on the income generated from waste picking, with some families having multiple members engaged in this activity. The average daily income from waste picking is around PKR 800-900, and the project aims to improve waste pickers' access to waste without negatively impacting their livelihoods.

5 CONSULTATION WITH STAKEHOLDERS

58. According to the World Bank's ESF, specifically ESS10, stakeholder engagement is essential for conducting systematic and inclusive consultations with the APs and other interested parties. These consultations aim to document their views and concerns while implementing mitigation measures in relation to the construction of a sanitary landfill within the Jam Chakro disposal site and with selected GTSs.

59. The specific objectives of these consultations were as follows:

- Providing a platform for stakeholders to voice their concerns or suggestions to the Project team and foster a collective sense of ownership for the Project activities.
- Informing stakeholders about the proposed project, ensuring they have a clear understanding of its nature and scope.
- Enabling those involved in planning the proposal to ensure that the benefits are maximized and that no significant impacts have been overlooked.
- Allowing the public to positively influence the project design, thereby enhancing its overall outcome.
- Promoting transparency and accountability in decision-making processes.
- Developing a project that is truly sustainable in its approach and implementation.

60. In addition, the consultations aimed to fully share key information about the project with the APs. This exchange of information ensured that the Project team obtained a comprehensive understanding of the needs and proposed priorities of the affected people, as well as feedback on the activities during the project's implementation. Transparency was emphasized in all activities related to livelihood restoration for the affected communities, fostering trust and openness throughout the process.

Stakeholder Identification & Analysis

61. The public consultation and participation processes start by identifying the stakeholders of the Project. Under ESS10, the ESIA Consultant has prepared a detailed Stakeholder Engagement Plan (SEP) to identify the key stakeholders and ensure that all stakeholders are engaged throughout the project. The stakeholders of the subproject were identified through a ‘stakeholder mapping exercise.

62. The range of stakeholders involved in project consultations included the following:

Affected Parties
The community at Jam Chakro including men, women and children and the waste pickers at the GTSs.

Other Interested Parties

- Vocational Training Institutes
- Non-Government Organizations
- Construction Projects and Industrial States

Summary of Consultations with APs

63. A series of public consultations with APs were conducted throughout the planning stage of the project to get the feedback/concerns of both men and women. One of the overarching

pillars of meaningful consultation is the inclusion of vulnerable groups. Consultation Snapshots are provided as **Annex III.**

Consultation with Jam Chakro Community

Table 5.1: Number of Consultations Conducted at Jam Chakro

S#	Types of Consultation/ Meeting	Dates	Number of Participants (males)	Number of Participants (females)
1	Initial Visit of Jam Chakro to meet SSWMB staff and community members, teachers, volunteers	15 April 2022	15	6
2	Pre-census consultations	20 June 2022 to 30 July 2022	22	4
3	Consultations with village elders, political workers and volunteers	13 July 2022	12	-
4	Jam Chakro Household Census Survey	1 August 2022 to 10 August 2022	710	615
5	Jam Chakro Business Community Census Survey	11 August 2022 to 15 August 2022	29	-
6	Consultation with Educational Institutions	30 September 2022	2	8
7	Consultation with Healthcare Facilities	30 September 2022	2	-
8	Follow up of census	13 Oct 2022	12	2
9	Cutoff date information declaration	26 Nov 2022	67	5
10	Focused group discussion with male and females on gender-based violation issues	28 Nov 2022	16	32
11	Pre-skill trade need assessment consultations	3 March 2023	16	2
12	Need assessment consultations	13 March 2023	250	50
13	Training Need Assessment of all APs of Jam Chakro	21st May to 5th June 2023	841	226

Feedback from the Stakeholder and their Addressal

64. The key concerns that emerged from these consultations are summarized below.

Jam Chakro Community

65. A summary of the key concerns expressed by Jam Chakro and GTS waste pickers during consultations meetings are given below:

Concerns Raised	Responses
Waste pickers and residents will be preferred for jobs during construction and operation phase of the Project	It was ensured to community that contractor will prefer locals for skilled and unskilled jobs. A clause will be included in the bidding document to engage local community including women for skilled and unskilled jobs during construction and operations phases.
Women of the area are already making *Rillies* (Sindhi style handmade quilts) but they don't have market	NGOs will be approached to create linkages in market and increase their marketing skills

Concerns Raised	Responses
access and required skill to sell their items in market so through this project linkages may be developed and skills to be provided to these women.	in stitching, selecting patterns and color schemes. Linkages with other Mina Bazars/District Municipal Corporation run weekly bazars will be developed to promote their hand made products.
Women also showed interest in rearing Livestock	Training on livestock will be provided to interested women.
Villagers enquired that will be any physical relocation of houses?	It was communicated that there will not be any relocation of houses or resettlement under this project. The PIU will however, continue to analyze and discuss options with residents about how to improve the living standards in the impacted settlement.
Will people with their livelihoods connected to waste picking not be affected? Or if there will be a loss of current livelihood, will it be compensated in kind to ensure similar or better opportunities of livelihood?	It was informed that the project is working to facilitate in providing skills to restore livelihood. A livelihood Restoration Plan will be prepared in this respect.
Community also informed that SWWMB Contractors at LFS have also hired people from their community, therefore any upcoming contractor must hire them for such jobs such as Sweeping of roads/streets, door to door waste collection?	It was informed that contractor will give first priority to locals for skilled and unskilled jobs including women.
Engaging in construction/housing societies	Efforts will be made to create linkages to engage/hire these waste pickers in nearby construction activities.
APs also shared that they are more inclined to work on daily wage/physical work (*khuli mazdoori*) rather than some very technical work	They were informed that subject to their choice and interest they will be engaged in skill improvement plan
Consultation with Waste Pickers at GTS Sites	
The residents demanded the authority to develop a proper boundary wall for the GTS site and ensure no drivers are allowed to dump waste outside the boundary walls	Agreed and it was informed that GTS design include the boundary walls.
The waste pickers looked favorably upon the project and expressed their desire to join the SSWMB as official employees in the project area. Afghan immigrants should be provided with some legal rights and should be hired as official workers of SSWMB in various GTS stations, Land Fill Sites and in Waste Collection Process itself.	It is beyond the project capacity to get them hired in SSWMB. They will have access to GTS sites
Authority should engage NGOs/CSOs arranging and implementing a behavioral change and mobilization campaign around waste segregation and management with a focus on clean and green initiatives to aid the SSWMB.	Agreed, SSWMB is also working on sensitization of masses to keep the city clean through its different campaigns.

Consultation with NGO and Vocational Training Institutes

66. Consultation meeting were conducted with different institutions including NGOs to identify and establish the possible linkages to facilitate affected people of Jam Chakro LFS and GTS sites. These meetings focused on fostering collaboration and establishing partnerships to aid in the restoration of livelihoods for APs. Additionally, discussions were held regarding the development and implementation of vocational training programs, encompassing tasks such as curriculum design, training methodologies, evaluation frameworks, and program logistics coordination. The capacities of NGOs and Vocational Training Institutes to deliver quality vocational training programs were assessed, and efforts were made to support policy advocacy

for APs. Furthermore, strategies were explored to engage stakeholders, influence policy decisions, and emphasize inclusiveness in addressing societal needs.

67. The following is a list of NGOs and institutes with which meetings were conducted:

S. No	Organization/Institute Name	Remarks/Feedback
1	ZVMG-Rangoon Wala Trust (vocational center) HOME – ZVMG Rangoon Wala Trust	The Trust has agreed to work for Jam Chakro by providing customized trainings. It will offer a number of trade-specific trainings to empower individuals in acquiring the necessary skills and knowledge. Through these trainings, the Trust aims to enhance the employability and livelihood opportunities for the people of Jam Chakro.
2	Initiator Human Development Foundation (NGO) Initiator Human Development Foundation	IHDF has eight years of experience of working with waste pickers, recognizing the importance of their role in waste management and their socio-economic vulnerabilities. The organization aims to provide non-formal education to waste pickers, empowering them with knowledge and skills to improve their livelihoods. IHDF also values the experiences of waste pickers and will incorporate their insights into its programs. Moreover, IHDF will offer socio-psychological counseling to waste pickers, recognizing the potential emotional and mental health challenges they may face. Additionally, health and hygiene sessions will be conducted to educate waste pickers on maintaining their well-being and preventing diseases. IHDF has established links with various organizations, including UNHCR, Red Cross, Women and Children Protection at the Police Station, UNICEF, and PDMA and other organizations working for children and their rights. These collaborations enable IHDF to leverage resources, expertise, and support to further its mission and provide holistic assistance to the beneficiaries it serves.
3	DevCon- An Association for Rural Development (NGO) DevCon – An Association for Rural Development (devconpk.org)	DevCon has agreed to work with Jam Chakro, a specific area, by providing customized trainings tailored to the needs of the local population. These trainings will cover a variety of trades, equipping individuals with the skills necessary to enhance their employment prospects and improve their livelihoods. DevCon has gained valuable working experience in a similar category in the Korangi industrial area. This experience has provided them with insights and knowledge that can be applied to their work in Jam Chakro, enhancing their ability to address the specific challenges and requirements of the area. In addition, DevCon has successfully linked around 4000 workers with factories, creating valuable employment opportunities and contributing to the economic growth in District Korangi. This accomplishment highlights their ability to establish meaningful connections between job seekers and potential employers.
4	The Hunar Foundation (Vocational Training Institute) HUNAR FOUNDATION	THF has expressed its willingness to work at Jam Chakro, indicating its commitment to extend its services and educational programs to the community in that area. The organization aims to provide customized training to cater to the specific needs and aspirations of the individuals in Jam Chakro. By tailoring the training programs, THF can effectively address the requirements of the local population. In addition to providing training, THF also manages transportation and schedules for its students. This ensures that participants have access to the necessary means to attend the

		training sessions conveniently. Furthermore, the organization takes responsibility for managing the training plan and benches, ensuring a structured and organized learning environment for the students. Overall, THF has a commendable track record of delivering vocational programs, and its willingness to expand its efforts to Jam Chakro demonstrates its commitment to reaching and serving marginalized communities. To enhance the paragraph, you could consider providing more information about the specific training programs offered by THF and the impact they have had on the lives of the graduates.
5	MITI- Memon Industrial and Technical Institute (Vocational Training Institute) Memon Industrial & Technical Institute – MITI (wmomiti.com)	THF has expressed its willingness to work at Jam Chakro, indicating its commitment to extend its services and educational programs to the community in that area. The organization aims to provide customized training to cater to the specific needs and aspirations of the individuals in Jam Chakro. By tailoring the training programs, THF can effectively address the requirements of the local population. In addition to providing training, THF also manages transportation and schedules for its students. This ensures that participants have access to the necessary means to attend the training sessions conveniently. Furthermore, the organization takes responsibility for managing the training plan and benches, ensuring a structured and organized learning environment for the students. Overall, THF has a commendable track record of delivering vocational programs, and its willingness to expand its efforts to Jam Chakro demonstrates its commitment to reaching and serving marginalized communities. To enhance the paragraph, you could consider providing more information about the specific training programs offered by THF and the impact they have had on the lives of the graduates.
6	SEF-Sindh Education Foundation (semi-autonomous organization) Sindh Education Foundation (sef.org.pk)	SEF Funded agency to local NGOs on education AALTP Adolescent & Adult learning & Training Program its new program including skills development Program. It can only support through NGOs working for education and for adults and children in nearby areas of Jam Chakro and help in creating linkages with educational institutes for children at GTS sites.
7	SHARP Pakistan - Society for Human Rights and Prisoners' Aid (NGO-UNHCR funded) SHARP PAKISTAN – Society for Human Rights and Prisoners' Aid (sharp-pakistan.org)	Agreed to provide Legal Protection and support liaison for Afghan refugees at GTS with other government agencies and NGOs working for wellbeing of refugees.
8	KVTC- Karachi Vocational Training Centre Vocational Training Centre - KVTC	KVTC work for differently abled persons and children in Karachi they can be engaged for differently abled affected persons of Jam Chakro They agreed to conduct awareness workshops, livelihood engagement and customized vocational training to differently abled persons after basic screening.
9	Vocational Training Institute (Women) VOCATIONAL TRAINING INSTITUTE (WOMEN) – SINDH TECHNICAL	This institute is near Jam Chakro comparatively than other vocational institutes for women. The institute can customize the vocational training for women can provide holistic module for them.

	EDUCATION AND VOCATIONAL TRAINING AUTHORITY (vtiwbzone.edu.pk)	
10	GarbageCAN Sustainable Waste Management (Profitable Organization) https://www.garbagecan.pk/	A sustainable waste management company with a focus on environmentally friendly waste management practices such as reduce, reuse, and recycle. GarbageCAN believe that the garbage CAN be cleaned, and the garbage CAN be recycled.
11	SPARC Society for the Protection of the Rights of the Child (NGO) SPARC - Pakistan's Leading Child Rights Organization (sparcpk.org)	SPARC can provide assistance in education, health and safety and customized vocational trainings to waste pickers specifically children.
12	Health and Nutrition Development Authority (NGO) HANDS: Non-profit organization in Pakistan | Top NGO of Pakistan	HANDS has experience of executing project for waste pickers at Gond Pass (disposal site) a community development project. A consultative meeting was arranged by SWEEP with HANDS regarding their poverty alleviation program for Jam Chakro. HANDS can provide customized vocational training program for waste pickers Jam Chakro.
13	Consultation with Idara Al-Khair Schools	They will provide the facility for vocational trainings for women after school timings and agreed to provide some permanent space women subject to space requested by the LPRIF. PIU SWEEP will ensure a positive and long-term collaboration with the school and LRPIF along with support of Jam Chakro community.
14	Rana Liaqat Craftsmen's Colony https://rlccpk.org/about-rlcc/	RLCC management has agreed to customize vocational trainings for women of their selected trades as proposed by APs of Jam Chakro, they will chalk out detailed plan subject to approval of proposal. They have vast experience of using recyclable material by upscaling and selling different items made from recyclable material.

Consultation with nearby Industries and Residential Settings at Jam Chakro

68. The area around Jam Chakro is experiencing a surge in construction projects, which presents a significant opportunity for both skilled and unskilled laborers. Notable projects such as North Town Residency, North Town Villas, Marva Hill View, and others are currently underway, involving the construction of numerous housing and industrial units. This surge in construction creates a demand for various trades, including masons, electricians, plumbers, carpenters, and more.

69. The purpose of consulting nearby industrial and residential settings in Jam Chakro is to raise awareness about livelihood restoration for waste pickers and explore potential employment opportunities. This involves sensitizing stakeholders, assessing employment potential, identifying suitable trades for training, and establishing partnerships for the integration of trained waste pickers into nearby settings. The overall goal is to enhance livelihood restoration efforts.

70. Following business entities were consulted along with visit and informed them about the purpose of consultation:

Al-Ghafoor Industrial Estate, May 23, 2023

- Meeting with the Contract (infrastructure works) of Al-Ghafoor Industrial Estate was undertaken.
- The project is currently developing major infrastructure and base structures for open plots for industries.
- Hence all the work is undertaken by heavy machinery.
- We need drivers of heavy vehicles as contract basis; however, the work is usually done by sub-contractors.
- It will take time to develop the individual industries and also the hiring in those particular industries.
- It may be possible that future development of industries will create jobs for the locals.

Sky Clan Global (Stone Cutting Factory), May 23, 2023

- M/s Sky Clan Global is a stone / marble cutting factory and having a huge yard in which cutting machines are installed.
- The team had a meeting with the Manager of the factory.
- While providing a brief about the project and agenda of the meeting, the team asked about the hiring for labor work or any other skilled job.
- Manager said that mostly the work is performed by machines, while occasionally, we require daily wage labor for which we contacted nearby villages.
- The team emphasized that any laborious work in future which requires daily wage workers comes up, the trained persons of Jam Chakro will be prioritized.

Ali Town Residency. May 23, 2023

- Meeting with the CEO of Ali Town, a residential housing scheme, was undertaken regarding the livelihood restoration of waste pickers.
- CEO is of the view that major infrastructure works of the scheme has been completed and now the plots are for sale. If any plot owner will require local labor for the construction of the its house, he can contact the us or hire directly.
- We can support, if possible, when the construction labor and skilled labor is required, but right now, we do not commit for their hiring under the project as most of the work is done by contractors.

GFS Builders and Developers, May 23, 2023

- The GFS Builders and Developers are developing North Town Residency – Phase II which is a housing project.
- Meeting with the GFS representatives regarding the livelihood opportunities for Jam Chakro Waste pickers concluded with the follow points:
- The residential scheme is under construction and all the construction work is usually assigned to construction contractor.
- The contractor then only hires their labor for two types of works; a) major construction work in which roads and large infrastructure is built which is usually done by subcontractors via heavy vehicles, so the manual works is not required and b) small daily wage works usually requires when the houses are going to be constructed.
- They have the opinion that if any drivers having heavy vehicle skill can be contracted out with the subcontracted.
- The daily wage workers as well as skilled labor will also be required when houses are to be constructed by owners of the plots. However, it is basically on the need basis.

- If any trained labor work force available in the area, share the details with GFS's Engineering and construction department.

Hamdard Laboratories Factory, May 23, 2023

- Meeting with the in-charge Hamdard Laboratories was undertaken.
- The facility in-charge was reluctant to provide any information or commitment and said that all the matters were dealt by Human Resource Department.

NTR Industrial Zone, June 08, 2023

- The NTR Industrial Zone is in its initial development and marketing stage.
- Met with a clerk, who said that the zone is in its initial stage and definitely after its maturity stage when industries will be developed in the zone, there will be many employment opportunities in construction and technical areas such as electricians, masons, pipe fitters, plumbers etc.

The Pearl Villas, June 08, 2023

- The Marketing Executive informed that the Pearl Villas is a gated community project which will have about 300 housing units and 750 apartments.
- He said, at this stage they are in the marketing and selling stage and development work is going on.
- After that definitely construction phase will be started by main and petty contractors, who will engage skilled and non-skilled laborers, including masons, shuttering contractors, electricians, painters, flooring laborers, carpenters, kitchen makers etc.

North Town Villas, a project of GFS Builders, June 08, 2023

- One senior official informed that; North Town villas is a project of 650 villas of 120 yards.
- He said that boom of construction industry brings employment to hundreds of thousands of people associated with different trades and skills.
- He said GFS are builders are not involved in construction, which is done by numerous contractors, engaged by the plot owners, so there will be a good opportunity for Jam Chakro waste pickers, if they learn new skills seriously and apply them for their livelihood.

Marva Hill View Project, June 08, 2023

- They are a project of 300 Bungalows and 650 apartments and are in development stage.
- Site In charge said that he doesn't have any idea that how many trained workers could be absorbed in the project, but definitely this is good intention on behalf of Sindh government to provide technical training to poor waste pickers so that they can improve their life through training and facilitation. However, he said the will welcome this initiative.

Falaknaz Wonder City, June 08, 2023

- Office assistant said that the project is spread over 450 acres, where 3500 villas and apartment are planned.
- He expressed similar views about employment opportunities for trained waste pickers.

Information Disclosure

71. The LRP will be disclosed at SWEEP, SSWMB, and WB websites in accordance with WB Policy. The executive summary of final LRP will be translated into Urdu and Sindhi for local

disclosure and all versions will be made available at key publicly accessible and convenient locations such as Jam Chakro disposal site and GTSs and office of SSWMB, contractor(s), sub-contractors and other parties involved in the Project implementation. The important aspects of the LRP will be further disclosed to the male and female APs by organizing face-to-face orientation sessions, by the LRPIF through location specific meetings in coordination with PIU-SWEEP.

Consultations with APs during Project Implementation

72. The LRPIF through its consultants will conduct meaningful consultation with APs and other affected groups throughout the project lifecycle. Consultation proceedings will be properly documented. The essential documents will include: date, location, a list of the key issues raised by the participants, agreed actions, photographic records, and list(s) of participants. The minutes of the consultations, together with scanned sign-in sheets of the participants will be included in the monthly and quarterly reports and in the LRP. The data will be disaggregated by gender, with the key information recorded at the top of the minutes, stating the number of participants, the number of men, and the number of female participants.

6 LIVELIHOOD RESTORATION MEASURES

73. This section outlines alternative livelihood options and effective strategies for restoring livelihoods for individuals impacted by the development of the LFS at Jam Chakro and GTS sites. These measures include a range of initiatives designed to provide training, skills development, and capacity-building opportunities for APs.

74. Through a collaborative and participatory approach, the subproject will ensure that the affected waste pickers are actively engaged in the decision-making process. Their inputs, aspirations, and concerns will be considered and integrated during implementation of the proposed livelihood restoration initiatives.

Training Need Assessment (TNA) at Jam Chakro

75. The TNA for all the affected individuals of Jam Chakro was carried out at the Jam Chakro disposal site. The primary objective of this assessment was to thoroughly evaluate the required training and skills necessary for the restoration of livelihoods, as well as to address the adverse impacts on livelihoods resulting from the operations of the LFS. For reference, the questionnaire employed during the TNA survey is attached as **Annex IV**.

76. The specific main objectives of the need assessment were to:

- Determine the preferences for alternative livelihood options through the need assessment process.;
- Assess APs capacities and vulnerabilities; and
- Identify and plan measures to be implemented under the LRP.

77. Through this assessment, the purpose was to gather vital information to devise and execute efficient measures for the LRP. This process entailed identifying the precise requirements and obstacles encountered by the APs while comprehending their current capabilities and vulnerabilities. Additionally, the focus as on exploring their preferences for alternative livelihood options, ensuring that the proposed measures align with their aspirations and interests.

78. Anticipating the required skills would aid in the creation of jobs or self-employment, assist participants in generating income. Increased economic independence and quality of life, especially for women, would lead to an improvement in their standard of living, which would serve as a deterrent to the acceptance of antisocial behavior like gender-based violence (GBV).

Data Analysis of TNA

79. All APs were surveyed and asked about their aspirations for skill training requirements. Below tables represents the counts based on age and gender, training skills required / proposed by APs themselves and options of skills that were offered to APs to learn.

Table 6.1: Respondents Data by Age Composition and Gender

Respondent Age Group	Total Respondents		Gender			
			Male		Female	
	Count	%	Count	%	Count	%
	1067	100%	841	100%	226	100%
33	3%	19	2%	14	6%	7%
74	7%	53	6%	21	9%	11%
64	6%	50	6%	14	6%	33%
220	21%	181	22%	39	17%	37%
279	26%	225	27%	54	24%	8%
190	18%	158	19%	32	14%	0%
117	11%	90	11%	27	12%	4%
Figures are column percentages						
Source: SWEEP: Training Need Assessment Data						

80. While asking their present skills, most of the APs only know the waste picking while few of them know different trades as given in the Table 6.2.

Table 6.2: Present Skills of APs by Gender

	Total Respondents		Gender			
			Male		Female	
	Count	%	Count	%	Count	%
Base: Total Respondents	1067	100%	841	100%	226	100%
Only Waste Picking	1025	96%	804	96%	222	98%
Mason	17	2%	17	2%	0	0%
Labor Work	11	1%	11	1%	0	0%
Driving	4	0%	4	0%	0	0%
Tailoring /Sewing/Cutting of Fashion Dresses	4	0%	0	0%	4	2%
Mechanic (Bike/Car)	2	0%	2	0%	0	0%
Cooking/Food Stalls/Catering Services	2	0%	2	0%	0	0%
Painter	1	0%	1	0%	0	0%
Livestock Management	1	0%	1	0%	0	0%
Figures are column percentages Multiple responses hence the total can be more than 100 *Source: SWEEP: Training Need Assessment Data*						

81. Among the female participants, an overwhelming 90% expressed a strong desire to acquire skills related to tailoring, sewing, and cutting of fashion dresses. On the other hand, the male participants predominantly expressed an interest in labor-intensive work, particularly to be involved in construction such as labor or masonry, as well as driving. However, it's worth noting that a portion of male participants also showed enthusiasm towards vocational skills such as tailoring, electrician work, and mechanics. It is important to highlight that only a small percentage of the APs displayed an inclination towards business-oriented or self-employed related skillsets. Details are given below in the Table 6.3.

Table 6.3: Required Training Skill(s) by Gender (age 15 and above)

Base: Respondents Age 15 & above	Total Respondents		Gender			
			Male		Female	
	Count	%	Count	%	Count	%
	960	**100%**	**769**	**100%**	**191**	**100%**
Driving	211	22%	211	27%	0	0%
Tailoring /Sewing/Cutting of Fashion Dresses	177	18%	6	1%	172	90%
Mason	130	14%	130	17%	0	0%
Mechanic (Bike/Car)	63	7%	63	8%	0	0%
Livestock Management	63	7%	59	8%	4	2%

Electrician	60	6%	60	8%	0	0%
Plumber	40	4%	40	5%	0	0%
Painter	39	4%	39	5%	0	0%
Carpenter/Wood worker	33	3%	33	4%	0	1%
Tire Repairing	31	3%	31	4%	0	0%
Mobile phone repairing	30	3%	30	4%	0	0%
Kitchen garden & Flower Nursery	25	3%	25	3%	0	0%
Cooking/Food Stalls/Catering Services	20	2%	18	2%	2	1%
Rug Making	12	1%	3	0%	9	5%
Poultry Farming	9	1%	7	1%	2	1%
Computer related trainings	9	1%	9	1%	0	0%
None (Respondent demand Jobs only)	5	1%	3	0%	2	1%
Hair Dresser	3	0%	3	0%	0	0%
Figures are column percentages *Multiple responses hence the total can be more than 100* *Source: SWEEP: Training Need Assessment Data*						

82. Out of the total surveyed population for the TNA, only APs aged 18 years and above will be considered for training and remaining will be enrolled for non-formal education. The Consultants also provided the APs a list of various sets of skills and business options and help them to choose a skill different from their initially desired option. It is worth noting that a significant majority, around 84% of the females, decided to pursue tailoring, sewing, or fashion dressmaking skills. On the other hand, the male APs displayed a similar trend, with a majority selecting driving or labor/masonry-related skills.

Key Findings of TNA

83. The women who participated in the survey exhibited a preference for traditional skills over contemporary ones, and this choice can be attributed to various societal factors. These factors include growing up in male-headed family backgrounds, which may have influenced their perceptions and interests, leading them to favor traditionally female-dominated occupations. Additionally, the women may have been disinclined to pursue male-dominated occupations due to cultural and social norms prevalent in their communities. Furthermore, the presence of poverty among the surveyed women acted as a deterrent to exploring entrepreneurial options, as their immediate focus was on meeting their basic needs rather than venturing into business opportunities.

84. Similarly, the surveyed men predominantly opted for daily wage occupations that could provide immediate income to support their families. Poverty once again played a significant role in their decision-making process. Many men expressed reluctance to become self-employed or start small businesses due to the time and resources required for establishing and generating stable revenues. Given their urgent need to earn money and provide for their families, they favored occupations that offered immediate financial returns.

7 ELIGIBILITY AND ENTITLEMENT

Compensation Eligibility

85. There will be economic displacement resulting from loss of access to dumped waste at the Jam Chakro disposal site. Each AP has been enlisted and issued a unique identification number to confirm his/her presence on the Jam Chakro disposal site prior to the cut-off date at the time of LRP implementation. The cut-off date has been disclosed to the APs through consultative meetings, focus group discussions, field surveys and other means of communication including face-to-face communication with communities. The disclosure of cut-off date has been formalized through documentation of consultation meetings and disclosure reports.

Cut-off Date

86. The eligibility for compensation was limited to the announced cut-off date on first day of the start of the census that involves livelihood impacts that was announced on 26th of November 2022. The cut-off date was set and announced to avoid false and frivolous claims for compensation and rehabilitation entitlements. Any persons who encroach on the identified area after the cut-off date will not be eligible for any compensation or assistance from the project. Several measures were undertaken to communicate the cut-off date to residents and clarify that persons not identified in the census will not be eligible for any support for livelihood impacts. Such measures have included mapping of all existing structures at the cut-off date, public announcements, placement of notices, communication during consultation meetings and interviews on site, and delineation of site boundaries. Further measures including third party monitoring and documentation of project site will also be taken during the implementation phase.

Eligibilities of APs

87. In line with ESF, all rehabilitation tasks of the legacy dumping site will be implemented in accordance with the eligibility and the entitlement. All APs including women are eligible for income restoration for their livelihood loss, irrespective they have no recognizable legal right on the encroached land or they occupy or use. The Sindh Prohibition of Employment of Children Act, 2017 prohibits the employment of any children to take part in any hazardous work as listed in the Schedule of this Act.

Categories of APs

88. As per the census survey, almost all the households are below the poverty line, and all are considered as vulnerable. A poverty threshold is defined below the officially announced minimum wage for the Financial Year 2023-24 is PKR 32,000. All identified APs at Jam Chakro Site are eligible for vulnerable assistance. Waste pickers have been categorized based on their age and gender.

- Waste pickers residing Jam Chakro site – All APs (≥ 18 years of age)
- Children waste pickers (< 18 years of age) of Jam Chakro disposal site
- Differently abled APs
- Female headed Households
- Elderly (≥ 65 years of age)
- Waste Pickers at GTS sites
- Children waste pickers at GTS sites

Entitlements for Jam Chakro LFS APs

89. In the updated Resettlement Framework (RF) document, it is devised that LRP will include measures to allow all APs, who experience adverse livelihood impacts, to be provided opportunities to improve, or at least restore, their means of income-earning capacity, production levels, and standards of living. The following entitlements for LFS will be offered to waste pickers with the aim of assisting them to restore and improve their livelihoods.

Livelihood Restoration

7.4.1.1 Training and Capacity Building

90. All selected APs will receive various benefits, including skill training, a travel allowance, and toolkits upon completion of the training. Additionally, women and other vulnerable groups will be offered basic training to assist them with employment opportunities. During a meeting with vocational institutes such as the Memon Industrial and Technical Institute and the Hunar Foundation, it was recognized that illiteracy poses a challenge. To address this, the training will be customized, and certification will be provided to participants, along with creating linkages for future employment.

91. **Vocational Training Program:** Access to a proper vocational training program for APs wishing to improve or learn a specific skill set and to be self-employed. Women will be provided options on training on skills other than tailoring /sewing/ fashion dresses as identified in TNA.

92. **Special Assistance to APs with particular needs:** The project recognizes that individuals who are unable to participate in training due to physical disability, age, or being the female head of the household can nominate a family member to take part in the skill program on their behalf. The initiative also places emphasis on providing special need assistance to vulnerable individuals. This assistance may include a person specific tailored training program, provision of equipment such as wheelchairs and walking aids, hearing and vision aids or one-time healthcare assistance that will be provided where needed. To support these vulnerable individuals, a specific allocation of funds will be dedicated to special needs assistance.

7.4.1.2 Income Restoration

93. **Transitional Allowance:** Transitional allowance APs will be provided to compensate APs household that is 660, the lost income for 6 months based on the officially announced minimum wage rate by the Government of Sindh. These 660 households include vulnerable people as well as children, and majority of household's entire families are engaged in waste picking, therefore same household will be having transitional allowance along with the skill development training for their family members.

94. **Waste Pickers Children:** The waste picker children at Jam Chakro will have the support to non-formal education and supplementary support. LRPIF will provide non-formal education programs offering basic literacy, numeracy, and basic vocational training to waste pickers children for improved job and income earning opportunities.

Waste Pickers at GTS Sites

95. There are several alternative activities that can be explored for waste-picking refugees/migrants to provide them with sustainable livelihood options. It is important to work in collaboration with NGOs, government agencies, community-based organizations, and other relevant stakeholders to provide comprehensive support to waste-picking refugees. It is

essential to involve relevant stakeholders such as NGOs, vocational training institutes, government agencies, and community organizations to support and implement these alternative activities. Following measures would be taken to support waste pickers at GTS sites.

96. **Waste Pickers Children:** The waste picker children at GTSs will have the support to non-formal education and supplementary support. PIU will use the services of NGO(s) to provide non-formal education programs offering basic literacy, numeracy, and basic vocational training to waste pickers children for improved job opportunities. The NGO will initiate an outreach and advocacy campaign to raise awareness about the challenges faced by these children and advocate for policy changes that protect the rights of children and address the root causes of waste picking of Afghan children. The NGO will collaborate among stakeholders such as government agencies, charity organizations, and businesses to provide healthcare services, counselling and emotional support including regular check-ups and treatment to address health hazards.

97. **Provision of PPEs:** Conducting awareness raising activities at GTS site for waste-pickers regarding using Personal Protective Equipment (PPEs). Waste pickers at GTS sites will have access to essential services such as clean water, sanitation, and washing facilities.

98. **Linkages for Recycling and Upcycling Initiatives:** Facilitate in linkage establishment of recycling and upcycling of recyclable material. In the meeting with different NGOs, Rana Liaqat Ali Craftsman Colony (RLCC) works in upcycling of recycled material from which they create handicrafts, artwork and produce eco-friendly products. These initiatives not only provide income opportunities but also contribute to environmental sustainability. Collaborations will be created between waste picker and RLCC management to support sustainable livelihood.

99. **Advocacy and Policy Engagement:** Advocate for inclusive policies that protect the rights and address the needs of waste-picking Afghan refugees. PIU will collaborate with relevant stakeholders to ensure their voices are heard and their concerns are addressed in policy discussions and decision-making processes.

8 GRIEVANCE REDRESSAL FOR LIVELIHOOD RESTORATION

100. The Grievance Redress Mechanism (GRM) is a crucial element of project management and accountability, ensuring that concerns, complaints, and grievances are addressed effectively. In the context of SWEEP, a project-specific GRM has already been established and will be operational once the LRP and construction phase will start. Following upon this successful model, the same grievance GRM implemented for the LRP, dedicated to receiving, evaluating, and facilitating the resolution of concerns raised by affected parties regarding the performance of the LRP.

101. To ensure transparency and proper management of complaints, all grievances received, whether communicated verbally or in writing, will be documented and recorded in the Complaint Management Register(s). Furthermore, to enhance accessibility and convenience, an easily accessible web-based GRM platform will be developed, enabling individuals to lodge their complaints conveniently.

102. Every effort will be made to address complaints through the project-specific GRM, and complainants will be encouraged to seek resolution through this mechanism. In cases where complainants remain unsatisfied with the outcome, they retain the right to escalate their complaint to higher levels of government administration or to pursue legal recourse through the relevant court. This ensures that individuals have recourse to seek justice if their grievances are not adequately resolved within the project's grievance redressal framework.

103. Following are the key procedural components related to livelihood restoration which are included in the main GRM document and which need to be invoked during any livelihood related grievance.

- Complaint will be recorded in the system under the LRP.
- Complaints so raised by system will be transferred immediately to the Social Safeguard Specialist as the focal person of GRM.
- Call and complain numbers already in use by SSWMB, will be used for complains. A dedicated 4-digit helpline number 1128 and PTCL Number: +921-99333702, 021-99217788)
- Complaints can be lodged using SSWMB Application and on website of SSWMB and SWEEP

104. Due to the sensitive nature of the aspect, LRP related complaints will mutually be dealt by Social Safeguard Specialist at PIU SWEEP and LRPIF. Existing GRM team will assist in managing complaints.

105. For further information on the grievance mechanism please refer to the SWEEP GRM document where detailed information on the recording and resolution processes is included.

9 IMPLEMENTATION OF THE LRP

Overview

106. This section identified the roles and responsibilities of the key actors involved in LRP implementation, key activities and to facilitate the implementation of the LRP.

Institutional Roles and Responsibilities

SWEEP Project Implementation Unit (PIU)

107. The SSWMB is the primary agency for all activities undertaken under SWEEP. SSWMB will be closely looking after activities in Component 2 (Development of SWM Backbone Infrastructure), including construction and operation of infrastructure. In addition, SSWMB will also support SWEEP–PIU) social development, gender, stakeholder engagement, grievance redressals mechanism and communications and monitoring and evaluation (M&E), including a Management Information System (MIS).

108. The PIU will be responsible for the general project execution of the project and streamline the safeguards-related tasks of different subprojects headed by the Project Director (PD). The PIU is responsible to:

- Ensure compliance with the national as well as World Bank environmental and social standards requirements including implementation of the LRP.
- Regular liaison with the waste pickers and contractor/s.
- Collect information and progress on LRP implementation compliance.
- Grievance redressal and,
- Organize training programs on social management aspects and the successful implementation of the LRP activities.

The PIU E&S Team

109. The PIU E&S team has core responsibility of implementation of this LRP. The PIU's Social Safeguard Specialists and Resettlement Specialist will be responsible for the general project execution of the project and streamline the safeguards-related tasks of different subprojects headed by the Project Director (PD). The E&S is responsible to:

- Ensure compliance with the national as well as World Bank environmental and social standards requirements including implementation of the LRP.
- Coordinate and monitor the planning and execution activities of LRPIF for the implementation of the LRP.
- Manage GRC at PIU and at subproject sites.
- Monitor and assist LRPIF to coordinate with different government and non-government training and vocational training institutes for admission and training of the project APs
- Signing of Memorandum of Understanding (MoU) with different training institutes for the training of the APs.
- Signing of MoU) with I/NGO(s) for education and skill development of any underage workers identified at Jam Chakro and GTS sites
- Regular liaison with the waste pickers and LRPIF
- Collect information and monitor the progress on LRP implementation compliance

- Organize training programs on social management aspects and the successful implementation of the LRP activities

LRPIF

110. For LRP implementation, the PIU will engage a consulting firm, having experience in implementing the vocational and technical training program. The main responsibilities of the firm/consultants include Implementation of LRP and to keep close coordination with PIU staff and Design and Supervision Consultant. The LRPIF will support the PIU for performing their functions, The detailed ToRs are attached as **Annex-V**.

Implementation Schedule of LRP

111. The implementation of the LRP will begin once it is cleared by the WB. The first step involves procuring an LRPIF, selected in accordance with WB procurement guidelines and PEPRA rules. The anticipated start of LRP implementation is tentatively scheduled for November 2023, following the hiring of the LRPIF, expected to be finalized in September 2023. Timelines specified in the document will commence after the contract is awarded and initial documents are submitted.

112. Aligned with LRP principles, the LRPIF will enhance the implementation schedule, maintaining the same overall implementation timeframe. Livelihood restoration activities will commence tentatively before civil works, focusing on capacity building and assistance services for the first six to ten months. In case of disruptions or delays in implementation, the plan's lifespan will be adjusted to accommodate changes in the construction plan or the project itself. This ensures alignment between the modified timeline, project goals, and the LRP.

113. For successful livelihood restoration activities, the LRPIF will collaborate closely with the SWEEP PIU. Training will continue until all APs are trained, and a dedicated database will be established by LRPIF to record LRP activities and PIU SWEEP will have all access to the data for monitoring purposes. It will be updated on daily bases and fortnightly reports will be generated for monitoring purposes. The database will enhance transparency, aid in monitoring and budget planning, and enable SWEEP to track activities in Jam Chakro disposal site and GTS sites. It will also facilitate easier reporting and help prioritize and manage risks and costs, considering seasonal limitations like monsoon rains and urban flooding.

114. The key tasks, proposed timeline and major milestones for the implementation of LRP are provided in the Table.

Table 9.1: Key Tasks and Implementation Schedule

Training Activity	Responsible	Months																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.0 LRP Approval	PD																		
Submit final LRP for WB approval	PD/SDS																		
2.0 Procure Firm for LRP Implementation	PIU																		
2.1 Advertise and seek bids	PIU																		
2.2 Evaluate bids and select Firm	PIU																		
3.0 Develop and IEC Material	PIU, LRPIF																		
3.1 Disseminate at Jam Chakro and GTS sites	SDS, LRPIF																		
3.2 Conduct orientation sessions with APs on LRP	SDS, LRPIF																		
3.3 Provide gender-sensitive counselling services and educational opportunities for children withdrawn from waste picking	LRPIF																		
4. Prepare and Conduct Training	LRPIF																		
4.1 Identify eligible APs and skillset choices (by trade and gender)	LRPIF																		
4.2 Explore and select training institutes	LRPIF																		
4.3 Coordinate with institute and finalize training design and modules	LRPIF																		
4.4 Provide transitional allowance to APs	LRPIF																		
4.5 Organize and conduct training	LRPIF/Training Institute																		
4.6 Provide toolkits to eligible trained APs	PIU/LRPIF																		
4.7 Provide Health and safety awareness sessions with all APs	LRPIF E&S, Team/PIU																		
4.8 Provided PPEs to waste pickers at GTSs	LRPIF																		
4.8 Prepare non-formal education syllabus for waste pickers children	LRPIF/NGOs																		
4.9 Implement and offer non-formal education to children	LRPIF/NGO																		
5. Explore Livelihood Opportunities																			
5.1 Explore employment opportunities with entities consulted and agreed	LRPIF																		
5.2 Identify, select employable APs and link with service industry	LRPIF																		
5.3 Link differently abled persons with NGO for rehabilitation and livelihood support	LRPIF																		

Training Activity	Responsible	Months																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
5.4 Link and seek support from UNCHR for Afghan waste pickers	LRPIF/PIU																		
6. LRP monitoring																			
6.1 Monitor and assess training and livelihoods restoration results	PIU																		
6.2 Submit quarterly reports to WB	PIU																		

10 LRP BUDGET

115. The cost of preparation and implementation of LRP, including the cost of vocational training, IEC material logistics, provision of toolkits and administration, will be part of the overall budget of the Project. SSWMB will be responsible for securing the project-related financing. The budget will also make provisions for additional assistance for vulnerable households to restore their livelihood. The overall budget for the LRP implementation is PKR 247.51 million.

Table 10.1: LRP Budgetary Requirements

Sr. No.	Cost Head	Unit	Unit Cost (PKR)	Total Amount (PKR)
A	**IEC Material Development**			
1	Posters (18x23 inches 128-gram Art paper quantity	40	1,000	40,000
2	Banners for 3x5 Pena flex banner-100 banners)	1000	1,500	1,500,000
3	Sign Boards (Health & Safety boards) 5 Board for each GTS)	15	5,000	75,000
4	Roll up Standee	40	6,000	240,000
	Sub Total			**1,855,000**
B	**Technical Training***			
1	Driving (Two Months)	211	24,000	5,064,000
2	Sewing/Cutting of Fashion Dresses (Four Months)	177	48,000	8,496,000
3	Mason (Three Months)	130	36,000	4,680,000
4	Mechanic (Bike/Car) (Six Months)	63	92,000	5,796,000
5	Electrician (Six Months)	60	87,000	5,220,000
6	Livestock Management (Two Months)	63	23,000	1,449,000
7	Mobile phone repairing (Two Months)	30	33,000	990,000
8	Painter (Six Months)	39	65,000	2,535,000
9	Plumber (Six Months)	40	87,000	3,480,000
10	Tire repairing (One Month)	31	24,000	744,000
11	Carpenter/Wood Work (Six Months)	33	79,000	2,607,000
12	Kitchen Garden & Flower Nursery (Two Months)	25	26,000	650,000
13	Cooking/Food stalls/Catering Services (Two Months)	20	33,000	660,000
14	Computer related trainings (Six Months)	9	80,000	720,000
15	Rug making (Four Months)	12	48,000	576,000
16	Poultry Farming (One Month)	9	23,000	207,000
17	Hair Dresser (Three Months)	3	51,000	153,000
	Sub total	**955**		**44,027,000**
C	**PPEs**			

1	Basic PPEs (fluorescent jackets, gloves & Masks) for Waste Pickers) 3,000 x 300 Package	300	3000	900,000
	Sub Total			**900,000**
D	**LRP Implementation Firm (indicative)**			
	LRP Implementation Firm Operation and Admin Cost (12 Month)			
1	Team Leader-1	1	250,000	3,000,000
2	Vocational Skill Development Expert-2	2	150,000	3,600,000
3	Industrial Relation Expert-1	1	150,000	1,800,000
4	Social Expert-1	1	200,000	2,400,000
5	Community Engagement Expert- 4	4	80,000	3,840,000
6	Monitoring and Evaluation Expert- 1	1	200,000	2,400,000
7	Reporting and Database Management-1	1	200,000	2,400,000
8	Human Resource and Admin/Logistic-1	1	80,000	960,000
	Sub Total			**20,400,000**
E	**Education and vocational support for Waste Picking Children**	**Lumpsum**		**4,000,000**
F	**Special Assistance for APs with particular needs**	**Lumpsum**		**3,000,000**
G	**Transitional Allowance (6 months)**	660	32,000	**126,720,000**
	Sub-total (A+B+C+D+E+F+G)			**200,902,000**
H	**Overhead cost of LRPIF 10%**			**20,090,200**
I	Monitoring & Evaluation (2%)			4,018,040
J	**Total**			**225,010,240**
K	Contingencies (10%)			**22,501,024**
	Grand Total (PKR)			**247,511,264**
	Grand Total (PKR Million)			**247.51**

* Include training fee, transportation and toolkit cost.

This budget will be financed by Government of Sindh Counterpart Funds.

11 MONITORING AND EVALUATION

116. Monitoring and Evaluation are the critical activities in assessing the extent of achievements of livelihood restoration objectives. It is a periodic assessment of planned activities providing inputs facilitating changes, feedbacks and directions to activities. Two forms of monitoring, internal and external will be undertaken to assess the effectiveness and on-going progress of the LRP. Internally the process of monitoring will be undertaken by PIU team at both the project and field level.

117. The monitoring process will include:

- The activities are carried out according to work plan
- Inputs are delivered and used as planned
- Project results are produced or being produced according to the agreed quality and quantity
- Project objectives and impacts are realized as expected

118. The objectives are to monitor the progress of LRP implementation activities, evaluate the effectiveness of assistance programs, identify and address problems with implementation partners, propose corrective actions, and ensure the achievement of LRP objectives. To monitor the livelihood activities of the project, gender disaggregated information will be collected through meaningful consultations, interviews with Afghan immigrants, community leaders, and public meetings at Jam Chakro.

Internal Monitoring

119. Internal monitoring responsibilities for the LRP implementation lie with the social safeguard staff within the PIU. It encompasses administrative monitoring, socio-economic monitoring, and impact evaluation monitoring.

- Administrative monitoring includes monthly planning, implementation, feedback, troubleshooting, maintaining individual APs' database, and progress reporting.
- Socio-economic monitoring involves collecting baseline information to compare APs' socio-economic conditions, income generation, community relationships, and the number of complaints.
- Impact evaluation monitoring assesses the restoration/improvement of income standards and socio-economic conditions of APs.

120. The indicators for internal monitoring are directly linked to immediate LRP activities and outcomes. The gathered information will be used to evaluate progress, make necessary adjustments to the work program, and continue monitoring until APs' livelihoods are improved. The PIU will oversee and verify LRP implementation to ensure the achievement of LRP objectives, restoration of livelihoods and living standards, and provide recommendations for enhancement.

External Monitoring

121. To ensure the successful implementation of the LRP, the PIU-SWEEP will hire an Independent Monitoring Consultant (IMC) responsible for conducting independent monitoring and evaluation throughout the project. The IMC's role is to review the progress of LRP implementation, evaluate objective achievement, identify any gaps, and propose remedial measures. The ToRs of IMC is provided as **Annex VI**.

122. This external monitoring will ensure compliance with project guidelines, effectiveness of mitigation measures, and adherence to social and livelihood restoration requirements. The monitoring and evaluation activities serve key objectives within the LRP, including tracking progress, assessing program adequacy, identifying issues, implementing corrective actions, and achieving LRP objectives.

SWEEP
Solid Waste Emergency and Efficiency Project

SSWMB
Sindh Solid Waste Management Board



September 2023

Vol. II - Annexures

Livelihood Restoration Plan for Development of New Landfill Cell at Jam Chakro and Five Garbage Transfer Stations in Karachi



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ANNEX II: INTERVIEW QUESTIONNAIRE– WASTE PICKERS AT GTS SITES

Interviews with Waste Pickers at GTS Site

Interviewee Name: _____ **Date:** _____

GTS Site:_____

Questions	Response
Since when have you been settled here? Or coming form outsiders? If you than tell area name? What are the main ethnic/religious groups?	
Since, how long have you been associated to collect the solid waste? Probe: At what age? You were willing to choose the profession? Forcibly for the profession?	
Have you ever gone to school? If no, why? Willing to go to school? If yes, why?	
What kind of solid waste collected by scavengers/ waste picking? Chemical waste? Bio Medical waste? Domestic waste? Where the solid waste has been sold? How much amount do you earn on daily basis?	

Questions	Response
What is the process to carry the solid waste? ***Probe***: Sorting the waste, recycle, reuse, and remake? How to carry the solid waste? ***Probe*** By feet, By cycle/motor cycle? Donkey cart? Etc.? how many hours do you work?	
Do you know the waste picking may increase the health risks and hazardous for the health?	
Do you use the personal protective equipment (PPE) during the waste collecting? If yes, ask which equipment? If no, why? What kind of health problems do you face? List down of diseases? Where from you get the treatment? Are you satisfied with treatment? Who will pay the expenses of treatment?	

ANNEX III: CONSULTATION SNAPSHOTS



Consultative Session at Jam Chakro



Consultations with males of Haji Ibrahim Goth



Consultation with females of Haji Ibrahim Goth





Disclosure of Project and cut-off date announcement

Consultations with female waste pickers



Consultation with waste pickers, GTS Gutter Baghicha



Afghan waste picker, GTS Gutter Baghicha

Consultative session at GTS Sites









Training Need Assessment Survey Pictures (March 2023)

ANNEX IV: TRAINING NEED ASSESSMENT SHEET – WASTE PICKERS AT JAM CHAKRO

S#	Waste Picker Data (A)	CNIC (B)	Educational Qualification (C)	Monthly Income (D)	Present Skill or Required Skill(s) (E)	Proposed Skill Training** Code (F)	Remarks (G)
1.	Name: Age: Gender (M/F/T)*:						
2.	Name: Age: Gender (M/F/T)*:						
3.	Name: Age: Gender (M/F/T)*:						
4.	Name: Age: Gender (M/F/T)*:						

* (M/F/T) = Male / Female / Transgender

**** D - Proposed Skill Training Set**

Mason (construction)	Electrician
Painter	Tire repairing
Carpenter / wood worker	Hair Dresser
Mechanic (bike / car)	Livestock management
Plumber	Poultry Farming
Driving (Heavy transport)	Kitchen garden and flower nursery

ANNEX V: TERMS OF REFERENCE (TORS) OF LRP FIRM

Terms of Reference for Implementation of Livelihood Restoration Plan in Jam Chakro and all GTS Sites

A. Introduction

The government of Sindh under the Sindh Solid Waste Management Board established a project Solid Waste Emergency and Efficiency Project (SWEEP) that aims to mitigate the impacts of flooding and COVID-19 emergencies and to improve solid waste management services in Karachi.

The primary focus under the project is the improvement of backbone infrastructure for waste management in the city. A Project Implementation Unit (SWEEP-PIU) has been established to execute these sub-projects.

The first phase of subprojects under SWEEP are being prepared and these works are expected to be tendered out in 2023. The investments under the first phase will include: Construction of a Landfill Site (LFS) at Jam Chakro along with five Garbage Transfer Stations (GTS). The Jam Chakro disposal site is in Bund Murad, Mangho Pir, District Council Gadap Town, District Karachi West. There are five sites identified for GTSs, near Sharafi Goth, Dinga Morr, Imtiaz Store, Gutter Baghicha, and Sohrab Goth. The proposed GTS sites are already in use for interim storage and transportation of waste except Sohrab Goth. Three of the sites have open access and are accessed by informal waste pickers who sort and collect valuables from the waste.

1. GTS Dinga Morr – Gulberg Zone – District Central
2. GTS Gutter Baghicha – SITE Zone – District West
3. GTS Imtiaz – Korangi Zone – District Korangi
4. GTS Sharafi Goth – Landhi Zone – District Malir
5. GTS Sohrab Goth – Gulshan Zone – District East

Resettlement is not involved in any of the sub-project sites. No land will be acquired since it is already owned by the city government. There have been no recent anti-encroachment operations at any of the proposed sites and no removal of encroachment is envisaged as the engineering designs do not require any resettlement of communities at the sites.

Project Requirements

A key objective of LRP is improving, or restoring the livelihoods of economically displaced persons to pre-project levels. SWEEP aims to (i) avoid involuntary resettlement wherever possible; (ii) minimize involuntary resettlement by exploring project and design alternatives; (iii) enhance, or at least restore, the livelihoods of all affected persons in real terms; and (iv) improve the standards of living of the economically displaced poor and other vulnerable groups at Landfill stie.

Further to this, LRP will also encompass to promote and support in providing opportunities for learning and training, Jam Chakro residents have access to safe, culturally appropriate livelihood opportunities, support communities, organizations, schools, non-government organizations and other partners in pursuing sustainable livelihoods programs. Reciprocal, multi-generational learning opportunities will be supported. Equal opportunities regardless of age, knowledge, skill level and experience will be provided for increased sustainable livelihoods and, Creation, promotion and support to the opportunities for program development. It is to ensure programs run effectively, efficiently and support the people who need them, and endurance of accountability in Action Plan implementation.

Ensuring that the diverse, broad opportunities meet the needs of all residents, regardless of age, skill, experience, knowledge, gender, ability, socio-economic status and other factors. Strengthen communication and information about sub-projects to promote sustainable livelihoods at multiple levels. Identifying potential resources and partnerships to create, promote and support opportunities for livelihood development. Strengthen partnerships with a variety of other stakeholders to support Jam Chakro community particularly people with limited access (e.g., single parents, Elders, people dealing with addictions, people with different mobility needs, etc.).

Livelihood restoration activities must be implemented with disclosure of information, consultation, and the informed participation of APs Special provisions must be made for individuals belonging to vulnerable groups to improve livelihood of affected people and other vulnerable groups. Monitoring and assessing the livelihood restoration outcomes, their impacts on the standards of living of economically displaced persons, and whether the objectives of the livelihood restoration plan is achieving by taking into account the baseline conditions and the results of livelihood restoration monitoring, and to disclose the monitoring reports. Grievance Redress Mechanism to address LRP, to receive and facilitate the resolution of AP's concerns. Preparation of a plan for economic displacement that represents data from field surveys with APs and to ensure that their pre-Project livelihood status is at least restored.

Livelihood Restoration Policy

SWEEP's LRP is developed with reference to World Banks guidelines and provincial legislations. The Project's guiding principles for livelihood restoration are as follows:

- SWEEP LRP is designed to minimize adverse impacts
- SWEEP LRP will give particular attention to women, the poor and the most vulnerable APs
- All APs were meaningfully consulted, including vulnerable groups, and were given opportunities to participate in livelihood-proposed activities
- For the purpose of the project, all APs are considered to be vulnerable because they are living below the extreme poverty line.
- APs will be assisted in their efforts to improve their livelihoods and standards of living.
- SWEEP's Livelihood restoration activities will be monitored during Project implementation via internal monitoring and external monitoring

B. Scope of Work

Under the overall guidance of the Project Director, Solid waste Emergency and Efficiency Project and the direct supervision of the Social Safeguard Specialist and Resettlement Specialist, the Livelihood Restoration Plan Implementing Firm will be responsible to fulfill the following functions:

The scope of work for this project includes, but is not limited to:

Validating the training needs assessment (TNA): The firm will be required to validate the results of a comprehensive TNA conducted in May 2023 for all Affected Persons (APs) at the Jam Chakro disposal site, with the aim to reconfirm choices around skill development, determine any specific needs, and mapping the validated list of APS to optimal solution providers. Particular attention may be given to women and vulnerable APs. In addition, a detailed profiling of waste pickers at Garbage Transfer Stations (GTSs) will also be required, with a particular emphasis on identifying any underage informal workers at these sites. This will involve data collection, analysis, and consultation with informal workers, with the aim to build interfaces to promote operational health and safety, and to identify local solution providers (NGOs) to serve education or skill development needs for any underage workers.

Implementation of a Livelihood Restoration Plan: Based on the training needs assessment, the firm will be required to implement the LRP that currently outlines the strategies and activities required to support affected individuals and families in rebuilding their livelihoods. The implementation will also include the consultations and focus group discussions involving all relevant stakeholders as but not limited to NGOs, secondary stakeholders, etc.

Following are main activities that will be carried out by LRPIF but not limited to:

1. Implementation of LRP for APs of all sub-project sites.
2. Registration, screening and facilitation to all APs for their admission in different vocational training institutes.
3. Agreement, or MOUs signing with the training and vocational institutes for training of the APs of Jam Chakro
4. Agreement with NGO(s) for awareness, health and hygiene and using PPEs, through engagement and collaboration with organizations working for Afghan Refugees
5. Agreement, or MOUs signing with I/NGO(s) for education, skill development, and other needs of underage workers identified at Jam Chakro and GTS sites
6. Identification, agreement/MOUs signing with the small and large industries in the area for the employment of the scavengers in different industries after the completion of the training
7. Budget management (as per allocation) for LRP implementation.
8. Develop a mechanism to pay stipend and travelling allowance to APs. Ensure compliance with the national as well as World Bank environmental and social standards requirements including implementation of the LRP.

9. Provide assistance to APs in selecting vocational training and subsequently getting job opportunities.

Liaison with Stakeholders:

- Identification, and engagement with local institutes, industries, and employers to ensure that waste pickers have access to employment opportunities,
- Engage with local employers to create job opportunities for them.
- Identify and engage vocational training institutes and individual vocational trainers to train APs on-site.
- Coordination with UNHCR and I/NGOs working for vulnerable groups/waste pickers in Karachi.
- Liaison with local authorities to create policies that promote the inclusion of waste pickers in formal employment.

Implementation of the plan: The firm will be responsible for implementing the livelihood restoration plan in accordance with the agreed-upon timeline and budget. This will involve the mobilization of resources, the coordination of activities, and the provision of support and assistance to affected individuals and families. Submission of periodic work and financial plan, reviewed and endorsed by the PIU SWEEP for clearance.

Monitoring and evaluation: The firm will be required to monitor the progress of the livelihood restoration plan and evaluate its effectiveness in achieving its goals and objectives. Fortnightly reporting and communication with relevant stakeholders will be required.

Reporting: The firm will be required to submit regular progress reports and a final report upon completion of the project. The final report should include a summary of the activities undertaken, the outcomes achieved, and any lessons learned.

The successful firm will be required to demonstrate expertise and experience in the field of livelihood restoration. They should also have a proven track record of delivering high-quality projects on time and within budget.

Governance and Accountability

The firm will work under the overall guidance of the PD SWEEP and the supervision of Social Safeguard and Resettlement Specialist.

The firm shall closely coordinate with the PIU SWEEP, APs, and others as identified by the PIU. The PIU shall confer with the proposed plan, while the APs of the landfill site will mostly participate, decide, contribute and concur in the designing process. Lastly, PIU SWEEP with World Bank's support will provide direction to the LRPIF, and review and accept the deliverables.

Expected duration of the contract/ assignment

The contract will cover one year from August 2023 until July 2024.

Professional Qualifications of the Successful Firm and its key personnel

The professional qualifications of a successful firm and its key personnel for a livelihood restoration plan for waste pickers, the relevant qualifications and skills that could be considered are:

Experience in developing and implementing livelihood restoration plans:	□ Registered under Securities and Exchange Commission of Pakistan or Societies Registration ACT 1860 or Companies ACT 2017 or registered with Sindh Technical Educational and Vocational Authority □ Fifteen years and above relevant experience in designing and implementing projects that aim to improve the livelihoods of vulnerable communities. □ Experience working and partnering with various stakeholders such as governments, non-governmental organizations, and local communities; Has proven established and stable partnerships with global institutions and the private sector. □ The firm should have proven skills in community development, including facilitation, community mobilization, and stakeholder engagement. □ The firm should have proven technical expertise in areas such as enterprise development, vocational training, and marketing, linkage development, liaisons with national and international NGOs. □ The firm should have experience working with waste pickers or other informal workers and understand the specific challenges and opportunities faced by this group. Has at least three (3) existing and/or past projects on designing and implementation of LRP of vulnerable communities. □ The firm should have experience in managing budgets, tracking expenses, and financial reporting. □ The firm should be able to design and implement monitoring and evaluation plans to track project progress and measure impact. □ The firm should hire personnel who have strong communication and interpersonal skills to build relationships with stakeholders, facilitate partnerships, and engage with the target community. □ The majority of the Landfill site community speaks Sindhi, and at GTS sites the majority of waste pickers speak Afghani therefore, the firm should hire social mobilisers who are fluent in these languages to facilitate effective communication.
Experience of Personnel:	
Team leader	□ A master's degree in a relevant field (e.g., social work, social sciences, sociology). □ At least 7 years working experience as a development and execution expert.; □ Experience working with the marginalized communities and has knowledge of waste pickers in the city; □ Confirmed experience in community development activities, preferably in implementing income generating activities and strategies. □ A proven track record in livelihood restoration, development, planning and implementation; □ Understanding of working with marginalized and vulnerable communities, their issues and concerns; □ Excellent organizational and time management skills; □ Demonstrated leadership and technical abilities to communicate ideas verbally and in writing.

	▯ Outstanding communication, interpersonal and leadership skills.
Vocational skill development expert	▯ Must have 3-5 years of experience in assisting and guiding individuals to develop the practical skills they need to succeed in their chosen profession. S/he must have: ▯ Industry-specific knowledge which includes understanding the trends and best practices within a particular industry, as well as the regulatory requirements and standards that must be met while training the aps. ▯ Have a deep understanding of the vulnerable community and their current skill sets and be able to identify the specific skills that are most in suitable and in demand in market. ▯ Have excellent communication skills and be able to design and deliver training programs that meet the needs of different learners especially vulnerable groups.03018274424 ali ▯ Have expertise in designing and implementing vocational training programs for organizations, underprivileged community groups and vulnerable groups.
Industrial relation expert	▯ At least 3-5 years' experience in liaison creation with industries, NGOs, companies and firms; ▯ Experience in conducting a risk analysis, impact assessments and livelihood models; ▯ Demonstrated ability to understand, negotiate, and/or oversee the development of public-private alliances and partnerships related to placement of individuals in jobs; ▯ Knowledge of trends and markets related to information products and services to integrate aps in different jobs; ▯ Excellent communication analytical skills.
Community Engagement Expert	▯ A bachelor's or master's degree in a relevant field (e.g., gender studies, social sciences, international development). ▯ At least 3 years' experience working with, and confirmed knowledge of, community-based organizations, ngos and other civil society organizations operating at the local level; ▯ Building and maintaining positive relationships with community members and stakeholders ▯ Understanding and respecting cultural differences is key to successful ▯ Managing community engagement projects, including planning, implementation, and evaluation. ▯ Have an understanding of community development principles and practices ▯ Ability to analyze data and report on community engagement activities, including progress and outcomes ▯ An excellent communicator and have the ability to tailor message to different audiences. ▯ Familiarity with socio-economic conditions in underprivileged areas and marginalized communities. ▯ Expertise in working with differently abled and vulnerable groups; ▯ Experience in conducting workshops, meetings and fgds with communities, elderly and influential groups; ▯ Fluency in sindhi is an advantage.
Social expert	▯ A bachelor's or master's degree in a relevant field (e.g., gender studies, social sciences, international development).

	▯ At least have experience of 3-5 working in communities or project to improve livelihood of marginalized communities and underprivileged people. ▯ Have a deep understanding of social issues and challenges, such as poverty, inequality, discrimination, and social exclusion ▯ Responsible for designing and evaluating social programs, such as community development projects or social service programs. ▯ Be excellent communicators, both in writing and in person ▯ Able to explain complex social issues and policies in clear and accessible language and build relationships with stakeholders and community members ▯ Be aware of cultural differences and be able to work effectively with people from diverse backgrounds. ▯ Be able to adapt their approach to different cultural contexts and show respect for different beliefs and values. ▯ Proven experience in managing and resolving complaints, grievances, or conflicts within an organizational or project setting. ▯ Strong knowledge of grievance redressal frameworks, policies, and best practices. ▯ Excellent analytical, problem-solving, and decision-making skills. ▯ Ability to conduct impartial investigations and maintain confidentiality. ▯ Strong interpersonal and communication skills to facilitate mediation and conflict resolution. ▯ Familiarity with applicable labor laws, regulations, and compliance requirements. ▯ Experience in working with diverse stakeholders and managing sensitive situations. ▯ Proficiency in using relevant software applications for documentation and reporting. ▯ Strong ethical standards and the ability to handle sensitive and confidential information appropriately.
Gender/GBV specialist	▯ A bachelor's or master's degree in a relevant field (e.g., gender studies, social sciences, international development). ▯ At least have 3-5 years demonstrated of working in ▯ experience working on gender equality and women's empowerment issues. ▯ Strong knowledge of gender analysis frameworks and gender mainstreaming approaches. ▯ Familiarity with provincial, national and international laws, conventions and frameworks related to gender equality and women's rights. ▯ Excellent analytical, research, and report writing skills. ▯ Strong communication and facilitation skills, including the ability to deliver training programs and presentations. ▯ Experience in project management and implementation. ▯ Ability to work effectively in a multicultural and diverse environment. ▯ Fluency in written and spoken English (additional language skills may be preferred depending on the context). ▯ Knowledge of relevant regional and local gender dynamics

Monitoring and Evaluation Expert	▯ At least have experience of 5-7 years of M&E on different projects and ate least have experience of LRP implementation in two projects. ▯ Have a deep understanding of M&E principles, including data collection, analysis, and reporting. Familiar with different M&E frameworks and methodologies, such as logical frameworks, results-based management, and participatory monitoring. ▯ Data analysis skills, including the ability to design and implement surveys, conduct focus groups and interviews, and use statistical software to analyze data. ▯ Be responsible for managing M&E activities, including planning, implementation, and reporting ▯ Be an excellent communicator, both in writing and in person. Be able to explain complex data and findings in a clear and accessible manner and build relationships with stakeholders and team members. ▯ Should be familiar with different types of data collection tools and methods, such as surveys, questionnaires, and interviews. Be able to use different software tools to analyze and visualize data ▯ Be able to identify and address data quality issues and ensure that data is accurate, complete, and reliable ▯ Be able to design and implement program evaluations, including impact evaluations, process evaluations, and outcome evaluations
Other Skills:	▯ Qualifications and / or industry certification and /or demonstrable experience in the following applications: Microsoft Office (advanced ▯ user certification of MS Access, MS Excel and MS Word desirable) and Lotus Notes are desirable.

ANNEX VI: TERMS OF REFERENCE FOR INDEPENDENT MONITORING CONSULTANT

(The following deliverables only pertain to LRP, detailed ToRs for IMC will be provided at the time of engaging/hiring of the consultant)

The objective of the monitoring activities, is to assess the progress, effectiveness, and impact of the livelihood restoration plan.

Performance Evaluation: Evaluate the performance and progress of a restoration plan to assess whether the desired goals, objectives, or targets are being achieved effectively and efficiently.

Identification of Issues and Problems: Identify any issues, challenges, or problems that have aroused during the implementation of a project. This includes identifying bottlenecks, deviations from plans, or areas where improvement is needed.

Compliance: IMC will provide information on the LRPIF that organization,individuals, or processes adhere to established standards, regulations, or policies. IMC will identify any non-compliance or deviations and share appropriate actions with PIU to address them.

Reporting and Communication: IMC will report the collected data, findings, and analysis. Deliverables include monthly reports, dashboards, presentations, or visualizations to effectively communicate the progress, achievements, findings, analysis, challenges, and recommendations to PIU SWEEP and recommendations. Final LRP monitoring report summarizing the overall assessment and recommendations by the end of the contract.

Confidentiality and Intellectual Property: IMC will maintain confidentiality and the ownership of data and reports generated during the monitoring process and at the end of the contract will submit to PIU SWEEP.

Decision Support: IMC will provide evidence-based information that will support informed decision- making, key indicators and trends, decision-makers can assess the impact of interventions, allocate resources effectively, and make adjustments to strategies or plans as needed.

Key Responsibilities/Deliverables: The main responsibilities of the monitoring consultant, which may include but are not limited to the following:

- Developing a detailed monitoring plan, including timelines and milestones.
- Conducting regular field visits to assess the implementation of the livelihood restoration plan.
- Collecting relevant data and information through surveys, interviews, focus group discussions, and other appropriate methods.
- Analyze the collected data and preparing comprehensive monitoring reports. e. Identifying challenges, gaps, and bottlenecks in the implementation of the plan.
- Providing recommendations for improving the effectiveness and impact of the plan.
- Collaborating with relevant stakeholders, including government agencies, project staff, and local communities.

This part encompasses only LRP part of IMC further requirement such as Qualifications, Experience, Selection Process, Contractual Arrangement, Budget Allocation and other contractual require.

ANNEX VII: GAPS BETWEEN LAA 1894 & WB ESS 5

Pakistan 1894 Land Acquisition Act	World Bank ESS5	Gap Filling Measures
The expropriation elaboration contains a detailed list of properties to be expropriated, their location, information about individuals who have formal legal rights on these properties. No socio economic study is required.	Through the preparation of this LRP, individual RPs, census survey and socioeconomic study is envisaged. The study should include information on (i) current occupants in the affected area, (ii) characteristics of displaced households and their standards of living and livelihoods, (iii) magnitude of expected losses and extent of displacement, and (iv) information on vulnerable groups or persons.	All documents must be prepared in accordance with WB ESS5. Requirements, in addition to national legal requirements. The implementation of a census is required to identify the persons who will be affected by the project (including those who are not registered through national procedures). The implementation of census survey/ household census is necessary also to identify characteristics of displaced households, including standard of living, level of vulnerability, establishing baseline conditions for monitoring and evaluation purposes, and to set a cut-off date
The Expropriation Law recognizes the eligibility of persons who have formal legal rights on land and structures, as registered by the registry and those whose rights are recognizable under national laws (factual ownership).	WB ESS also recognizes those who have no recognizable legal right or claim to the land they are occupying as they are also eligible for rehabilitation assistance and compensation for loss of non-land assets at replacement value.	Compensation and assistance to Aps without legal right or claims will be made per principles and entitlements provided in the entitlement matrix of this LRP, if they are present in the project affected area at the time of the cut-off date. Asset inventory and valuations of their affected properties will be conducted and all measures will be recorded in the database prepared
Compensation for land and other assets is based on average values and department unit rates that do not ensure replacement market value of the property acquired. However, LAA requires that a 15% compulsory acquisition surcharge supplement the assessed compensation.	Aps are to be compensated for all their losses at replacement cost, including transaction cost and other related expenses, without deducting for depreciation or reductions based on salvageable items.	Land valuation is to be based on current replacement (market) value with an additional payment of 15%. The valuation for the acquired housing land and other assets is the full replacement costs keeping in view the fair market values, transaction costs and other applicable payments that may be required.

No provision for resettlement expenses, income/livelihood rehabilitation measures or allowances for displaced poor and vulnerable groups.	Requires support for rehabilitation of income and livelihood, severe losses, and for vulnerable groups	Provision should be made to pay for resettlement expenses (relocation, transportation and transitional allowances), compensate for loss of income, and provide support to vulnerable persons and those severely impacted (considered to be those losing more than 10% of their productive assets).
Lack of formal title or the absence of legally constituted agreements is a bar to compensation/rehabilitation. (Squatters and informal tenants/leaseholders are not entitled to compensation for loss of structures, crops).	Lack of formal title is not a bar to compensation and rehabilitation. All Aps, including non-titled Aps, are eligible for compensation of all non-land assets.	Squatters, informal tenants/leaseholders are entitled to compensation for loss of structures and livelihood and for relocation.
Land acquisition and compensation process is conducted independently by the Land Acquisition Collector following a lengthy prescribed legal and administrative procedure. There are emergency provisions in the procedure that can be leveraged for civil works to proceed before compensation is paid.	Involuntary resettlement is conceived, planned and executed as part of the project. Affected people are supported to re-establish their livelihoods and homes with time-bound action in coordination with the civil works. Civil works cannot proceed prior to compensation	SWEEP PIU will prepare land acquisition and resettlement plans, as part of project preparation based on an inventory of losses, livelihood restoration measures, Pakistan law and principles enumerated in SPS. Where gaps exist in the interpretation of Pakistan law and resettlement practices, requirements of World Bank 's involuntary resettlement policy will prevail. Civil works may only proceed after the resettlement plan is implemented and compensation for loss of assets and other allowances (budgeted as part of the project cost) is fully paid.
No convenient grievance redress mechanism except recourse of appeal to formal administrative jurisdiction or the court of law	Requires the establishment of accessible grievance redress mechanisms to receive and facilitate the resolution of Aps' concerns about displacement and other impacts, including compensation	SWEEP PIU will establish easily accessible grievance redress mechanism available throughout project implementation that will be widely publicized within respective subproject area and amongst the Aps.

Except invoking legal process by notifying the land under different provisions of the LAA and announcement of award, LAA does not require social impact assessment and preparation and disclosure of specific LAR planning and monitoring documents.	World Bank requires a social impact assessment and preparation and disclosure of specific Involuntary Resettlement (IR) documents at different stages of project planning, design and implementation and these include IR categorization checklists, Social Impact Assessment, SMF/RP/s and periodic monitoring reports etc.	Following ESS5 criterions, the SWEEP PIU, in collaboration with World Bank shall conduct social impact assessment of the projects and will prepare RPs for the project with IR impacts and social due diligence reports for the project without tangible IR impacts at project planning and design stage. While the periodic monitoring reports (internal and external) confirming RP implementation progress will be prepared periodically during implementation.

ANNEX VII - Community Transition Plan

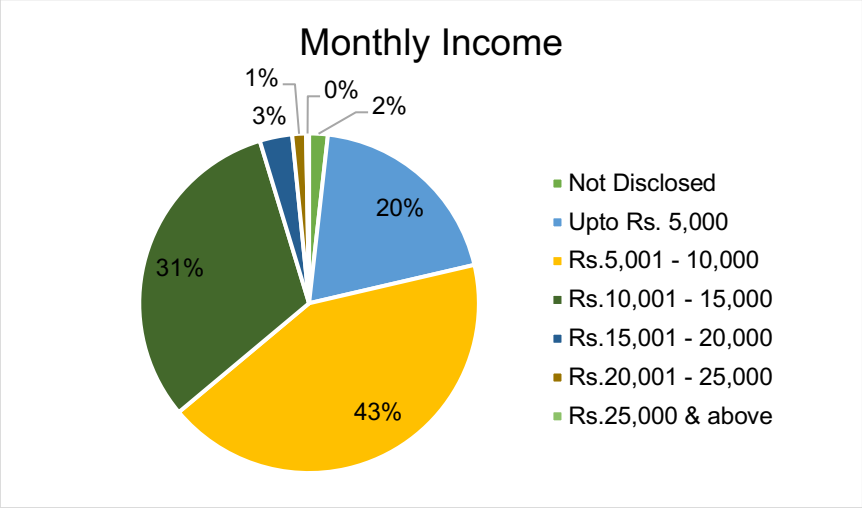
Transition Plan

1. Economic Prediction Model:

a. Current situation:

In the surveyed community of Haji Ibrahim Goth at Jam Chakro, the comprehensive household census revealed that 31% of the population is engaged in the waste picking profession. The waste picker demographic comprises both adults (aged 15 to 80) and children (124 in total).

Below is a breakdown of the monthly income distribution among waste pickers:



Current Monthly Income of Waste Pickers

During the construction phase, the livelihoods of waste pickers remain unaffected as they will continue their work. However, it is anticipated that in the operation phases, waste pickers' activities will be restricted, impacting their source of income. Recognizing the potential impact on income sources, the PIU-SWEEP has devised a Livelihood Restoration Plan is based on a comprehensive training needs assessment of waste pickers ensuring that waste pickers acquire the necessary skills to explore alternative employment opportunities and conducting focused group discussions with waste pickers, this involved identifying viable alternatives to sustain their livelihoods during operation phase where waste picking would be restricted.

Based on the market survey and skills/training provided by the institutes in Karachi are created on the demand as it is the biggest city in Pakistan in terms of economy and population therefore has subsequent entrepreneurial opportunities, broader economic and market trends, and market demand for the acquired trades/skills offered in almost all public and private institutes.

Following are the trades/skills identified by waste Pickers:

i. Driving
ii. Sewing/Cutting of Fashion Dresses
iii. Mason
iv. Mechanic (Bike/Car)
v. Electrician
vi. Livestock Management
vii. Mobile phone repairing
viii. Painter
ix. Plumber

x. 1Tire repairing
xi. Carpenter/Wood Work
xii. Kitchen Garden & Flower Nursery
xiii. Cooking/Food stalls/Catering Services
xiv. Computer related trainings
xv. Rug making
xvi. Poultry Farming
xvii. Hair Dresser

In implementing a transition plan, particularly utilizing an economic prediction model, we have developed a comprehensive strategy for projecting the anticipated income of waste pickers. This involves a dual-pronged approach that integrates both qualitative and quantitative predictions.

b. Expected Income After Receiving Skills/vocational Training:

Following are the expected incomes of waste pickers after getting skill training (inflation rate is not included)

Mobile Phone Repairing or Kitchen Garden & Flower Nursery: Skills development training equips individuals with the knowledge and abilities needed to excel in various fields. The forecasted income post-training can significantly differ based on the nature and duration of the program, as well as the industry demand for the acquired skills. Short-term courses, such as two-month programs in Mobile Phone Repairing or Kitchen Garden & Flower Nursery, offer opportunities for quick entry into the job market, with earnings ranging from 15,000 to 20,000 rupees initially.

Mechanics or Electricians: For professions requiring more extended training, such as Mechanics or Electricians, a six-month program can lead to a steady income between 15,000 to 32,000 rupees per month, depending on expertise and demand in the area.

Sewing/Cutting of Fashion Dresses or Computer-Related Trainings: with duration ranging from four to six months, said skills may provide income ranging from 15,000 to 30,000 rupees, with the potential for growth over time.

Carpentry or Plumber services: It's important to note that self-employment options, such as carpentry or plumber services, often come with income variability based on market demand and location. However, skilled individuals can potentially earn between 20,000 to 30,000 rupees monthly, as they build their client base and reputation.

Hairdressing or Rug Making: Specialization in niche fields like Hairdressing or Rug Making can offer competitive earnings, ranging from 15,000 to 20,000 rupees initially and increasing with experience and a loyal customer base.
Skills development training can lead to a wide range of income opportunities, with initial earnings largely dependent on the chosen field and location. Continuous improvement, dedication, and adapting to market demands are key factors in achieving sustained income growth in any profession. While the initial forecasted incomes may provide a baseline, individuals can significantly enhance their earnings through continuous learning, experience, and dedication to their chosen craft.
Further to this they will have an opportunity of social acceptance and inclusion in the society which they were deprived of being associated with waste picking. This will also create awareness and provide exposure of current trends and earning/income opportunities resulting better lifestyle for entire family and subsequently community.

Table given below is the current income associated with different trades mostly in private sector. This information was provided by the Hunar Foundation, Memon Industrial and Technical Institute and local industrial sector near Jam Chakro.

Current Market-Based Income:

Sr. No.	Descriptions	Market Based earning	Self-base earning
1	Driving (Two Months)	25000 to 35000	-
2	Sewing/Cutting of Fashion Dresses (Four Months)	20000 to 25000	15000 to 30000
3	Mason (Three Months)	20000	-
4	Mechanic (Bike/Car) (Six Months)	25000	15000 to 20000
5	Electrician (Six Months)	28000 to 32000	15000 to 20000
6	Livestock Management (Two Months)	20000	15000
7	Mobile phone repairing (Two Months)	-	15000 to 20000
8	Painter (Six Months)	-	20000 to 30000
9	Plumber (Six Months)	-	20000 to 30000
10	Tire repairing (One Month)	-	15000
11	Carpenter/Wood Work (Six Months)	-	20000
12	Kitchen Garden & Flower Nursery (Two Months)	15000 t0 20000	15000
13	Cooking/Food stalls/Catering Services (Two Months)	18000	-
14	Computer related trainings (Six Months)	15000 to 20000	15000 to 20000
15	Rug making (Four Months)	-	16000
16	Poultry Farming (One Month)	-	15000
17	Hair Dresser (Three Months)	15000-20000	15000-20000

Predictable Income

Given table depicts the trends of daily wages as per the bureau of statistics of Pakistan for 21-22.

It is envisaged that once waste pickers are trained on their selected skills will have better opportunities and higher source of income compared to waste picking as 63% of waste pickers will have higher income i.e., PKR 15,000-25,000 compared to their current income. i.e., PKR 5,000-10,000.

References

https://hunarfoundation.org/
https://wmomiti.com/

Table 4.20 Average monthly wages of employees in the main job by occupation and sex

Occupation	Monthly Mean Wages (2018-19)			Monthly Median Wages (2018-19)		
	Total	Male	Female	Total	Male	Female
Total	**21326**	**22172**	**15461**	**16000**	**16800**	**8400**
Mangers	64606	65592	52953	58000	60000	45000
Professionals	36514	42315	25663	30000	35000	18000
Technicians	30010	30838	24622	25000	25000	21000
Clerical support workers	29878	30100	24078	27000	28000	23000
Services and Sale workers	18103	18186	14054	15417	15540	12417
Skilled Agri. & Forestry Workers	17342	17456	3360	16800	16800	3360
Craft and related trade workers	17466	19199	5773	16800	18000	4200
Plant and Machinery Operators	19260	19336	11745	17400	17500	12000
Elementary Occupation	14274	15257	8199	12600	14280	7000

Occupation	Monthly Mean Wages (2020-21)			Monthly Median Wages (2020-21)		
	Total	Male	Female	Total	Male	Female
Total	**24028**	**24643**	**20117**	**18000**	**18900**	**12000**
Mangers	68214	68935	61112	60000	60000	45000
Professionals	41815	47597	33236	35000	38630	28000
Technicians	33553	34392	28362	30000	30000	24000
Clerical support workers	34259	34329	32721	32000	32000	32000
Services and Sale workers	20770	20871	17650	18000	18000	15000
Skilled Agri. & Forestry Workers	24917	24948	14036	21000	21000	7560
Craft and related trade workers	20091	21709	10554	18667	20000	8400
Plant and Machinery Operators	21721	21742	19980	19800	20000	13000
Elementary Occupation	16238	17241	10170	15000	15120	8820

Source: Labor Force Survey 2020-2021 PBS
https://www.pbs.gov.pk/sites/default/files/labour_force/publications/lfs2020_21/LFS_2020-21_Report.pdf

ANNEX VIII - Chance Find Procedures

ARCHAEOLOGICAL 'CHANCE FIND' PROCEDURE

1. BACKGROUND

The purpose of this document is to address the possibility of archaeological deposits becoming exposed during ground altering activities within the project area and to provide protocols to follow in the case of a chance archaeological find to ensure that archaeological sites are documented and protected as required.

Whilst there are no sites of declared antiquity or cultural heritage at or near the project site, these procedures have been developed as a precautionary step.

The Antiquities Act, 1975, protects archaeological sites, whether on Provincial Government owned or private land. They are non-renewable, very susceptible to disturbance and are finite in number. Archaeological sites are an important resource that are protected for their historical, cultural, scientific, and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents. The objectives of this 'Archaeological Chance Find Procedure' are to promote preservation of archaeological data while minimizing disruption to construction and ensuring all on site personnel and contractors be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

2. POTENTIAL IMPACTS TO ARCHAEOLOGICAL SITES

Developments that involve excavation, movement, or disturbance of soils have the potential to impact archaeological materials, if present. Activities such as road construction, land clearing, and excavation are all examples of activities that may adversely affect archaeological deposits.

3. RELEVANT LEGISLATION

It ensures the protection, preservation, development and maintenance of antiquities in the provinces of Pakistan. The Act defines "antiquities" as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the relevant provincial governments to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the subproject proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, report to the Department of Archaeology, any archaeological discovery made during the course of the project.

4. REMEDIES AND PENALTIES

The Antiquities Act, 1975 provides for heritage inspection or investigation orders, temporary protection orders, civil remedies and penalties to limit contraventions. These powers provide: ''A contravention of any provision of this Act or the rules shall, where no punishment has been specifically provided be punishable with rigorous imprisonment for a term which may extend to two years, or with fine up to rupees ten hundred thousand, or with both.''

5. ARCHAEOLOGICAL 'CHANCE FIND' PROCEDURE

If it is believed that any archaeological materials have been encountered, then stop work in the area and follow the procedure below:

The following 'chance-find' principles will be implemented by the contractor throughout the construction works to account for any undiscovered items identified during construction works:

i. Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance.
ii. Should any potential items be located, the site supervisor will be immediately

contacted and work will be temporarily stopped in that area.

iii. If the site supervisor determines that the item is of potential significance, an officer from the Department of Archaeology (DoA) will be invited to inspect the site and work will be stopped until DoA has responded to this invitation.

iv. Work will not re-commence in this location until agreement has been reached between DoA and SWEEP as to any required mitigation measures, which may include excavation and recovery of the item.

v. A precautionary approach will be adopted in the application of these procedures.

6. DETAILED PROCEDURAL STEPS

- If the Director, department of Archaeology receives any information or otherwise has the knowledge of the discovery or existence of an antiquity of which there is no owner, he shall, after satisfying himself as to the correctness of the information or knowledge, take such steps with the approval of the Government, as he may consider necessary for the custody, preservation and protection of the antiquity.
- Whoever discovers, or finds accidentally, any movable antiquity shall inform forth with the Directorate within seven days of its being discovered or found.
- If, within seven days of his being informed, the Director decides to take over the antiquity for purposes of custody, preservation and protection, the person discovering or finding it shall hand it over to the Director or a person authorized by him in writing.
- Where the Director decides to take over an antiquity, he may pay to the person by whom it is handed over to him such cash reward as may be decided in consultation with the Advisory Committee.
- If any person, who discovers or finds any movable antiquity contravenes the provisions of the Act, he shall be punishable with imprisonment for a term which may extend to five (05) years, or with fine not less than fifteen hundred thousand rupees or with both and the Court convicting such person shall direct that the antiquity in respect of which such contravention has taken place shall stand forfeited to Government.
- The Director or any officer authorized by him with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose.
- The owner or occupier of the premises, place or area shall afford all reasonable opportunity and assistance to the Director.
- No photograph, copy of reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made.
- Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.
- If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part under the Land Acquisition Act, 1894 (I of 1894), as for a public purpose.

ANNEX IX- Guide Sanitation Plan

SANITATION PLAN

INTRODUCTION

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

1. PURPOSE OF THE PLAN

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

2. MANAGEMENT OF SANITATION DURING CONSTRUCTION PHASE

i) Responsibility

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

ii) Location of Camp Sites

The accommodation and ancillary facilities for labor shall be constructed and maintained to standards and scales approved by the Resident Engineer.

The camps must be located such that the drainage from and through the camps shall not endanger any domestic or public water supply.

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

iii) Water Supply

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

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

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

iv) Toilet Facilities and Hygiene

According to health and safety guidelines OR-OSHA number of toilets required at construction site is as one toilet for 20 workers. **Table 1** shows the number of toilets required in accordance with the number of employees at construction site. The total numbers of employees at construction site are estimated to be 220 persons.

Table 1: Number of Toilets Required for Employees at Construction Site

No. of Employees	No. of Toilets and Urinals by OSHA	Total No. Toilets and Urinals Required at Construction Site
Up to 20 Employees	1 Toilet	5 Toilets
Up to 40 Employees	1 Urinal	2 Urinals

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

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

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

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

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

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

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

v) Waste Disposal

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

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

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

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

vi) Maintenance of Sanitary Facility

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

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

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

3. Management of Sanitation During Operational Phase:

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

- Site Clearance;
- Sewage Pipe Clearing, and
- Solid Waste Management.

i) Site Clearance

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

ii) Solid Waste Management

Municipal solid waste and medical waste produced along the road should be collected and managed properly by the concerned department. Waste bins should be placed along the road side; regular cleaning of the road should be carried out using mechanical sweepers and at least two to four sweepers should be deputed for the whole proposed road to assure regular cleaning.

iii) Awareness and Training

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

ANNEX X - Health & Safety Manual

1. GENERAL

The landfill will comprise the following:

- 6 phases for the disposal of MSW, each with an approximate lifespan of 1-1.5 years;
- The installation in each Phase of an engineered basal lining system developed over a prepared subgrade;
- The installation in each Phase of a leachate collection system above the basal lining system to collect leachate (contaminated water that has drained through the waste mass), with leachate draining by gravity to sumps located at the lowest point in each Phase and cell for onward transfer to the leachate ponds;
- The installation of gas collection wells in each Phase as waste is placed and compacted;
- A gas collection system to transfer captured gas to the landfill gas plant;
- Inter-Phase embankments to separate each Phase;
- Stormwater management system to keep clean water separate from leachate; and
- Internal haul roads to access each tipping area.

1.1 Health and Safety Objectives, Strategy, and Policy

1.1.1 Health and Safety Manual Objectives

During the construction, operation and post-closure of the landfill, it is perceived that employees and visitors are likely to be exposed to hazards and life-threatening risks through various means including direct contact with waste, leachate and landfill gas. There is also a potential for harm and/or bodily injury for site workers during the construction and operation of heavy equipment. Therefore, the purpose of this manual is to set out the general guidance and establish employee safety/protection standards and mandatory operation processes in relation to both physical and chemical hazards which is likely to be encountered on site during all project stages. However, site-specific guidance relevant to an operator's own safety requirements should be available in the organisation's relevant health and safety statements and working procedures. All operators of landfill facilities should have read, understood and, where appropriate enacted, the requirements of the provisions mentioned above in this manual.

The selected Contractor and Operator is committed to accomplish its duties and responsibility for the project using the available resources to achieve outstanding performance in completing the work and attaining the following Project Health and Safety (H&S) objectives:

- Complete the project with distinguished H&S record;
- Reduce risk to personnel, natural environment, business performance and reputation to levels as low as reasonably practicable;
- Meet all our environment commitment;

- Manage integrity and risk in all aspects of design, construction, transportation, installation, and operations using criteria compatible with statutory requirements;
- Instil and promote Health & Safety consciousness amongst employees and subcontractors to prevent accidents and injuries and provide a healthy workspace with high hygiene standard;
- Conduct effective H&S training;
- Provide availability of adequate medical treatment for all personnel involved in the Project and establish efficient medical evacuation procedure;
- Implement innovative measures to continuously improve our safety practices;
- Provide the best possible care in design, construction and maintenance of equipment and facilities;
- To observe Pakistan's Health & Safety and regulations and other international regulations;
- Minimize the generation of hazardous waste and handle all waste in environmental sound manner;
- Prevent releases; spills and leaks take immediate containment measure in the event of accidental discharges;
- Restore the environment on work accomplishment in compliance with enforced statutory requirements and according to contractual commitment; and
- Encourage recycling and re-use of materials.

1.1.2 Health and Safety Strategy

The following set out the H&S Strategy, achievement of which will ensure compliance with the Project's H&S Policy and state objectives.

- Identify and implement the requirements of H&S contained within acts, regulations, and codes of practice;
- Ensure compliance with appropriate national and international regulations, in Compliance with ISO 45001:2018 or equivalent local rules, regulations, and code of practice;
- Ensure that the WBG EH&S Guidelines for Landfill will be followed;
- Establish and maintain communication with government a genies, local authorities and unions on all matters relating to H&S;
- Ensure that appropriate safety system is applied throughout the project and vendors and fabricators have met their contractual and statutory H&S requirements;
- Ensure that sufficient and appropriate documentation is supplied to permit development of maintenance program for construction equipment;
- Encourage positive involvement of all staff to promote H&S awareness by:
    - Through investigation of all accidents and incidents inclusive Lost Time incidents. First Aid Case and Near Miss case are as to identify causes and initiate preventive measures to prevent recurrence;

- Convene regular safety meetings throughout the execution of the project; and
- Conduct regular H&S inspection.

- Ensure that H&S training is carried out in accordance to the needs of individuals and the work at hand.

The Project shall:

- Create awareness and promote engagement on all H&S aspects from all team members;
- Maintain highest level of ethical and professional standard during project execution;
- Create a healthy and safe working environment for all project participants;

H&S promotion will be an integral part of duties of all managers and supervisory staff.

- All personnel involved in the project have the duty to conform to the H&S policy and procedures;
- The Project Manager (Contractor) and the Facility Manager (Operator) have the overall responsibility for H&S; and
- The top management of the Contractor and the Operator supports fully this policy and encourages all employees to pro-active approach with respect to H&S matters in executing their duties.

1.1.3 Health and Safety Policy

During construction, the selected Contractor shall provide and maintain a healthy and safe working environment in compliance with good business practices and legislative requirements. During operation and post closure, the selected Operator and/or operational staff shall comply with all relevant Health and Safety practices and legislative requirements. All operations shall be conducted in such a manner that there will not be any contravention of the applicable environmental laws and regulations.

The policy will be applied on daily basis in all operations in the following manner:

- Comply with all applicable laws, regulations, and standards where law do not exist;
- Follow all relevant regulations in WBG EH&S Guidelines;
- Lead, train and motivate workers contractors and suppliers to work in a safe and responsible manner;
- Identify access and manage risks that impact health, safety and the environment prior to commencing activities and when circumstances change;
- Implement health management programs including effective injury management and rehabilitation to maintain and improve the well-being of workers; and
- Drive continual improvement in health, safety and environmental performance through open reporting and effective assessment and analysis of our

performance, leadership and engagement with our stakeholders.

Through continuous communication with project team members, the commitment to health and safety shall be reflected in the day-to-day work via the following principles:

- Organization: A project team wide organizational structure and culture will be established that recognizes and encourages the full and active participation of all employees in the systematic identification, assessment and management of health and safety issues;
- Accountability: Responsibility for the protection of the health and safety is a matter of corporate policy and is a matter of law, with potentially severe consequences for failure to comply. Management at all levels is responsible for ensuring that operations are conducted in accordance with this policy and that appropriate environmental programs, procedures and systems of work have been developed and implemented for the project;
- Management Systems and Standards: The project team will develop, implement and continuously improve the project health and safety management systems and develop health and safety management standards using company documented standards where available, ensuring that they reflect best industry practices;
- Risk Management: The project team will ensure that potential health and safety risks associated with all our construction activities are assessed as early as is practicable in order to minimize and manage adverse effects and to identify opportunities for improvement;
- Legislative Compliance: The project team will operate to standards Environmental Health and Safety (EH&S) Guideline's general EH&S Guidelines and Environmental Hazardous Material Management that will comply with the requirements of applicable local and appropriate national and international legislation and codes of practice and will strive beyond compliance and recognize these principles as a valued way of life;
- Training: The Managers and staff will be qualified by reason of education or experience H&S Officer should be ISO 45001:2018 or equivalent certified to discharge their responsibilities and will participate in a program of continuing professional development. In addition, the project team is committed to provide training and development on health and safety matters that is appropriate to each employee's job duties and responsibilities. The project team will be proactive in the management of third-party contractors to ensure they are fully aware of the health and safety issues and to ensure that their actions are aligned with project health and safety standards;
- Health and safety risks: The project team will continuously evaluate the health and safety risks of the project activities through all of its phases. The goal will be to develop and provide products and services that have minimal health and safety risks;
- Continuous Improvement: The project team believes that effective health and

safety management is good business and is committed to continuous improvement of health and safety risks management practices; and

- Monitor, Audit and Review: Effective management requires on-going assessment and review, accordingly, an on-going assessment, self-evaluation and audit program shall be implemented and maintained for the project activities. The objective of this program is to provide management with verification so that operations are in compliance with laws, regulations, Company policies and standards and to facilitate the spread of best practices throughout the project following WBG EH&S Guidelines standards.

2. ORGANIZATION AND KEY PERSONNEL

The following personnel shall be employed during the different stages of the project to over ensure compliance with health and safety protocols on site.

2.1 Construction Phase

2.1.1 Project Manager

Th Project Manager has overall responsibility for assuring the health and safety of all employees at the site. In addition, the Project Manager will ensure that site activities do not present an increased hazard to human health or the environment beyond the perimeter of the site. The Project Manager has overall responsibility for all H&S matters on the project:

- He/she is responsible to the top management for ensuring that the Project H&S Plan is regularly reviewed, kept up to date and implemented;
- He/she will ensure that all line management staff are conversant with the relevant requirements of current local legislation and the Project H&S Plan and are assigned appropriate duties and responsibilities to assist in its effective implementation; and
- He/she will arrange for the H&S performance of all subcontractors to be continuously monitored.

2.1.2 Health and Safety Manager

Accountable to the Project Manager for supervising and monitoring the overall implementation of this Project H&S Plan, in particular his duties will include:

- The regular review of the Project H&S Plan to ensure that it remains comprehensive, effective, up to date and reflects the prevailing requirements of the project. Where there has been significant change in the organizational structure. Hazards or arrangements for H&S on the project requiring amendment or adjustment of the plan, he will report this to the Project Manager;
- The provisions of a comprehensive H&S advisory service to the Senior Project Manager, relevant members, and where appropriate representatives of subcontractors on the project;
- The establishment and maintenance of H&S inspections procedures, including the preparation and appropriate distribution of written reports detailing defects, weaknesses and recommendations for improvements;
- The establishment and maintenance of adequate procedures to ensure that all accidents and dangerous occurrences are thoroughly investigated and promptly reported to appropriate parties;
- Preparation of an Action Plan to avoid recurrence of accidents;
- The maintenance of comprehensive accident and dangerous occurrence statistics for the project;
- Liaison with client representative, relevant enforcement authorities. Sub-contractor’s safety personnel and other relevant there should be no panic on

H&S matters; and

- The submission of monthly written reports to the Project Manager accordance to the stipulated format.

2.1.3 Site Health and Safety Officer

The Site Health and Safety Officer (H&SO) designation will perform daily site inspection, compliance and ensure employee work under safe conditions. This person is responsible for all health and safety activities, including subcontractor activities, air monitoring, site inspections, and overseeing the proper decontamination of personnel, equipment, and materials leaving the site. The H&SO is also charged with the responsibility of enforcing the use of personal protective equipment (PPE) and training site personnel as outlined in the Training Section of this plan. The H&SO will have experience in field operations with air monitoring instruments, personal protective equipment, decontamination procedures, and emergency equipment and procedures.

The nominated H&SO certified in ISO 45001:2018 or the equivalent has responsibilities to ensure that:

- Draft safe site working procedures and obtain project RE should also approve the H&S Plan;
- Workers working over water are wearing the floating vests;
- Workers working over scaffoldings / formworks at heights over 3m are tied with Internationally approved harnesses.
- All movements of heavy machinery are directed by a flagman with green light and retro-reflective safety vests in order to avoid fatalities (for instance workers might sleep under the machine during their lunch break); and
- The temporary accommodation complies to IFC's Worker's Accommodation Processes and Standards.

The site safety officer shall liaise directly with the Project Manager regarding matters related to the control of traffic. The site safety office shall, inter alia, control and co-ordinate the movement of construction vehicles, be responsible for training the Contractor's staff in terms of road safety, ensure that reflective clothing is worm by all employees working on or near public roads, be responsible for implementing actions requested by the traffic authorities with regard to the work to be carried out, be responsible for the erection and maintenance of all obstructions related to the Contractor's activities are removed before nightfall every day, and ensure that roads are safe for night traffic. He shall also be available after hours if required to rectify problems or to deal with emergencies.

2.1.4 Site Engineer

- To integrate environmental and health and safety considerations in all decisions made as regards the management of works;
- To ensure through the H&S that the Environmental Management Plan (EMP) is duly implemented; and
- To ensure that working staff is adequately sensitized to environmental and

health and safety issues.

2.1.5 Foreman

- To implement the EMP at the work site and report all occurring environmental and health and safety incidents/accidents;
- To liaise with the H&SO about all environmental and health and safety issues met during the works;
- To sensitize workers about implementation of environmental and health and safety measures; and
- To ensure the verification and periodic maintenance of the environmental equipment such as mud segregation, retention tanks, places for deposition of waste, drainage systems etc.

2.2 Operation Phase

2.2.1 Landfill Operation Personnel

Every person employed on the project has a statutory duty to take reasonable care for their health and safety of themselves and others who may be affected by their actions or omissions at work.

- Regarding the statutory duties imposed on their employer, they must cooperate with their employer to enable him to comply with the relevant statutory requirements;
- No person shall intentionally or recklessly interfere with or misuse anything provided for H&S under the relevant statutory provisions;
- All personnel shall wear or use the appropriate safety equipment or clothing and use the appropriate safety devices;
- All personnel will familiarize themselves with the relevant requirements of the Project H&S Plan;
- All personnel will report any accidents and damage to property or equipment to their immediate supervisor, irrespective of whether persons are injured;
- All personnel are encouraged to make suggestions to improve H&S to their supervisor and the H&S Officer; and
- All personnel will sign the code of conduct including the H&S related requirements.

2.2.2 Waste Pickers

If permitted at the site, waste pickers shall undertake safety training prior to commencement of work and must have the appropriate PPE before they are permitted on site. Again, in order to prevent human-vehicular accidents, the waste pickers should respect all traffic signaling and ensure the use of demarcated pedestrian walkways on site.

2.2.3 Nurse

A Nurse shall be available during the project stage prepared to provide the following assistance:

- Give proper first aid treatment in case of accidents to all staff treatments to all personnel on site workplace;
- In case of a serious accident or emergency, the injured will be taken to the nearest hospital by ambulance.
- Ambulance for the same hospital will be available for any emergency;
- Conduct periodical health examination to all staff and labour;
- Implement the emergency response mechanism regarding any damage to health; and
- Carry out education and publicity about Covid-19 and other communicable diseases.

3. HEALTH AND SAFETY DURING PROJECT IMPLEMENTATION

During construction and operation, the Contractor and operational staff shall comply with all relevant local statutory H&S and World Bank and international ISO 45001:2018 or equivalent requirements.

Therefore, a range of H&S management techniques will be designed to ensure compliance such as preparation of H&S plans, permit to work system, job safety analysis, H&S inspections, H&S audits, regular H&S meetings and reporting.

This Project H&S Plan is prepared to describe how is intended to satisfy these obligations and to manage and co-ordinate the operations accordingly.

3.1.1 Foreseeable Hazards of the Project

The foreseeable hazards associated with various operations with this project can be summarized as follows:

- Work at height and the associated risks of fall of persons or object;
- Work in confined spaces;
- The use of plant and equipment, including lining appliances machines, Generators, etc.;
- Rigging and handling wire ropes;
- Handling use, storage, and transportation of materials and substances;
- Powered Hand Tools operations;
- Use of explosivesl;
- Exposure to environmental or health risks associated with dusts, fumes, vapours, etc.;
- Exposure to excessive noise levels;
- Pressure Testing;
- Spray Painting and Blowing;
- Heavy Lifting;
- Hazards of movements of heavy machinery;
- Energizing/De-energizing of Electrical System;
- Excavation; and
- Hazards in Driving.

The foregoing list identifies the major areas of concern which it is necessary to control or guard against by implementing safe practices and places, permit to work system, adequate monitoring and control arrangements and the provision and use of suitable protective clothing and equipment.

The majority of practice of the foregoing hazards can be found in the safe work practices instruction (refer to Section 5.5 in this H&S manual).

Risk Assessment as an integral part of the project accident prevention program will implement arrangements to ensure that all construction activities are subject to a formal assessment of risk prior to the commencement of individual operations. The

respective contractors and operators shall carry out the risk assessments and the results monitored by the Project H&S Manager/Officer. The following paragraphs describe the arrangements for ensuring that the risks arising from the foregoing hazardous activities are eliminated or adequately controlled.

3.2 Group Meetings

Regularly scheduled meetings on H&S are an essential element in H&S Management. The following meeting shall be held:

- Weekly safety meeting plan;
- Accident investigation meeting;
- Weekly progress meeting and reporting; and
- Sub-contractors' site managers meeting.

3.3 Hazard Identification and Health and Safety Audit and Inspections

Contractors are to have current Material Safety Data Sheets (MSDS) for all hazardous substances that are to be used at the site/workplace. The MSDSs are to be kept in a Hazardous Substance Register which is to contain a description of the substance along with all other relevant details. This register and its contents must be available for perusal by the subcontractor's employees. A copy of the contractor's Hazardous Substance Register (HSR) and MSDSs are to be given to (company name) prior to bringing or using the substances on site.

All hazardous Chemicals and Dangerous Goods must have proper labelling, handling, storage and transportation procedures. The operators are obligated to conduct risk assessments, training, health assessment and health surveillance, gases and dust and inspections for all chemicals.

Unsafe conditions might be continuously undertaken by the labor of people using tools and equipment. It is important that remedial action is taken to revert such conditions without delay. Proper training and enforcement of the H&S regulations will greatly reduce the number of unsafe conditions, However, due to wear and tear of the tools and equipment and action of men, it is important that hazard identification and safety inspections are carried out on a regular basis.

The objective of this inspections is the following:

- Identify potential problems that were not anticipated during design or task analysis;
- Identify equipment deficiencies, particularly problems of wear, abuse or misuse;
- Identify substandard work practices;
- Complement preventive maintenance program;
- Identify the effect of changes in process or materials; and
- Demonstrate Management commitment to H&S.

All project personnel will be obliged at all times to identify and correct hazards as part of their normal duties whenever possible. Any hazard identified, which is outside their ability or cannot be rectified immediately to be made safe with appropriate measures

such as barricades, warning signs, etc. and such condition are brought to the attention of the Supervisor concerned immediately.

Site safety officer shall be responsible for recording all work-related injuries, illnesses, dangerous events, incidents and near misses. Again, investigate on the occurrence of an incident will be conducted to assess the root cause and provide preventive measures to avoid future occurrence. employees are to inspect all plant, machinery, equipment, tools, excavations, confined spaces etc. to ensure they are safe and without risk to the health and safety of themselves or others before using or entering them. All hazards, unsafe conditions, defective items, damage to property or equipment are to be reported to site safety officer, barricaded and/or removed from service immediately they are detected. Site safety officer is responsible for complying identified hazards, unsafe condition and damages for assessment and rectification. Risk assessments are to be undertaken prior to commencing any task to assess the risk of injury and/or damage to plant and equipment.

A schedule of inspections shall be developed by the H&SO at the commencement of each calendar year. The manager shall ensure that regular inspections are conducted as per schedule for allocated work areas utilising a specific area inspection checklist and any corrective actions required from these inspections shall be documented. Where required, conduct a risk assessment of the hazard to identify corrective actions and risk level and respond to any outstanding actions required and advise the responsible manager and the H&SO. The H&SO shall review progress for the hazard(s) corrective action until the hazard has been rectified and escalate if required through the appropriate process.

If a worker finds themselves in a job they believe is too risky to complete, the following steps should be taken:

- Do not continue the job and immediately report the problem to your manager;
- The manager, in consultation with affected workers, shall discuss and assess the risk using the risk assessment form; and
- The risk shall be removed, or if this is not possible then it should be reduced to a safe level using the hierarchy of control. This should be done to everyone's satisfaction prior to the commencement or recommencement of the task.

4. HEALTH AND SAFETY INFORMATION AND TRAINING

4.1 Induction

During construction and operation of the landfill, the Contractor's employees, personnel coming to the site to carry, and visitors must undergo relevant safety inductions prior to work commencement at the site. All new employees inclusive of those from sub-contractors will be given Induction Training prior to being placed on the job. The following are the categories of persons that will be inducted:

- Personnel coming onto the site to carry out site-specific works. This will be done by the designated employee of the specific site;
- Employees Site Specific and Work Method Statement Inductions conducted by site safety manager to discuss all safety aspects of the Construction Safety Plan/Work Method Statement relevant to the persons work prior to commencing work on site;
- Contractor's Workplace, Site Specific and Work Method Statement Inductions conducted by the subcontractors for their employees in relation to individual trade and company standard work procedures and work methods which is also to incorporate in the Contractor's Health, Safety and Environmental requirements;
- All site personnel must undertake a General Safety Induction; and
- All visitors must undergo a Visitor's Induction prior to coming onto the site and receive appropriate orientation and they must be accompanied at all times by a contractor's employee whilst on the site/workplace.

A written record of the date of the induction and the name/details of the worker inducted is to be kept on-site for reference purposes.

4.2 Information and Training

In addition to the safety induction, the landfill management shall arrange training which covers health and safety issues related to specific tasks being performed, as well as training in the overall approach to health and safety taken by our organisation when required. The following guidelines are to be adhered to by all managers, supervisors, employees and contractors:

- Conduct training needs analysis across the organisation;
- Develop formal training needs and competencies for position requirements at all levels, including management;
- Use Registered Training Organisations (RTO) and appropriately accredited and approved courses/trainers where required;
- Ensure training is competency based;
- Record all training;
- Review the effectiveness of training; and
- Provide training for languages other than English and other relevant learning barriers should they be required.

The provision of adequate H&S information and training for all level of personnel makes a vital contribution towards and effective accident prevention program and will therefore ensure that suitably structured schedule of information and training is adopted by all parties throughout the duration of the project. The contractor will ensure that each employee working on the project received adequate training to enable them to perform their work function/tasks in a safe and efficient manner.

All visitors to the project site shall attend a site safety briefing prior to visiting the construction site. The Safety Officer is responsible for the development of the training matrix. The training matrixes spelt out training need for the individual work function and task all training courses, together with records of personnel attendance, will be properly documented. These records shall be maintained on file and readily for inspection as and when required.

Training will include (but not limited to):

- General introduction H&S Risks to activities on the site;
- Overview of legal requirements in relation to H&S performance on the site;
- Licenses and competencies to perform tasks;
- Specific hazards, conduct of risk analysis and implementation of risk controls;
- Consultation and communication arrangements;
- Health and Safety Dialogs;
- Behavioural Safety Training;
- COVID 19 issues (prevention and mitigation measures);
- First Aid;
- Fire extinguisher training - Use and Inspection;
- Incidents reporting management;
- Risk assessment and management;
- Emergency response and medical evacuation management;
- Personal responsibilities and liabilities;
- H&S Management Systems;
- Preventive medicine;
- Incident reporting and corrective actions;
- Risk management; and
- Alcohol and drugs abuse.

During all project stages, one person shall be designated as the main trainee, after they get trained and aware of the importance of the environmental protection, they should implement the relevant regulations and instruct the labors to execute the construction work complying the H&SP, technical specification as well as the relevant legislation.

A variety of techniques will be adopted such as displaying of posters, distribution of H&S information sheets, newsletters and bulletins in order to generally promote the H&S of the project. A site entrance accident statistics board will be displayed showing the safety performance of the project.

4.3 Permit to Work System

Many hazards are recognizable and can be overcome by physically separating people from them, e.g. by using effective guarding on machinery.

Permit to Work System is needed when Hazards cannot be physically eliminated and some element of risk remains. Under such circumstances formal procedures which results from systematic examination of a task in order to identify all the hazards. It defines safe methods to ensure that Hazards are eliminated or risks minimized.

Therefore, the following constitute the Permit to Work System objectives:

- Ensure that such work can be carried out with due regard to the health, safety, environmental and welfare of the workers;
- Prevent any incompatible work from being carried out at the same time in any location of the project, for instance by different contractors performing work at the same site without communication; and
- Ensure that the necessary safety precautions are taken and enforced when such work is being carried out.

4.3.1 Work Type which a Permit to Work System apply

For this project works that need permits prior to commencement are listed below but not limited to:

- Any hot-work, regardless whether carried out in a confined space or otherwise. Personnel are to ensure welding screens, signs and barricades are in place, where practical to protect other personnel from welding flashes etc. Appropriate personal protective equipment is to be worn during welding, heating or cutting activities. Adequate exclusion zones around and below welding/cutting operations are to be kept clear and defined with barricades and signs. An appropriate fire extinguisher must be securely fixed to or kept in close proximity to all electric ARC welding, oxy/acetylene and LPG welding, heating and cutting plants;
- Any work which involves the use of any hazardous, volatile, corrosive, or flammable chemical, material, or solvent;
- Any work involving entry into any confined space;
- Spray painting operation;
- Any grit-blasting work carried out on site;
- Any repair maintenance or testing work carried out on the hydraulic system;
- Any energizing / de-energizing of electrical system for the commissioning or testing of electrical and mechanical system;
- Any pressurizing of pipe/ vessel on the project or filling of gas or liquid into the system;
- Radiography operation;
- Any excavating work;
- Blasting;

- Work at different heights by different contractors; and
- Any other hazardous work as decided by H&S Personnel / Senior Project Manager/Supervision.

4.4 Job Safety Analysis (JSA)

The purpose of job Safety Analysis is to provide a systematic and documents method of identifying hazards, selecting control measures and establishing health and safe and environmentally responsible methods.

The requirements set out herein apply to the project site controlled and managed by Site H&S manager.

4.4.I Guide for Selection of Task to be Analysed

- Hazard Potential: Some tasks have a recognizable hazard potential greater than activities generally conducted at the site/workplace. For example, dual cranes lift, spray painting within close vicinity of hot-work, etc.;
- Consequence of Failure: A work method failure during the execution of some tasks may result in unacceptably damaging consequences. For instance, pressure pneumatic testing of pipelines;
- Accident History: Any task associated with a poor accident record; and
- Changed Work Methods: Changes to the work method/ procedures for repetitive tasks.

For the Contractor JSA shall be conducted for, but not limited to, the following tasks:

- Dual or multiple cranes lift;
- Module stack-up;
- Module weighting;
- Hydrostatic and pneumatic pressure testing;
- Sensitive leak test;
- High-tension cable/equipment testing/commissioning; and
- Module load-out.

4.4.2 Job Safety Analysis Procedures

At the planning stage the project in-charge, with the assistance of the H&S personne,l identifies the critical tasks to be analyzed.

A team leader will then be appointed for each task to be analyzed. He must be technically competent and thoroughly familiar about the task. Other members in the JSA team include the H&S personnel for the project, supervisor and others who may be involved in the task at times. The client representative will also be invited to join in.

At the JSA meeting, the tasks are divided into a series of logical steps and listed in their normal order of occurrence. Each logical step is then thoroughly reviewed and all potential hazards associated with the step will be identified. In doing so the JSA team should consider:

- Personnel involved; and
- Equipment involved.

Effect of Movement of personnel or equipment on Environment effects:

Having identified the potential hazards (air, water, or soil contamination), action to be taken will then be mapped out for implementation. Generally, action will be formulated along the following lines:

- Substitution: where Hazardous materials have been identified as a hazard then the preferred option is to replace the material with a less hazardous one;
- Engineering, the removal of the potential hazards by engineering the job is a preferred option. This, for example, may involve such action as re-designing pipe-work/equipment or configuring a crane;
- Ventilation, natural or forced ventilation may be used to control airborne hazards;
- Administrative Control: The application of administrative control to hazards may include such actions as limiting the time of exposure, rotating of personnel, restricting unauthorized entry, etc.; and
- Personal Protective Equipment: The provision of appropriate PPE does not eliminate the hazards, but only shields those exposed from such action. Must be coupled with training in the correct use of the equipment.

The detailed JSA is then recorded in the form as shown in the attached and distributed to all concerned.

Front line supervisor shall use the form as a briefing note while carrying out pre-job briefing to all involved in the task.

5. MANAGEMENT PLANS OF HEALTH AND SAFETY

This H&S Manual shall apply to all staff and workers regardless of their position on the site.

5.1 Fundamental aspects for the Involvement of all Staff and Workers

- Management commitment to H&S;
- Effective H&S training for all staff and workers, to build up strong H&S awareness, and to be able identify and analyze all the possible H&S hazards during the construction;
- H&S walks/inspections/checks to monitor the performance and adherence to H&S during the construction;
- Weekly H&S review meetings, to identify and take remedial actions to improve H&S measures taken during the construction;
- Provide necessary PPE to all the staff and workers, install H&S signboards at work sites for awareness, reminder and warning the importance of H&S;
- Adoption of various incentive awards for exemplary H&S performance; and
- Keep detail records of H&S issues.

5.2 Management of Epidemic Prevention and Control

In the event of an outbreak of an epidemic, a team shall be responsible for epidemic prevention and control at the Landfill site. The project team will draw up a prevention plan. The project office shall be responsible for equipping all workers with equipment to prevent and control the spread of a pandemic outbreak. This shall include the following procedures:

- Equipping all workers with equipment to prevent and control the spread of a pandemic outbreak;
- In more serious cases, during the pending epidemic, the Landfill site might be completely closed;
- During the epidemic period, only one entrance and exit shall be opened and a system of control and registration of people entering and leaving will be implemented;
- All office, canteen, dormitory, toilet, and other staff flow areas should be disinfected at least twice a day;
- Awareness raising on health and safety at work shall be carried out by means of lectures, placement of advertisements among others; and
- All workers shall undergo compulsory testing.

5.3 Basic rules of Health and Safety to be complied with

- Strict compliance with applicable company management policies is a pre-condition of employment for all staff and workers;
- PPE such as safety helmet, safety shoes and reflective jacket must be worn by all staff and workers at site at all times. All safety signage should be clearly

visible. Alterations or modifications of PPE are prohibited. Eyes and face protection such as goggles and face shields are required and to be provided for operations such as grinding and welding;

- The use or possession of fire arms, illegal drugs or alcoholic beverages at work site is prohibited at any time. When drugs are prescribed by a physician, the Contractor's H&S Officer on site must be informed;
- Housekeeping shall be an integral part of H&S Plan. All the staff and workers are responsible for keeping their work areas clean and hazard-free. Clean up is required when a job is finished at the end of the day;
- All the lifting equipment and air compressing equipment must be checked by a professional/registered/certified M&E Engineer;
- Burning and cutting equipment shall be checked before being used. Flash back arresters shall be installed at the regulators on both oxygen and LP bottles. All gas shall be shut off and hoses disconnected from bottles and manifolds at the end of the work day. Caps shall be replaced on bottles when gauges are removed. When gauges are removed and caps replaced, the oxygen and LP bottles shall be separated into storage areas not less than 7 m apart with a "No Fire or Smoking" sign posted and a fire extinguisher readily available. Makeshift field repairs will not be allowed;
- All tools whether company or personal, must be in good working conditions. Defective tools will not be used;
- All extension cords, drop cords, and electrical tools shall be checked on regular basis; cords and equipment that do not meet requirements shall be immediately tagged and removed from service until repairs have been made. Electrical connections without a plug are prohibited;
- The work site speed limit will be 20 km/h for all vehicles on site construction and other roads speed limits outside the sanitary landfill area will be 80 km/h, which will be monitored by supervisory stuff for traffic management on site designated by the site H&S officer and software installation in vehicles will also be considered to reach this purpose. All the staff and workers must be sitting down inside the vehicle or vehicle bed when the vehicle is in motion. Riding as a passenger on equipment is prohibited unless equipment has the safe capacity for transporting personnel;
- All ladders must be in safe condition without broken rungs or split side rails;
- Damaged ladders shall be removed from service and replaced immediately;
- All floor openings or excavations shall be barricaded on all sides to ensure all the staffs and workers as well as the public are aware of the possible hazards. Floor holes shall be covered, with the covers secured and clearly marked;
- Warning signs, barricades, and tags will be used to the fullest extent and shall be obeyed;
- Beacon lights shall be used to notify working area at night;
- Measures shall be taken to avoid slip hazards such as preventing the spilling as well as ensuring that manholes are closed in order to avoid falls;

- Safety procedures shall be followed to keep all the staffs and workers safe when performing O&M activities on powered devices for the use of Lock-out Tag-out procedure which ensures that the breaker to the power source for the equipment that is to be repaired is turned off and locked in the off position; and
- Report all unsafe conditions and near accidents to the responsible H&S Officer so that corrective actions can be taken.

5.4 Site Health and Safety Management

5.4.1 Communication

The Project Manager shall manage all media communications in relation to the project. There will be at least two cell phones from different mobile networks available on the site. Next to these cell phones, there shall be a list of emergency contacts to be established in case of an accident.

5.4.2 Work Planning

Planning properly by collecting as much information about the project and the project site as possible before works begin to ensure H&S during construction and operation phase. Information that could be sought shall include but not be limited to:

- Underground utilities and services. Advice from the authority concerned should be sought prior to start of work;
- Presence of live bare electrical conductors, overhead insulated cables. Advice from the authority concerned should be sought prior to start of wor;
- Ground conditions;
- Contract documents;
- Nearby schools, commercial shops, office blocks, hotels, restaurants, parking etc.;
- Nearby hospitals, police offices, clinics and fire brigade etc.; and
- Other activities going on the site, such as public holidays, amongst others, the control of access to the site for safety and security reasons.

5.4.3 Work Responsibilities of Organization

Responsibilities regarding H&S between different stakeholders should be clearly allocated:

- Between Employer/Contractor/Operator/Subcontractor (if any);
- By appointed Safety and Health Officer; and
- By proper coordination on site between the Parties.

5.4.4 Health and Safety Facilities to be Provided

Ensure provision of basic H&S gears listed below to ensure safety, health and welfare of all the staffs and workers:

Barricades and Signage: For moving machineries and vehicles, warning signs and crash barriers must be provided, and speed limits should be displayed and enforced

by the site operator. Vehicles should not travel over unstable areas on a landfill surface and should they travel with their vehicle bodies raised up or being lowered. Sites Lightening should be adequate lighting to allow for safe and efficient operation at the tipping area at dawn and dusk. The site H&SO shall enforce the following:

- Employees are to ensure barricades and signages are erected to prevent access by unauthorised personnel to the site or hazardous work areas during construction and/or hazardous operations;
- Appropriate signage will be displayed to warn all site personnel and visitors of dangers and to indicate where protective equipment are required (Fig. 5.4.4-1);
- Barricades are to be of a standard and construction that clearly defines and restricts all unauthorised personnel from entering the work area and exclusion zones and are to be erected in accordance with Statutory Authorities' and manufacturers' requirements;
- Access points must be kept closed at all times when personnel are not using them to enter and exit the work area;
- When the facility is closed, security guards will ensure that the entrance to the site, the special waste cell and other plant compounds are secured and locked;
- Appropriate mandatory and warning signs must be erected at entrances and at other conspicuous locations on the fencing and barricading to inform personnel as to the nature of the site and the health and safety requirements for entry onto the site and entry into restricted areas;
- The entrance to the special waste cell and the landfill gas plant are to be fitted with a secure gate, the former fully attended by trained staff at all times when the Landfill is open for receiving waste.



Figure 5.4.4-1: Signboard for Site Safety

Personal Protective Equipment (PPE): Site personnel are to wear appropriate Personal Protective Equipment (PPE) for the tasks they are to perform where it is not practical to control risk of injury by other means.

- Safety helmets are to be worn at all times when working with cranes or in areas where personnel are working at heights or in trenches and there is the possibility of injuries from falling objects and/or in other designated hazardous areas;
- Appropriate safety footwear (enclosed with protective toe caps) is to be worn on site at all times;
- Eye, hearing and respiratory protection is to be used at all times during hazardous operations which may cause injury or exceed statutory requirements (eg. cutting compressed sheeting/CCA treated timber/concrete/blocks, using nail guns or explosive power tools, power saws, jackhammers, drills;.
- Gloves and protective clothing are to be worn in areas of risk to prevent injury from contact with hazardous substances, and sharp or abrasive objects etc.;
- All PPE requirements are to be assessed for each application and supplied accordingly by the Contractor;
- All defective equipment is to be removed from service immediately upon detection;
- All appropriate PPE must be provided to ensure that employees have received appropriate instruction in the correct selection, use, storage and maintenance of personal protective equipment prior to use;
- Safety harnesses with independently secured lifelines where protection against falls cannot be provided by other appropriate means;
- Distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure to danger from moving vehicles;
- Other equipment required for task specific safety. While the H&S Plan specifies the PPE required for each task, management will be responsible to ensure that appropriate PPE is provided, that staffs and workers receives training in the proper use of PPE, and staff and workers are complying with the requirements regarding PPE usage.

In the event that there is a specific odour concern, workers will be requested to remove themselves from the affected area and obtain directions from supervisory personnel before continuing to work in this area. Should dust become an issue in drier months, dust masks will be employed as a temporary control measure for the comfort of on-Site operating personnel and waste pickers. Operators of landfill equipment will be provided with hearing protection consisting of ear plugs or cap-mounted earmuffs. Any other Site personnel working in the immediate vicinity of the landfill equipment would also wear the same hearing protection.

5.4.5 Health and Safety Measures at Landfill Site

- Adequate, safe and separate pedestrian and vehicular traffic routes should be provided on and around the site. The main roads leading to the site which are used as the access road shall be regularly cleaned up and kept free from spoil and rubbish;
- Contractor will provide information on a plate about boundaries, adjacent land usage, access and measures to exclude unauthorized persons or vehicles.

Ensure public safety through appropriate fencing of site or by other means;

- Ensure adequate lighting of all worksites through natural and/or artificial lighting;
- The site should be kept tidy. Walkways will be separated from car lanes and stairs and kept free of slipping and tripping hazards. Ensure that there are no protruding nails on loose or fixed materials;
- Set up storage areas for plants, materials, equipment, flammable substances (e.g. flammable liquids and gases) and hazardous substances (e.g. chemicals). Store flammable materials away from other materials and protected from accidental ignition. Prevent obstruction of access routes/emergency escapes by proper storage of materials;
- Ensure fire safety on the construction site and Contractor's establishment by providing adequate means, such as fire extinguishers; and
- Temporary power cables, which connect to the distribution board, will be covered by appropriate insulation materials when in use and shall be kept in order at the distribution board when it is not used.

The temporary power cables and electric facilities should be monitored by a professional electrician. No other person is allowed to touch electric appliances.

No unqualified/unauthorized person is allowed to operate the construction equipment, as well as connecting and/or disconnecting power cables and electric facilities. All connections are to be done with appropriate plugging.

Fire fighting

There will be first response firefighting equipment consisting of at least 6 kg ABC dry chemical powder fire extinguishers strategically placed at various points on the construction site. Although this type of work does not require special fire measures, 6 kg ABC dry chemical powder fire extinguishers should be placed in some places where the activities to be performed are at risk of fire. This equipment will be properly marked in order to facilitate its identification and will be distributed in such a way as to allow effective action in case of fire. In recreation rooms, office area, switch box and generator shed, fire extinguishers are equipped in accordance with the relevant regulations.

The fire extinguishers are portable dry powder ABC fire extinguishers, and the generator sheds are also equipped with fire sand. Regular inspections of the fire protection facilities will be carried out to ensure that the fire protection facilities are always in good condition.

Stacking and storage of materials must meet fire prevention requirements, and a firewall will be set up between the amenity building and otherbuildings.

Mechanical vehicles are equipped with dry powder fire extinguishers.

When a fire occurs, notify the local fire department immediately and take the necessary steps to control the fire and evacuate personnel.

First Aid

A suitable first aid kit will be place at a location accessible to all employee on site office for emergency use only. Contractors are to ensure a suitable first aid kit is supplied and kept in each vehicle or in close proximity to the contractor's work area, irrespective of whether has supplied first aid kits on site. All first aid treatment is to be reported to site safety officer for recording.

Eye wash facilities also should be available: these should either employ running water or involve non-reusable eye wash bottles. Any bottle with a broken seal must be disposed of immediately and replaced. The operator should arrange for recognised occupational first aid training, with a minimum of one person with a first aid qualification normally present on site. All staff should be familiar with the first aid facilities available on site. The Health and Safety Authority has published guidelines on first aid.

5.5 Health & Safety Related Activities at Landfill Site (Safe Work Practice Instruction)

5.5.1 Health and Safety Related to Excavations

- Locate and identify all underground utility services, such as electrical, water and sewer in the area before start of excavation;
- Don't use pointed tools to probe for underground electrical cables;
- Remove or secure trees, utility poles, rocks or similar objects near the edge of an excavation to prevent staffs and workers from being injured;
- Support the sides of excavations by shoring and bracing to guard against danger to employees from fall or dislodgement of earth, rock or other material. Warning tape should be occupied around excavations to prevent anyone from falling;
- Inspect excavation slopes and/or supporting systems daily for erosion or deterioration;
- Do not place or move load, plant or equipment near the edge of any excavation where it is likely to cause its collapse and thereby endanger anyone unless precautions such as the provision of shoring or piling are taken to prevent the sides of excavation from collapsing;
- Provide anchored stop blocks and barriers to prevent vehicles being driven into the excavation;
- Do not allow heavy vehicles near the excavation unless the support work has been specially designed to permit it;
- If an excavation is likely to affect the safety of a structure on which Contactor's staff and workers are working, everyone should be evacuated and precautions should be taken to protect the structure from collapse by providing shoring; and
- Contactor's Traffic Management Staff should be on site when the works are ongoing.

5.5.2 Health and Safety Related to Working at Heights

A risk assessment is to be conducted prior to commencing any height work to assess the degree of risk and formulate work procedures and control measures necessary to

carry out the tasks in a manner that will minimise/eliminate any risk to the health and safety of personnel. Guard railing, edge protection, scaffolding, travel restraint devices, work platforms and appropriate work procedures (systems of work to minimise risk), whichever is identified by the Risk Assessment/Work Method Statement are to be in place while working at heights

- All travel restraint/fall arrest equipment/components are to be inspected by a competent person at six (6) monthly intervals and a written record of the inspection is to be kept. Any damaged or defective components/equipment is to be removed from service;
- All height work should be carried out from enclosed environments (eg. scaffolds, elevating work platforms) where practical; and
- Individual sheets of roofing iron/roofing tiles are to be securely tacked/fixed in position prior to personnel walking on them or using them as a work surface to fix subsequent sheeting/tiles. At no time are items to be thrown up or down to other workers on different levels. All items are to be lifted to other levels by appropriate lifting methods/systems. Only competent and experienced personnel are to be engaged in activities involving height work

General Provisions:

Ensure that working platform is secure and check that it:

- Will support the weight of employees using it and any materials and equipment they are likely to use or store on it;
- Is stable and will not overturn; and
- Is footed on stable ground or on a stable support or structure.

Safe Working Platform.

All working platforms should be:

- Fully boarded and securely fixed to prevent displacement;
- Strong enough to support the load usually placed on it (employees and materials); and
- Provided with toe-boards so as to prevent materials and tools from falling over the edges.

Scaffolds

All scaffolds should be:

- Properly designed and inspected, constructed, erected and maintained so as to prevent collapse or accidental displacement;
- Based on a firm and level foundation;
- Erected on a firm ground capable of supporting the weight of the scaffold and any load likely to be placed on it;
- Braced and tied into a permanent structure or otherwise stabilized;

- Provided with platforms that are fully boarded and wide enough for the work and for access;
- Provided with scaffold boards that are properly supported and rest on at least three supports; and
- Have a safe ladder or other access onto the work platforms.

Safe Use of Access Ladders

- Any ladder should be properly fixed to prevent slipping;
- A good grip should be provided to the ladder;
- The top of the ladder should rest against a solid surface and not on fragile or other insecure materials such as cement or plastic guttering;
- Both feet of the ladder should rest on a firm footing and cannot slip; and
- If the ladder cannot be fixed a second person should secure the ladder at the base while it is being used.

Stepladders

- Stepladders should be fully opened and both spreader bars should be locked;
- Stepladders should not be used on top of scaffolds, platforms, or other surfaces above the ground;
- Unattended tools, such as hammers, should not be left on top of stepladder. Stepladder should be dismounted before being moved;
- Top most rung of a stepladder should not be used;
- Ladders should be inspected regularly by a competent person and damaged ladders should be removed from service;
- Ladders should be properly stored on racks under cover and above ground; and
- Ladders should not be hung from its rungs.

Roof Works

- All roof-work operations should be pre-planned and properly supervised;
- Roof-work should only be undertaken by employees who are physically and psychologically fit and have the necessary knowledge and experience for such work;
- Work on roofs should not be carried out in weather conditions that threaten the safety of employees;
- All the edges and openings on a roof from or through which there is a risk of fall should be protected with suitable guardrails and toe boards;
- All covers for openings in roofs should be of substantial construction and be secured in position; and
- Where required to work on or near roofs or other places covered with fragile material, through which they are liable to fall, they should be provided with sufficient suitable roof ladders or crawling boards strong enough, when spanning across the supports for the roof covering, to support those employees.

5.5.3 Health and Safety Related to Handling of Explosive

General Safety Rules

To regulate the handling of explosives on site, the Contract made a series of rules as follows:

An employer, self-employed person or user shall ensure that:

- All explosives or ingredients thereof are at all times free of foreign material;
- All reasonable precautions are taken to prevent the spillage of explosives;
- Cleaning procedures in the case of a spillage of explosives are prescribed in writing by the explosives manager: Provided that where no cleaning procedures have been prescribed any unusual spillage of explosives shall be reported immediately to the supervising official;
- All waste, paper, timber, rags, cotton and similar materials that have been in contact with explosives or an ingredient of an explosive are disposed of in a manner prescribed in writing by the explosives manager: Provided that at the end of the working day all waste and floor sweepings from danger buildings shall be deposited in the designated places;
- The explosives or partly mixed explosives are conveyed as soon and as carefully as possible and taking such precautions and in such a manner as will effectively guard against any accidental ignition or explosion;
- Only containers provided for the conveyance of explosives are used for transporting explosives or partly mixed explosives and that such containers are at all times kept clean, free from grit and in a good state of repair;
- Vehicles containing explosives are left unattended only in designated places;
- Except for drying purposes, preparation on burning grounds or testing, explosives are not exposed to direct rays if the sun or to rain, whether being transported or not; and
- Manufactured explosives are removed as soon as is reasonably possible from the process building to an explosives workplace magazine or that they are immediately dispatched.

An employer, self-employed person or user shall ensure that:

- All material, equipment, tools or similar articles used in a danger area are decontaminated after such use, and that no person makes use of any such article that has not been decontaminated after use in a contaminated area; and
- The certification of the decontamination process contemplated in paragraph (a) is certified and approved by the explosives manager or a person authorized by the explosives manager.

Unless permission has been granted by the authority of occupational health and safety, no person shall use:

- Explosives in workplaces other than explosives workplaces approved by the authority of occupational health and safety; and

- Any explosives for which no provision is made in these regulations.

An employer, self-employed person or user shall ensure that:

- Explosives are transported and stored together or separately in the explosive's workplace in accordance with relative laws and regulations; and
- Explosives are stored by the means which according to the authority and regulations is in conformation with the safety and the explosives are kept in a condition which is advantageous to safety.

No person shall:

- By leaving explosives unattended allow unauthorized access to such explosives; and
- Bury, dump, hide or abandon any explosives.

No person shall use any explosive material for blasting purposes unless:

- He or she is in possession of a written permission (permit) issued by or under the authority;
- He or she is undergoing training while using such blasting material under the immediate and constant supervision of a person who is in possession of duly authorized permit;
- He or she is trained and is authorized by the relative agent to destroy or test explosives in a licensed workplace; or
- If the blasting material is used in a workplace other than a manufacturing or testing workplaces, he or she shall inform the monitoring engineer or supervisor not less than 24 hours prior to such use and be in possession of written permission issued by or under the authority of the chief inspector of explosives.

No person shall permit any other person who is not in possession of such a permission to use any blasting material unless such other person is, while using such blasting material, under the immediate and constant supervision of a person who is in possession of such permission.

Any explosives for which provision is not made in these regulations shall be used only in such manner and under such conditions as may be prescribed, in writing, by the chief inspector of occupational health and safety.

Any permission issued prior to the date of promulgation of these regulations shall be deemed valid: Provided that the conditions for obtaining permission as determined in these regulations shall be complied with within six months of promulgation of these regulations.

5.5.4 Health and Safety Related to Use and Temporary Storage of Flammable Liquid and Gas on Site

On site, there might be a high quantity of flammable liquids and gases and if they could not be handled and stored in a proper way, the Contractor could sustain serious

property loss and health damage. To regulate the action of using and storing the flammable liquids and gases on the Landfill site, the provision for use and storage flammable liquids and gas shall be as follows:

- Where flammable liquids and gases are being used, applied or stored at the workplace concerned, this shall be done in such a manner which would cause no fire or explosion hazard, and that the workplace is effectively ventilated; Provided that where the workplace cannot effectively be ventilated;
- Every employee involved shall be provided with a respirator, mask or breathing apparatus of a type approved by the chief inspector,
- Steps shall be taken to ensure that every such employee, while using or applying flammable liquid or gas, uses the apparatus supplied to him or her;
- No person shall smoke in any place in which flammable liquid or gas is used or stored, and such contractor shall affix a suitable and conspicuous notice at all entrances to any such areas prohibiting such smoking;
- Flammable liquids and gases on a construction site shall be stored in a well-ventilated reasonably fire resistant container, cage or room and kept locked with proper access control measures in place; and
- An adequate amount of efficient fire-fighting equipment shall be installed in suitable locations around the flammable liquids and gases store with the recognized symbolic signs;

Note:

- Powder fire extinguishers will be used in mixed risk environments involving flammable gases;
- Foam fire extinguishers will be used on fire involving solid combustible materials to prevent re-ignition after the fire has been extinguished;
- CO_2 fire extinguishers will be used on flammable liquid fires and fires involving electrical equipment;
- Water fire extinguishers will be used in environments containing solid combustible materials such as wood, paper and textiles; and
- Wet chemical fire extinguishers will be used on burning oil fires.

- Only the quantity of flammable liquid or gas needed for work on one day shall be taken out of the store for use;
- All containers holding flammable liquids and gases shall be kept tightly closed when not in actual use and, after their contents have been used up, shall be removed from the construction site and safely disposed of;
- Where flammable liquids and gases are decanted, the metal containers shall be bonded or earthed; and
- No flammable material such as cotton waste, paper, cleaning rags or similar material shall be stored together with flammable liquids and gases.

5.5.5 Health and Safety Related to Works Executed on or around Leachate Ponds/Tanks

- Nobody should stand on the edges of floating platform unless necessary and handrail on the edges of floating platform must be used and held when carrying out works on the edges;
- Test the depth of water/swampy ground if necessary before putting down feet in case of being caught into a marsh or unstable ground;
- Life vest must be worn properly by all labourers working on raft and any place where drowning may take place;
- When working in the places where hazardous gas exists, respirator or other special protectable mask must be worn to avoid the potential for gas poisoning; and
- Workers shall be vigilant of the potential risks posed by wild animals. Anti-venom snake bit kits must be present at site construction when cleaning the vegetations from facultative ponds and tanks.

5.5.6 Moving, Lifting and Handling Loads

Manual Handling

Lifting and handling of materials is to be done in a safe and sensible manner so as not to cause injury. Personnel are not to participate in manual handling activities if they have not been properly trained, or have an existing or previous injury which will hinder them, or will be aggravated by lifting, pushing, pulling etc. If the material/item is considered to be too heavy or awkward to handle by one person, assistance in the form of team lifting, a crane, forklift, hand trolley, wheelbarrow or other suitable mechanical devices are to be used.

Contractors and employees are to ensure they are familiar with correct manual handling techniques and are physically capable of carrying out the tasks they are to perform otherwise they are to request training. Contractors will be responsible for all materials handling equipment (eg. cranes, forklifts) relating to their contract, unless specified otherwise. Mechanical means such as cranes, forklifts, materials lifts and/or other suitable load shifting equipment is to be used to lift and/or move equipment that is awkward and/or is heavy from ground level to and/or between different levels of elevated areas.

Hoists

- Select a hoist, which is suitable for the site and capable of lifting the loads required;
- To prevent people being struck by the platform or other moving parts, enclose the hoist-way at places where people might be struck, e.g., working platforms or window/door openings. Provide gates at all landings and at ground level;
- Prevent falling down the hoist-way by making sure the hoist-way is fenced, where people could fall down, the gates at landings are kept closed except during loading and unloading, and the hoist platform is close to the edge of the landing so that there is no gap to fall through; and

- Prevent being hit by falling materials by stopping loads falling from the platform, e.g., make sure wheelbarrows are not overfilled, not carrying loose loads. Put loose loads in proper container or use a hoist with an enclosed platform. Not overloading the platform. Enclosing the hoist-way. Hoist should be used to carry materials only. Hoist should be used to carry materials only.

Lifts

- For the carriage of persons, lifts need to be especially constructed and installed for the purpose, with such features as mechanical and electrical interlocking devices on the cage and landing gates.

Site Vehicles

- Heavy vehicles shall be guided by a specific person with green safety sign, no standing is allowed within the working radial range of a mobile crane, mobile pump and excavating machines;
- Consider a one-way system and avoid needs for vehicles to reverse wherever possible;
- Fit reversing alarms to vehicles;
- Consider making use of signallers to control high-risk situations, e.g., where visibility is restricted;
- Prepare the running surface of temporary roads. Where the site is muddy, use hard-core or other fill to overcome the problem of skidding and repair potholes;
- Protect any temporary structures, such as scaffolds, which might be damaged and made unsafe if struck by a vehicle;
- Take precautions, such as stop blocks, were vehicles tip materials into excavations;
- Make sure that vehicles are not overloaded as they may become unstable, difficult to steer or have their braking efficiency impaired;
- Make sure loads are securely attached to vehicles and that loose materials cannot fall from lorries or site dumpers; and
- Take special precautions with blind corners.

Measures against Insect and Pest Nuisance

Contractor shall at all times take the necessary precautions to protect all staff and workers employed on the Site from insect and pest nuisance, and to reduce their danger to health. Contractor shall provide suitable prophylactics and shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

5.5.7 Site Access

It is the Contractor's and Operator’s responsibility to ensure the safety of all persons on site and the general public during execution of the Works and Operation. During the construction phase, the Engineer and his all supervisory staff should encourage the

Contractor and his workers to use safe methods of working and remind them of the provisions of the safety regulations and other relevant regulations.

The Contractor as well as the Operator shall appoint safety personnel who have adequate experience in the scope of the Works. The safety personnel shall supervise and monitor implementation of the Health and Safety Plan.

5.6 Diseases, Heat Stress and Wounds

Consideration should be given to the following:

- Open trenches and other depressions that accumulate stagnant water should be grounded as soon as possible to avoid breeding areas of mosquitoes that carry malaria;
- Outbreaks of malaria and dysentery are possible in times of flood. Outbreaks of these diseases should be avoided by providing uncontaminated, adequate and sanitary drinking water;
- Sufficient drinking water should be available on site to prevent dehydration and overheating;
- Open wounds should be treated in time with antiseptic/antibiotic to prevent disease development; and
- Promote HIV / AIDS and COVID-19 awareness and prevention measures.

Given the fact that there is a certain risk group for the spread of HIV / AIDS and Sexually Transmitted Diseases (STD), the Contractor should address this issue adequately.

The Contractor shall conduct an HIV / AIDS awareness program through an approved Service Provider as specified below to reduce the risk of transfer of the HIV virus between the Employees of the Contractor and their families and the local community to promote diagnosis and to assist affected individuals.

The Contractor shall institute HIV / AIDS awareness and prevention campaigns and training activities monthly and through the Approved Service Provider during the progress of the works. The main target group is the manpower employed and full participation will be guaranteed by the Employer.

HIV / AIDS awareness and prevention activities should include, but are not limited to:

- HIV / AIDS awareness sessions;
- During awareness sessions, they should have free condoms available;
- Local offices should display HIV awareness posters and leaflets; and
- Contractor must report on the campaigns carried out.

The Contractor shall ensure awareness on COVID-19 to reduce its dissemination in the workplace.

6. EMERGENCY RESCUE PROCEDURES

There shall be specific requirements in place for emergencies in the Emergency Contingency and Preparedness Procedure. This includes a requirement to conduct a site assessment to determine the possible scenarios and review and maintenance of the site evacuation plan and emergency response procedures. There should be an accessible emergency assembly point and an emergency alarm system installed as part of the emergency procedure.

The Contractor and the Operator shall implement suitable procedures and drills for emergency situations, including rescue operations. The foreseeable emergencies should include, but not limited to fire, drowning, soil collapse, natural catastrophe, person injured and chemical spill. In the event of other potential emergency situations being identified during the execution of the project, specific procedures shall be developed. The following paragraphs describe the common arrangements for emergency procedures.

6.1 Emergency Coordinator

To ensure that all emergency situations are effectively coordinated, a Project Emergency Coordinator and deputy shall be appointed. The names of both the Project Emergency Coordinator and his deputy and their contact numbers shall be made known to all concern. All concerned are required to alert the Project Emergency Coordinator immediately they become aware of an emergency.

The Project Emergency Coordinator's responsibility shall include ensuring that on-site emergency; rescue and all key personnel have been alerted and summoning the assistance of external emergency services such as fire, ambulance, from Nsawam Government Hospital (to confirm) away from the working site will be available and police as appropriate. He will also maintain a log of all relevant information for each incident, recording names, actions, dates and times, etc.

6.2 Emergency Rescue Operation

In order to ensure an adequate response to an emergency situation, an adequate number of competent trained personnel will be appointed for the use of firefighting equipment, provision of first aid, etc.

Suitable emergency/rescue teams shall be established to ensure rapid response to any emergency, the rescue teams will comprise subcontractors nominated personnel. The emergency rescue team will participate in the simulated emergency exercise organized by the Contractor.

6.3 Site Emergency Rescue Team

An accident emergency rescue team shall be appointed to organize, lead the accident rescue if any and to allocate various resources (manpower, vehicles, equipment), so as to take conduct the emergency response in the best possible way. The accident shall be reported to the higher management staff and related department, and the follow-up situation.

The phone of the team shall be 24 hours unimpeded. The rescue team shall be properly trained by professional personnel in specific fields. The training courses such

as electric shock rescue, falling accident rescue, heatstroke rescue, artificial respiration, drowning rescue etc., shall be provided.

Nsawam Government Hospital will be used as the emergency response medical services as well as for the provision of an ambulance.

Emergency Calls

Contractor and Operator will post at sites and issue to all staff and workers emergency Contact Card.

6.4 Accident Reporting Procedures Definition

Incidents

An incident is an unplanned event or chain of events, which hash or could have caused injury or illness and/or damage (loss) to people, assets, the environment, or reputation.

Injury

An injury is categorized such as cut, fracture, sprain, amputation etc., which results from a single instantaneous exposure.

Lost Time Injuries (LTI's)

Lost time injuries are the sum of Fatalities, Permanent Total Disabilities and Lost Workday Cases but excluding Restricted Work Cases.

Lost Workday Cases

A Lost Workday Case is any work-related Injury which renders the Injured person temporarily unable to perform any Regular Job or Restricted Work on any day after the day on which the injured was received. In this case "any day" includes rest day, weekend day, scheduled holiday, public holiday or subsequent day after ceasing employment.

Note: This definition deviates from OSHA guidance, which considers restricted work as a lost workday case.

A single incident can give rise to several Lost Workday Cases, depending on the number of people injured because of that incident.

Medical Treatment Case (MTC)

A Medical Treatment Case is any work-related injury that involves neither Lost Workdays nor Resident Workdays, but which requires treatment by, or under the specific order of, a physician or could be considered as being in the province of a physician.

Medical Treatment does not include First Aid even if Physician or registered professional personnel provide this.

Near Miss

A Near Miss is an incident which potentially could have caused injury or Occupational illness and / or damage (loss) to people, assets, the environment, or reputation, but which did not.

Permanent Disability

Permanent Total Disability is any work-related injury, which permanently incapacitates an employee and results in termination of employment.

Regular Job

A Regular Job is one, which has not been established to accommodate an injured employee. It should be an existing job or task within the Contractor's or Operator's organization, which the injured is deemed competent to perform.

Restricted Work Case (RWC)

A Restricted Work Case is any work-related injury, which results in a work assignment after the day the incident occurred that does not include all the normal duties of the person's Regular Job. The restricted work assignment must be meaningful and pre-established or a substantial part of a Regular Job.

Reportable Cases are:

- Fatality;
- Permanent Total Disability;
- Permanent Partial Disability - Lost Workday Case;
- Restricted Workday Case; and
- Medical Treatment Case.

6.5 Accident Reporting Procedure

The supervisor in the field of safety and health at work shall keep a record of the OH&S measures on the site which are entered in the Register of coordination as necessary.

All injuries regardless of whether it is a LTI, RWC, LWC, and MTC arising out of work are required to be verbally reported to the immediate Supervisor. If the Supervisor is not available, he shall report to H&S Officer. The Accident Reporting Procedure is as follows:

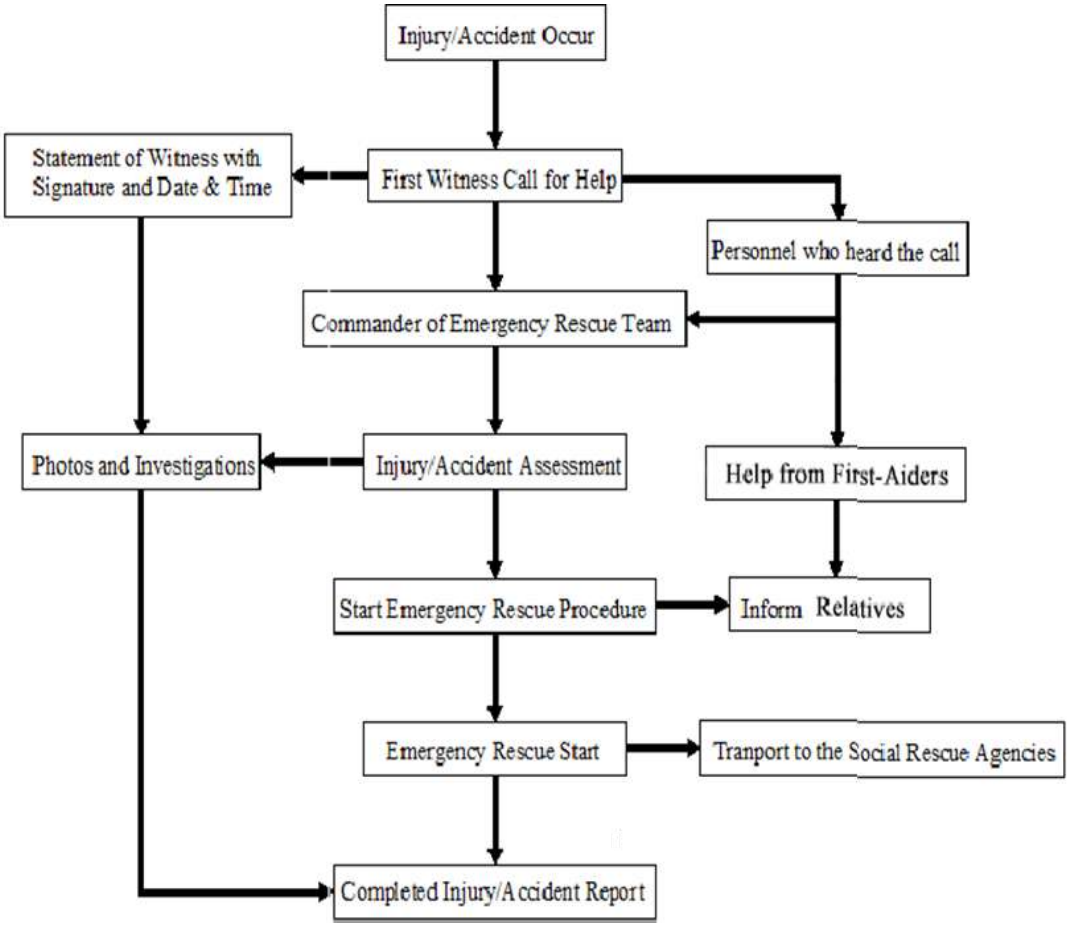


Fig. 6.5-1: Accident Reporting Procedure Scheme

In Case of Injury/Accident at Work

All workers shall have Social Insurance and facilities on the site. After the injured (if any) has been taken to the hospital, the emergency rescue team shall notify the Site Office and the Contractor's Representative as soon as possible. The H&S officer shall inform the next of kin with the contact means collected in personnel registration when employ prior to his commencement of construction activity on site. Statements from witnesses with signature, date and time shall be taken. Photographs of the area where the incident occurred, and any other relevant items are to be taken. The Contractor's Representative will assist in the investigation. The completed accident report form will be sent to the Site Office as well as the Employer's Representative in time. It will be done within 24 hours of the accident.

Transport

Where someone has suffered injury or illness at work necessitating his removal to his home or to a hospital or other similar institution, the Bidder (Contractor) shall promptly provide an appropriate means of conveyance for the one.

The first aider shall accompany the injured or ill one to a hospital or other similar institution whenever the circumstances so justify.

6.6 Evacuation Procedures

As far as the Evacuation Plan is concerned, a meeting point will be defined next to the main entrance. Evacuation routes will be kept unblocked and defined. Vehicles from xxx (to specify) will be called to carry out the transport to local health facilities.

The following scheme shows the Evacuation Response Procedure to be followed:

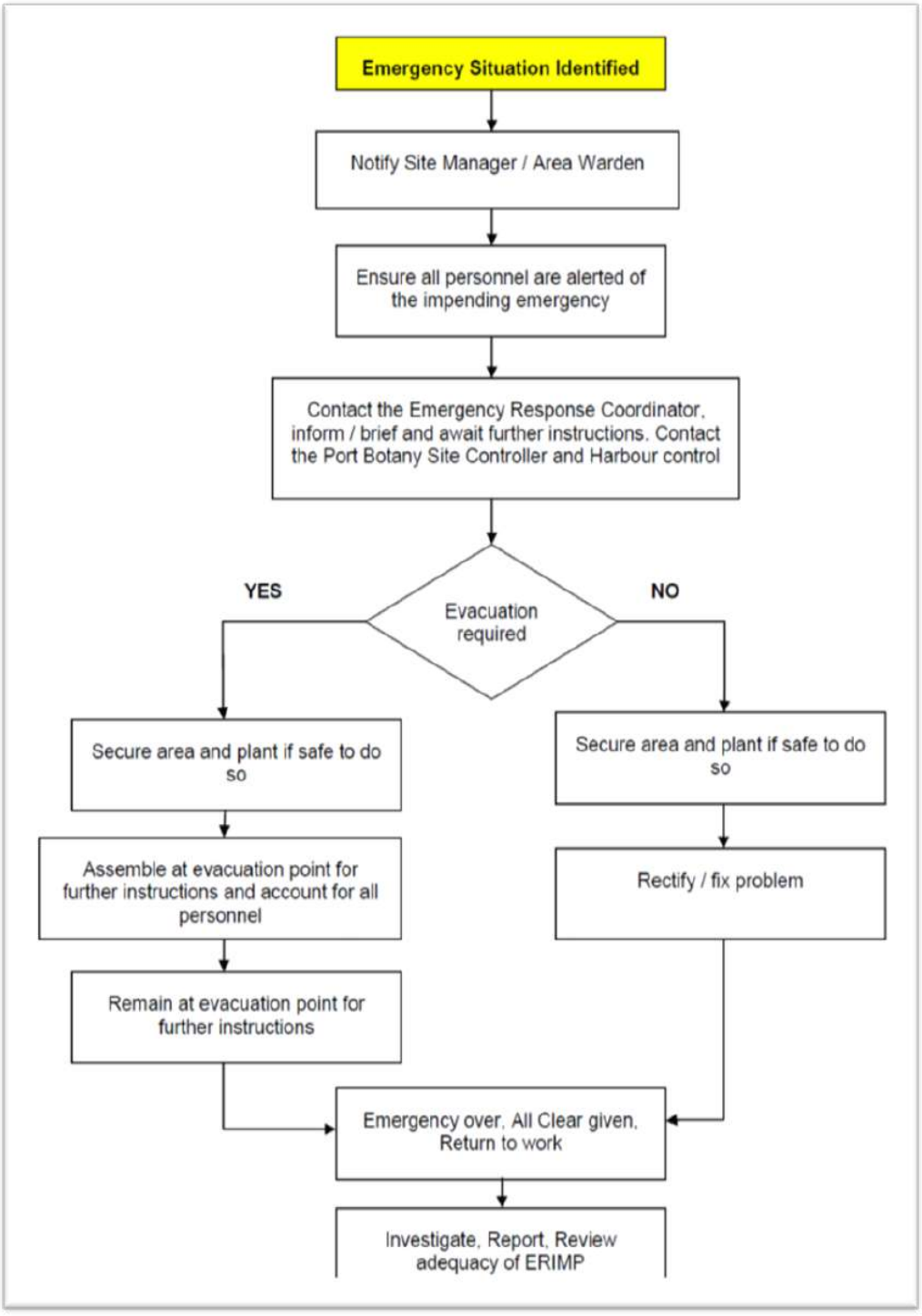


Figure 6.6-1: General Evacuation Response Procedure

ANNEXES

ANNEX 1 – ACCIDENT REPORT FORM

ACCIDENT NOTIFICATION AND INVESTIGATION REPORT

TO BE COMPLETED BY IMMEDIATE MANAGER/SUPERVISOR WITHIN 24 HOURS OF OCCURRENCE

NOTE: All incidents and injuries are to be recorded within 24 hours.

PART 1 NOTIFICATION Accident No:

IS THIS WORK RELATED?	☐ Yes ☐ No	If not why?	
IS THIS AN INCIDENT OR A Accident?	Accident ☐ Incident	**DATE/TIME REPORTED** Date ( ): Time ( ) :	
WHAT WAS AFFECTED?	People: ☐ Asset / Production: ☐ Vehicle Damage	☐ Environment	☐ Reputation
CATEGORY	☐ Cat. 1 – Client/Consultant employee ☐ Cat. 2 - Contractor/Subcontractor ☐ Cat. 3 – Partner / Customer ☐ Cat. 4 - Non H&SE primacy personnel ☐ Cat. 5 - Non-work related Cat. 6 – Not belong to the work	☐ Field Incident/ Accident ☐ Office Incident/ Accident ☐ Non-Field Accident	
AGENT OF INCIDENT	Powered Equipment/Tools ☐Machinery & fixed plant ☐ Mobile plant Transport	Non-powered Equipment/Tool ☐ Outdoor Environment ☐ Human Agencies ☐ Other (specific):	☐ Chemical Substance ☐ Indoor Environment ☐ Biological Agencies

Accident/ INJURY SUMMARY

DATE / TIME OF OCCURRENCE: Date (d/m/y): Time (24hr) :

FULL DESCRIPTION: *(Describe fully the events that resulted in the incident/injury. Describe what and how it happened. Use separate paper if necessary*

☐ Attachments included

IMMEDIATE ACTIONS TAKEN:

CLASSIFICATION *Complete both boxes using the classification table*

ACTUAL SEVERITY - *What were the actual consequences of this incident? If multiple consequences make multiple selections*

PEOPLE:	ENVIRONMENT:	ASSET / PRODUCTION	REPUTATION:
☐ A - No impact or First Aid Case	☐ A - No Impact	☐ A - Zero Effect or Slight Damage or Loss	☐ A - No /Temporary Local Impact
☐ B - Medical Treatment Case or Restricted Workday Case	☐ B - Localised	☐ B - Minor Damage or Loss	☐ B - Local Short Term Impact
☐ C - Lost Workday Case	☐ C - Moderate	☐ C - Local Damage or Loss	☐ C - Local Long Term Impact (manageable outcomes)
☐ D - Disability/Permanent Injury/Illness	☐ D - Significant (local)	☐ D - Major Damage or Loss	☐ D - Local Long Term Impact (unmanageable outcomes)
☐ E - Fatality	☐ E- Significant (widespread)	☐ E - Extensive Damage or Loss	☐ E – International impact

POTENTIAL SEVERITY (worst credible outcome) *Realistically, could this incident have had a worse outcome?*

PEOPLE:	ENVIRONMENT:	ASSET / PRODUCTION:	REPUTATION:

☐ A - No impact or First Aid Case ☐ B - Medical Treatment Case or Restricted Workday Case ☐ C - Lost Workday Case ☐ D - Disability/Permanent Injury/Illness ☐ E – Fatality	☐ A - No Impact ☐ B - Localised ☐ C - Moderate ☐ D - Significant (local) ☐ E - Significant (widespread)	☐ A - Zero Effect or Slight Damage or Loss ☐ B - Minor Damage or Loss ☐ C - Local Damage or Loss ☐ D - Major Damage or Loss ☐ E - Extensive Damage or Loss	☐ A - No /Temporary Local Impact ☐ B - Local Short Term Impact ☐ C - Local Long Term Impact (manageable outcomes) ☐ D - Local Long Term Impact (unmanageable outcomes) ☐ E - International Impact

☐ All incidents and near misses shall be investigated for a potential severity classification of 'C' or higher, Root Cause Analysis shall be undertaken

REPORTING PARTY DETAILS

PERSON REPORTING INCIDENT (NAME)	**EMPLOYMENT CATEGORY (of person reporting):** ☐ Hydroplan ☐ Casual/Work Experience ☐ Joint Venture Employee ☐ Member of Public/Visitor ☐ Client ☐ Contractor:

LOCATION DETAILS

LOCATION WHERE THE INCIDENT OCCURRED: (Name and address of location and exact whereabouts at the location)	**SITE:** **Point:**
	WORKPLACE: ☐ Office ☐ Site (above mentioned) ☐ Travel **Other**
WITNESS NAME (S):	

IMMEDIATE NOTIFICATION

	REQUIRED	ACTIONED
Immediate Notification to Hydroplan (refer Incident & Accident Reporting & Investigation Standard)	☐	☐

INJURY DETAILS – *Complete only if Injury/ illness sustained. For multiple injuries/illnesses, duplicate this section*.

FULL NAME OF INJURED PARTY		**SEX** ☐ Male ☐ Female	**OCCUPATION**
FULL RESIDENTIAL ADDRESS			**DATE OF BIRTH** (d/m/y):
DATE HIRED	**DATE EMPLOYER NOTIFIED OF INJURY/ILLNESS**	**EMPLOYMENT CATEGORY (of injured person)** ☐ Cat. 1 – Hydroplan employee ☐ Cat. 2 - Contractor / Subcontractor ☐ Cat. 3 – Partner / Customer ☐ Cat. 4 – Non H&S primacy personnel ☐ Cat. 5 – Non-work related Cat. 6 – Not belong to the work	
HOW LONG IN PRESENT JOB: ☐<3 montH&S 3 to 6 mtH&S 6mth to 2yrs ☐ 2yrs to 5yrs ☐ > 5 yrs			
INJURY TYPE: ☐ First Aid Case ☐ Medical Treatment Case Restricted Workday Case ☐ Lost Workday Case ☐ Fatality			
NATURE OF INJURY OR ILLNESS (eg. laceration, fracture, hearing loss, unconsciousness)		**PART OF BODY INJURED** (back, left wrist, right eye etc	
WHAT WAS INJURED PERSON DOING JUST BEFORE THE INCIDENT? (Please be specific. Identify tools, equipment or material in use)			

WHAT HAPPENED? (How did the injury occur)		
WHAT OBJECT OR SUBSTANCE DIRECTLY HARMED THE EMPLOYEE?		
WHERE WERE INJURIES TREATED? (i.e., name of clinic or location)	**WHO PROVIDED TREATMENT? (NAME OF PHYSICIAN OR HEALTHCARE PROFESSIONAL)**	
TREATMENT GIVEN? **BY:**		
HAS INJURED EMPLOYEE RETURNED TO WORK?	☐ Restricted Work ☐ Regular Work No. Days	Fatality Date of death

PART 2 INVESTIGATION

Investigation

INVESTIGATION TEAM (NAME): (SIGNATURE):

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____

INVESTIGATION TEAM TO COMPLETE ALL ITEMS BELOW:

Select one or more contributory factor:

☐ 1. Design of Plant Facilities, or Equipment	☐ 7. Plant Equipment Operated Incorrectly	☐ 13. Improper Vehicle Operation
☐ 2. Job Planning, Supervision or Instruction Inadequate	☐ 8. Housekeeping Congested, Incorrect Storage	☐ 14. Environmental Factors, Weather
☐ 3. Rules, Procedures or JHA Not Followed	☐ 9. Incorrect Tools or Mechanical Aids Used	☐ 15. Inattention to Details and Hazards of Job
☐ 4. Rules, Procedures or JHA Inadequate	☐ 10. Incorrect or Lack of Personal Protective Equipment	☐ 16. Action of Fellow Employee
☐ 5 Incorrect Body Position in Relation to Work	☐ 11. Inadequate Knowledge or Skill	☐ 17. Maintenance, Inspection Not Adequate
☐ 6. Guarding or Protective Devices Not Provided or Ineffective	☐ 12. Chemical Exposure, Personal Hygiene	☐ 18. Other

Indicate Immediate Causes (Select from the below list and enter appropriate Numbers) and Explain Reason Selected

A) **Substandard practices:**

☐ 1. Operating Equipment without authorization	☐ 7. Using defective equipment	☐13. Improper position for task
☐ 2. Failure to warn	☐ 8. Using equipment improperly	☐14. Servicing equipment in operation
☐ 3. Failure to secure	☐ 9. Failing to use Personal Protective Equipment properly	☐15. Horseplay
☐ 4. Operating at improper speed	☐ 10. Improper loading	☐16. Under influence of alcohol a drugs
☐ 5 Making safety devices inoperable	☐ 11. Improper placement	
☐ 6. Removing safety devices	☐ 12. Improper lifting	

B) Substandard conditions:

☐ 1. Inadequate guards or barriers	☐7. Poor housekeeping, disorderly workplace	☐13. Inadequate ventilation
☐ 2. Inadequate or improper protective equipment	☐8. Hazardous environmental conditions: gases, dusts, smokes, fumes, vapors	
☐ 3. Defective tools, equipment or materials	☐9. Noise exposures	
☐ 4. Congestion or restricted action	☐10. Radiation exposures	
☐ 5 Inadequate warning systems	☐11. High or low temperature exposure	
☐ 6. Fire and explosion hazards	☐12. Inadequate or excessive illumination	

Select one or more root causes:

☐1. Procedures & Safe Work Practices	☐ 7. Materials Control/ Procurement	☐ 13. Contractor Operations
☐ 2. Communications	☐ 8. Leadership Accountability	☐ 14. Training/ Competency
☐ 3. Design	☐ 9. Planning & Workload	☐ 15. Work Environment/ Workplace Layout
☐ 4. People & Behaviour	☐10. Hazard Prevention/ Investigation	☐ 16. Emergency Response
☐ 5. Monitoring & Inspection	☐ 11 Risk Recognition & Assessment	
☐ 6. Management of Change	☐ 12. Supervision/ Oversight	

Indicate Root Causes (select from the above list and enter appropriate Numbers) 10 and Explain Reason Selected.

10. Risk Recognition & Assessment

PART 3 CORRECTIVE ACTIONS, REVIEW AND APPROVAL

CORRECTIVE ACTION

ENSURE THEY ARE ENTERED AND CLOSED OUT IN OMNISAFE		
Action Item Description	**Person Responsible**	**Target Date for Completion**
1.		
2		
3		
4.		
5.		
6.		
7.		
8.		

ATTACHED DOCUMENTS

ALL ATTACHED DOCUMENTS MUST BE SCANNED INTO OMNISAFE	
Document name	**Document name**
1. Identification document (ID).	6. PPE Form List
2. Work contract	7.
3. Regulation for drivers and operators	8.
4. Training records	9.
5. Job ID Form	10.

REVIEW AND APPROVALS (complete at the end of the investigation Phase)

Prepared By:	**Signature**	**Date**
H&S Officer / Rep:	**Signature**	**Date**
Comments:		
Project Manager	**Signature**	**Date**
Comments:		
Hydroplan Officer (Classifications C and above)	**Signature**	**Date** / /

Categorization Table

The categories are defined in the table below:

	INCIDENT AND ACCIDENT CATEGORISATION TABLE	
	Category	**Includes injuries, illnesses, environmental incidents, and damage to or loss of assets, production, or reputation**
Work Related	**Category 1** Company Employees	Personnel working directly for the Company (permanent staff, casual staff, contracted staff, seconders, and agency personnel)
Work Related	**Category 2** Contractors and Subcontractors	Contractor and subcontractors working for or managed on behalf of a customer or a joint venture.
Work Related	**Category 3** Partners and Customers	Personnel other than Category 1 or 2 personnel assigned to work with the Company or a joint venture. This includes partner and customer personnel working under shared premises, shared systems and reporting within a project or alliance structure H&S has primacy.
Work Related	**Category 4** Non-H&SE Primacy Personnel	All personnel other than Category 1 personnel working on a project, *Improve* contract or joint venture where the Company has a role, but does not have H&SE primacy.
Not Work Related	**Category 5** Non-Work Related	Accidents or incident at the Company controlled work location deemed to be non-work related (ref. OSHA Standard 1904), including those involving visitors and members of the public, and; The Company personnel with non-work related injuries/ illnesses that might have potential to be aggravated at work, or otherwise trigger return to work processes (exempt from investigation)

Further explanation of these categories, and definition of H&SE primacy is provided in the H&SE Incident and Accident 0 Reporting and Investigation Standard.

ANNEX 2 – WEEKLY SAFETY MEETING TIMETABLE

MONTH-To All Labour and Staff by H&S Manager	
Week 1	Coronavirus: Social Distancing
Week 2	OSHA Focus for: Caught-in Hazards
Week 3	Personal Protection: Eye Safety
Week 4	First Aid: Aid Steps (or any First Aid topic)
Week 1	Coronavirus: Social Distancing

MOIS-To All Labour and Staff by H&S Manager	
Week 1	Electrical Safety
Week 2	Excavation Safety: Work Around Excavation Edges
Week 3	Health Hazards: Back Injury Prevention
Week 4	OSHA Focus for: Electrocution
Week 1	Electrical Safety

MONTH-To All Labour and Staff by H&S Manager	
Week 1	Fire Protection: Construction Site Fire Safety
Week 2	OSHA Focus for: Falls
Week 3	Personal Protection: Hand Protection
Week 4	Tool Safety: Bench and Grinders
Week 1	Fire Protection: Construction Site Fire Safety

MONTH-To All Labour and Staff by H&S Manager	
Week 1	Fall Protection: Scaffolding
Week 2	OSHA Focus for: Struck-by Hazards
Week 3	Site Safety: OSHA Visits
Week 4	Personal Protection: Head Protection (Hard Hats)
Week 1	Fall Protection: Scaffolding

ANNEX 3 – CONSTRUCTION HAZARDS INSPECTION SHEET

Construction Hazardous Inspection Sheet

Inspection Date:_____
Location:_____

Project Contact Person:_____ Inspector´s Name_____

INDICATE EITHER: S = SATISFACTORY/YES **U** = UNSATISFACTORY/NO **N/A** = NOT APPLICABLE

PERSONAL PROTECTIVE EQUIPMENT		HAZ COM	
Safety glasses and/or goggles available & being used?		MSDS openly available to all employees?	
Face shield available for bulk liquid tasks? Grinding?		Flammable liquids are in approved safety cans?	
Hand protection used/worn as required?		Flammable liquids storage containers labeled properly?	
Foot protection worn as required?		All hazardous containers labeled appropriately?	
Hearing protection worn where required?		Supplies on hand for hazardous material spills?	
Hard hats worn on construction site?		**LADDER/STAIR SAFETY**	
Respirators if required? Type?		Ladders are safe and inspected as appropriate?	
Fall protection, full body harness & lanyard used at > 6 ft?		Stair rails - for 30” change in elevation or 4 risers?	
ELECTRICAL SAFETY		Stairs or ladder provided for access points > 19” high?	
GFCI’s used for all portable electrical hand tools?		Extension & straight ladders extend 3’ beyond landing?	
Electrical panels are labeled appropriately?		Stepladders are only used in open position?	
Light bulbs for illumination protected from breakage?		**CONFINED SPACE**	
LO/TO is being used for appropriate tasks?		Permit completed for entry?	
Strain relief integrity for cords and plugs intact?		Rescue / retrieval equipment available on site?	
Extension cords 3-wire marked S, ST, SO, STO, SJ, SJO, SJT, SJTO?		Air monitoring equipment calibrated?	
Electrical cords inspected & have all prongs intact?		Training in hazards, precautions, PPE and rescue documented?	
Portable generators are grounded per NEC requirements?		**MATERIAL HANDLING**	
Electrical power tools are double insulated or grounded?		Chain slings tagged and inspected within last 12 montH&S	
Oxygen/acetylene torch units have flash back arrestors?		Crane used? Annual certification and load charts available?	
Compressed gas cylinders not in use have caps in place?		Hooks used for hoisting have safety latch in place?	

COMPRESSED GASSES		Wire rope slings free of kinks and broken wires?	
Compressed gas cylinders stored secured & upright?		Synthetic slings free of damage to webbing or stitching?	
EXCAVATION		**EMERGENCY/FIRST AID**	
Competent Person for excavation work designated and on site?		Emergency phone numbers posted and/or available to all workers?	
Excavation-ladders if > 4ft deep? Extend 3 ft? 50 ft apart?		Emergency eyewash and/or shower units accessible?	
Excavation – protection from cave-ins for > 5 ft?		First aid kit available at work site?	
Sloping and/or benching appropriate for class of soil?		Fire extinguishers readily available (not blocked)?	
Daily inspection of sloping and/or shoring documented?		Fire extinguishers inspected	
Tabulated available for shoring and/or trench boxes?		CPR & First Aid trained person on site?	
HAND TOOLS/POWER TOOLS		Exits marked? Not blocked?	
Grinders (portable & stationary) have guards in place?		**GENERAL SAFETY**	
Impact style air tools have safety clips/retainers installed?		General housekeeping is neat and orderly?	
Pneumatic power tools have hoses secured?		Wall openings & floor holes are covered or guarded?	
Portable circular saws equipped with protective guards?		Rebar cabs used for protruding bars?	
Unsafe hand tools are prohibited?		Concrete work? Silica dust training documented for all? Respirators?	
Impact tools, hammers kept free of splinters/mushrooms?		Scaffolding–guardrails and access ladders or stairs – used?	
OTHER		Competent person for scaffolding and fall protection on site?	
Traffic control in compliance with MUTCD Part VI or contract?		Scaffold design by qualified person?	
Workers wearing high-visibility garments?		Illumination adequate in all work areas?	
Tool-box talks conducted and documented?			
Signs/signals/barricades in place?			
Training conducted and documented?			
Health and Safety Plan available and reviewed with workers?			
Lasers in use? Warning sign posted?			

CORRECTIVE ACTION PLAN

For all items marked as “U,” list the item, person responsible, and expected completion date.

ACTION ITEM	PERSON RESPONSIBLE	DATE DUE	DATE VERIFIED*	Verified by**

OTHER OBSERVATIONS NOT RECORDED ABOVE

OBSERVABLE ITEM	REF.	PERSON RESPONSIBLE	DATE DUE	DATE VERIFIED	Verified by

* Date Observation/Corrective Action was verified as completed.

** Initials of the individual verifying the Observation/Corrective Action was verified as completed.

Reference columns should contain the OSHA regulation, DOT Contract Area or other standard or regulation being cited.

NO VIOLATIONS NOTED DURING THIS INSPECTION ☐

Signature of Inspector: Date

Signature of H&S Manager (any report with unsatisfactory items) Date

Copy of inspection sheets to:

- Safety/HR Manager (All reports)
- Safety Officer (All reports)
- Project Manager (reports which contain any unsatisfactory item)

ANNEX XI - Resource Conservation Plan

Resource Conservation Plan

1. Introduction:

Sustainable development calls for the need to conserve resources, especially the non-renewable resources.

2. Objective of the plan:

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

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

3. Planning:

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

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

4. Execution of the plan:

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

Material

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

Fuel/Energy

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

Water

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

Pollution:

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

5. Checking and Corrective Actions

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

ANNEX XII - Tree Plantation Plan

Tree Plantation Plan

1.1 Background

The proposed sub-project, revolving around the development of the sanitary landfill cells at the existing Jam Chakro landfill site will have impacts on the local environment, including the ecological environment. This document has been prepared to understand the extent of these impacts, and to accordingly define mitigation measures in line with the World Bank's mitigation hierarchy which would also be widely acceptable to the project stakeholders.

1.2 Ecological Baseline

In general, Karachi is an urban environment, where the natural fauna and flora-based ecosystems of the city are less in number, and as such are also of lower significance, where as a result, there is also low biodiversity all around. The same can be said for the area in and around the Jam Chakro landfill site, where the sub-project is proposed, which can be defined as a degraded/ deteriorated habitat for the following reasons:

1. Gradual increase over time in the waste being dumped at the site, resulting in more area being covered in waste than before, essentially encroaching upon areas where there may have been plants.
2. Excessive anthropogenic interventions in the form of developments of housing schemes, houses, and commercial ventures around the landfill site, resulting in excessive removal of native flora and driving out of fauna.
3. Gradual increase in amount of vehicular movement in the area due to construction activities and increased vehicles visiting the site for waste related activities, driving out fauna.
4. Burning of wastes where fire spreads to plants in the areas also

Some pictures of these phenomenon documented during site visits are shown below:

	
Figure shows the habitat destruction at the landfill site	Figure shows how unplanned fire has destroyed the biodiversity and niche

A map of the development of the landfill site is also provided below in Figure 1, with the different areas existing and proposed for development at the site are outlined:

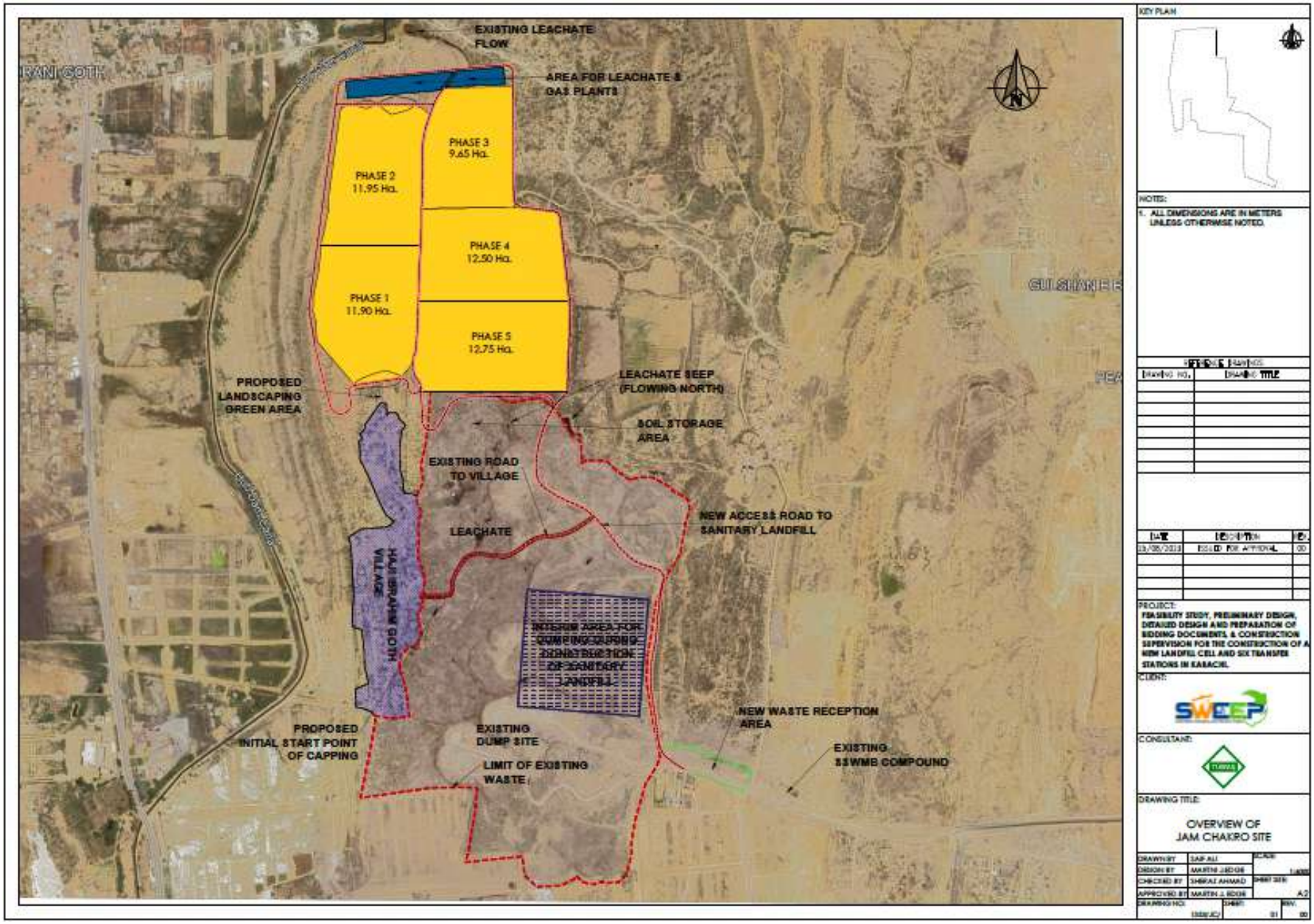


Figure 1 - Overview of Development at Jam Chakro Site

Furthermore, detailed investigations of the AOI were also conducted in terms of the ecological footprint in the area, where the flora documented is highlighted below:

Legend	
Symbol	**Meaning**
X	Observed in AOI
--	Not observed in AOI
No.*	Specific number of trees observed in AOI

S#	Species	Common Name	IUCN Status	Landfill site
	Threatened Flora			
1.	***Commiphora wightii***	Guggul	Critically endangered	667
	Total threatened flora			**667**
	Trees			
2.	*Azadarichta indica*	Neem	Not evaluated	X
3.	*Prosopis glandulosa*	Honey mesquite	Not evaluated	X
4.	*Senegalia senegal*	Gum Arabic tree	Not evaluated	X
5.	*Vachellia nilotica*	Babul	Not evaluated	X
6.	*Corymbia citriodora*	Safeeda	Least concern	X
7.	*Phoenix dactylifera*	Khajoor	Least concern	X
8.	*Conocarpus lancifolius*	Cono	Near Threatened	X
9.	*Tamarix aphylla*	Lai	Not evaluated	X
10.	*Pithecellobium dulce*	Jungle jalebi	Least concern	X
Total Trees Within Landfill site				**---**
Total Trees with in AOI				**10**
Shrubs				
11.	*Abutilon indicum*	Country mallow	Not evaluated	X
12.	*Achyranthus aspera*	Devil's horsewhip	Not evaluated	X
13.	*Barleria acanthoides*	---	Not evaluated	X
14.	*Barleria hochstetteri*	---	Not evaluated	X
15.	*Calotropis procera*	Aak	Not evaluated	X
16.	*Capparis decidua*	Kirrir	Least concern	X
17.	*Euphorbia caducifolia*	Thohar	Not evaluated	X
18.	*Grewia tenax*	White crossberry	Least concern	X
19.	*Haloxylon stocksii*	Saxaul	Least concern	X
20.	*Phagnalon daravazicum*	---	Not evaluated	X
21.	*Prosopis juliflora*	Devi/ vilayatikikkar	Not evaluated	X
22.	*Prosopis glandulosa*	Honey meaquite	Least concern	X
23.	*Salvadora oleoides*	Khabbar	Data deficient	X
24.	*Salvadora persica*	Khabbar	Least concern	X
25.	*Suaeda fruticosa*	Láani	Not evaluated	X
26.	*Tamarix aphylla*	Lai	Not evaluated	X
27.	*Maytenus senegalensis*	Hekel, Malkangni	Not evaluated	X
28.	*Mimosa hamata*	Alay	Not evaluated	X
29.	*Salsola imbricata*	Saltwort	Not evaluated	X
30.	*Ziziphus nummularia*	Beer	Not evaluated	X
31.	*Abelmoschus esculentus*	Bhindi/ okra	Not evaluated	X

32.	*Amaranthus viridis*	Chull	Not evaluated	X
33.	*Aerva javanica var. javanica*	Booh	Not evaluated	X
34.	*Blepharis sindica*	Bhangri	Not evaluated	X
35.	*Capsicum annuum*	mirchi	Least concern	X
36.	*Convolvulus prostatus*	---	Not evaluated	X
37.	*Convolvulus glomeratus*	---	Not evaluated	X
38.	*Cressa cretica*	Rudranti	Least concern	X
39.	*Cyamopsis tetragonoloba*	Guaar	Not evaluated	X
40.	Datura alba	Devil's trumpet	Not evaluated	X
41.	*Eclipta prostrata*	False daisy	Least concern	X
42.	*Fagonia indica*	Dhamasa	Not evaluated	X
43.	*Glinus lotoides*	Jima	Not evaluated	X
44.	*Heliotropium rariflorum*	Jamandar ka landa	Not Evaluated	X
45.	*Heliotropium europium*	---	Not evaluated	X
46.	*Inulla grantoides*	---	Not evaluated	X
47.	*Lagenaria siceraria*	Loki/kadu	Not evaluated	X
48.	*Leucas urticifolia*	Kubabhal	Not evaluated	X
49.	*Senna holosericea*	Sana mukhi	Not evaluated	X
50.	*Sesuvium sesuvioides*	Sea pursalnes	Not evaluated	X
51.	*Sida ovata*	Oval leaf	Not evaluated	X
52.	*Portulaca oleracea*	little hogweed	Least concern	X
53.	*Phylla nodiflora*	Frog fruit	Not evaluated	X
54.	*Solanum surattense*	kundiari, 'Momoli, Mokri	Not evaluated	X
55.	*Solanum lycopersicum*	Tomato	Not evaluated	X
56.	*Sonchus aspera*	Prickly sow-thistle	Not evaluated	X
57.	*Trianthema portulacastrum*	Black pigweed	Not evaluated	X
58.	*Trianthema triquetra*	---	Not evaluated	X
59.	*Tribulus terrestris*	Tekundi	Least concern	X
60.	*Trichodesma indica*	Indian borage	Not evaluated	X
61.	*Zygophyllum simplex*	Hurium	Not evaluated	X
62.	*Cyperus rotundus*	Nutgrass	Least concern	X
63.	*Cenchrus ciliaris*	Dhaman	Least concern	X
64.	*Chloris barbata*	Ganni, Jargi	Not evaluated	X
65.	*Desmostachya bipinnata*	Dabh/drabh	Least concern	X
66.	*Dichanthium annulatum*	Marvel grass	Not evaluated	X
67.	*Phragmites australis*	Kaano	Least concern	X
68.	*Typha domingensis*	Booh	Least concern	X
Total Shrubs and Herbs within AOI				**58**
Grasses				
69.	*Cyperus rotundus*	Nutgrass	Least concern	X
70.	*Cenchrus ciliaris*	Dhaman	Least concern	X
71.	*Chloris barbata*	Ganni, Jargi	Not evaluated	X
72.	*Desmostachya bipinnata*	Dabh/drabh	Least concern	X
73.	*Dichanthium annulatum*	Marvel grass	Not evaluated	X
74.	*Phragmites australis*	Kaano	Least concern	X

75.	*Typha domingensis*	Booh	Least concern	X
Total Grasses within AOI				**07**



Succulent plant *Euphorbia caducifolia* around the vicinities of the landfill site



Condition of IUCN's Critically endangered shrub *Commiphora wightii* in Hilly and rocky regions of the Landfill site



The close-up of the Commiphora wightii at the hilly and rocky region of the Landfill site



Vachellia nilotica a native tree in the AOI

As such, in total, there are over 58 species of shrubs, 07 species of grass, and 10 trees found within the AOI, however, particularly, there are 667 counts of the critically endangered Commiphora Wightii found within the landfill site.

1.3 Purpose of Tree Translocation & Plantation

As can be seen from Figure 1, there exists a buffer zone between the proposed new landfill cells and the Haji Ibrahim Goth Settlements (proposed landscaping green area in the figure), particularly:

- Distance between outer edge of cell and closest settlement – 65 m
- Distance between outer edge of road embankment and closest settlement – 52 m

Tree plantations have been proposed here to serve as a buffer between the proposed development and operations of the cells and the existing population. Currently, almost

900 metres of the face of the village is immediately adjacent to the existing dumpsite, where waste is being dumped and lit on fire close to the houses. With the development of the new landfill cells, the existing impacts of burning of waste, leachate generation, and landfill gas have been accounted for in the design to alleviate the population of these issues.

Furthermore, compared to the large area of the village that is exposed to the existing dumpsite, only 130 m of the area is exposed to the new cells, where tree plantations have been proposed to further mitigate any impacts of the new cells. This will be done through the extensive plantation of trees which is expected to provide the community with the following benefits:

1. Air Quality Improvement
   - Trees absorb carbon dioxide and release oxygen through photosynthesis, reducing greenhouse gas concentrations in the atmosphere.
   - They also help filter and remove pollutants, such as sulfur dioxide, nitrogen oxides, and particulate matter from the air, leading to improved air quality, all pollutants which were found elevated in the general area of the landfill site.

2. Noise Reduction
   - Trees can absorb and scatter sound, acting as a natural noise barrier. They reduce noise pollution and provide a quieter environment for nearby communities.

3. Erosion Control
   - Tree roots help stabilize soil, preventing erosion. They reduce the impact of heavy rains and wind on soil, which can lead to landslides, mudslides, and loss of topsoil.

4. Temperature Regulation
   - Trees provide shade, which can lower temperatures in urban areas, reducing the urban heat island effect and mitigating extreme heat impacts on communities.

5. Aesthetic and Psychological Benefits
   - Trees have aesthetic and psychological benefits, reducing stress and improving mental well-being. They provide a buffer against the negative impacts of urban living, promoting a sense of well-being, something that would be of value to the community there.

6. Community Spaces
   - Trees can create shaded and green community spaces, offering opportunities for recreation and relaxation, acting as a buffer against a lack of accessible public spaces.

7. Screening
   - Trees can serve as screens to visually buffer and screen out unwanted views, unsightly infrastructure, or industrial areas.

8. Wind and Dust Control
- Trees can help control the movement of wind and dust, reducing the impact of windborne dust and debris on nearby communities, which would be important during the construction and operation stages of the cells.

9. Pollinator Habitat
- Trees can serve as a buffer for pollinators, providing food and habitat for bees and other pollinating insects, supporting local agriculture.

Incorporating trees and green infrastructure into urban and rural planning can be a powerful way to mitigate a wide range of impacts, promote sustainability, and improve the overall quality of life for communities while safeguarding the environment, which is why tree plantations have been planned as an added buffer to the area between the cells and the population.

Given the benefits provided by trees, it is proposed that a considerable tree plantation be undertaken in the buffer zone, where not only the Commiphora Wightii be relocated from the area where development is to be undertaken, but also native trees to the area are planted with community consultations and involvement.

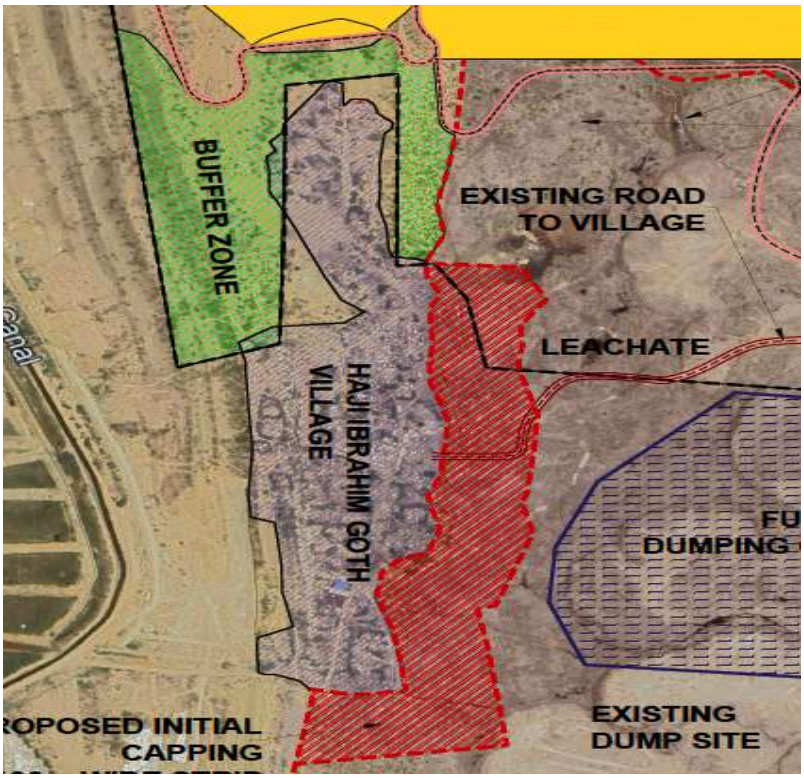


Figure 2 - Proposed area for tree plantations

As can be seen above, there are three areas that have been highlighted for tree plantations, the immediate north of the population which comprises of flat land, and to the left and right of the population which comprises of undulating, hilly terrain that surrounds the community.

At this stage, it is proposed to consider large tree plantations in the area immediately north of the population, along with on the hills surrounding the population to the extent possible. The relocation of the Commiphora wightii is proposed for the higher areas

and peaks of the hills surrounding the site where they will be relatively undisturbed moving forward.

1.4 Tree Translocation Plan

Once the area for the relocation of the Commiphora Wightii has been confirmed, then firstly, the uprooting of these plants will be required. This can be done manually through the use of approximately 4 workers, where an excavator can be used also.

These plants have resilient roots where they may all be removed first and then relocated in the different area. Given that they have shallow roots at roughly around 1 foot, their uprooting and relocation should be relatively easier. Average timelines should be:

- 4 workers taking 4 days for uprooting
- 4 workers taking 5 days for re-planting

Keeping 2 days as contingency, the task should take a total of 11 days.

Following relocation, to ensure that the roots are able to adapt to the new location, watering should take place every 2-4 weeks, 3 weeks on average, for the first year (for a total of 17 interventions per year) after which watering may take place every 6 weeks (8 interventions per year).

The average amount of water required per plant is 10-20 liters (average of 18 liters), where the average water requirement per watering session will be 18 liters/ plant * 667 plants = 12,000 liters (approximately 3170 gallons). Plantations can be carried out with a distance of 2 m between plants.

Assuming 80% plant rate survival, the remaining 20% must be replaced through nurseries.

The overall costing for this should be as follows:

Item/ Activity	Unit Cost (PKR)	Costing (PKR)
Cost for 4 laborers for 11 days	3,000 per laborer per day	(3,000*4*11) = 132,000
Cost of 1 day rental of truck for movement of plants	35,000 per day	35,000
Cost of 2 persons to take care of the plant following re-plantation (6 months care period and 1 year of aftercare)	3,000 per intervention per person	(3,000*2*17) + (3,000*2*8) = 102,000 + 48,000 = 150,000
Cost of water for watering	7,500 per 3,000-gallon truck (market rate)	(7,500*17) + (7,500*8) = 127,500 + 60,000 = 187,500
Cost of replacement of plants that did not survive	4,500 per plant (market rate)	(135 plants * 4,500) = 607,500
Sub-Total		**1,112,000**
Contingency (@ 10%)		**111,200**
Total Cost for Relocation, Potential Replacement & Care of Plants for 1.5 years (6 months care period and 1 year after care)		**1,223,000**

1.5 Tree Plantation Plan

Following the planting of the Commiphora Wightii along the higher areas of the hills, the remaining area may be used for the plantation of trees.

Following is a list of native plants to the city of Karachi that can be planted here:

Sr. No.	**Local Name**	***Scientific Name***
1.	Neem	*Azadirachata indica*
2.	Jungle jalebi	*Pithecellobium dulce*
3.	Sirris	*Acacia lebbek*
4.	Jacarnda	*Jacaranda moniosifolia*
7.	Silver Oak	*Grevillea robusta*
8.	*Pilkhan (white Fig)*	*Ficus virens*
9.	Jaman	*Eugenia jambolina*
10.	Kachnar	*Bauhinia variegate*

The total area highlighted in Figure 2 is roughly 89026 square meters, where if we carry out the relocation of the commiphora first, where 4 square meters would have 4 plants, then almost 170 square meters would be required for the 667 plants, leaving behind 88,856 square meters for tree plantations.

Using neem as an example as it is fairly common in the area and using an average distance of 4 meters between plants, 5,554 trees can be planted in the buffer area (assuming a uniform grid pattern). The choice of plant and plantation should be done in line with consultations with the community.

The overall requirements for these plantations would be:

- Procurement and transport of 5,554 trees saplings (average height of 16 inches) assuming 200 saplings per truck, for 28 trucks movement to and from the site.
- For a plantation period of 11 days, 5,554 plants will require 10 workers to plant an average of 47-50 plants per day.
- 10 caretakers of the plants during the growth period (roughly 2 years) who will train people at the community to take care of the plants, including pruning, watering, and any other items required.
- Watering for the growth period and then post growth – maturity period. The average amount of water required per plant is 10-20 liters during the growth period (average of 18 liters), where the average water requirement per watering session will be 18 liters/ plant * 5,554 plants = approximately 99,972 liters (approximately 26,410 gallons). This will be at a frequency of 03 weeks (17 interventions per year). Once trees reach maturity, they can survive on rainfalls, however, will require water during extended dry periods.
- Assuming 80% plant rate survival, the remaining 20% must be replaced through nurseries.

An estimated costing for this is provided below:

Item/ Activity	Unit Cost (PKR)	Costing (PKR)
Procurement of 5,554 saplings including transport	3,000 per plant	16,662,000
Cost for 10 laborers for 11 days	3,000 per laborer per day	(3,000*10*11) = 330,000
Cost of 10 persons to take care of the plant following plantation (for a period of 2 years till trees become relatively mature)	35,000 per month	35,000*24*10 = 8,400,000
Cost of water for watering	7,500 per 3,000-gallon truck (market rate)	(7,500*9 trucks*17 times a year * 2 years) = 2,295,000
Cost of replacement of plants that did not survive	3,000 per plant (market rate)	(1,110 plants * 3,000) = 3,330,000
Sub-Total		**31,017,000**
Contingency (@ 10%)		**3,101,700**
Total Cost for Plantation of 5,554 trees and care for a period of 02 years		**34,118,700**

Total Cost of the Tree Plantation and Relocation is as follows:

Item	Cost (PKR)
Tree Relocations (Commiphora Wightii)	1,223,000
Tree Plantations	34,118,700
Total	**35,341,700 (Approximately 35.34 Million)**

ANNEX XIII - Waste Management Plan

CONSTRUCTION WASTE MANAGEMENT PLAN

Construction waste material consists mainly of concrete, masonry, limestone, sandstone, metal, and wood, depending on the construction type. In building waste, a larger percentage of paper, plastic, etc. is expected due to packaging materials and the wood retired from formwork and scaffolding. This is in addition to significant amounts of concrete, masonry and metal materials.

1.0 Origins and Causes of Construction Waste

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

Origins of waste	Causes of waste
	▪ Time pressure ▪ Poor work ethics
Residual	▪ Waste from application processes (i.e., over preparation of mortar) ▪ Off-cuts from cutting materials to length ▪ Waste from cutting uneconomical shapes ▪ Packaging
Other	▪ Weather ▪ Vandalism ▪ Theft

2.0 Construction Waste Management Plan

1) Waste Management Goals

To establish that this project shall generate at least 50% less waste into landfills and the processes shall be employed to ensure that this goal is met. These shall include prevention of damage to materials to be incorporated into the work due to mishandling, improper storage, contamination, inadequate protection or other factors as well as minimizing poor quantity estimation, as well as through building design.

2) Responsibility

- The Project Director shall be responsible for the implementation of the administrative portions of this program, including the notification of subcontractor management, the training of the site supervisor and the onsite posting of this plan.
- The site supervisor will be responsible for the implementation of the onsite portions of this program including the training of subcontractor personnel.

3) Waste Prevention Planning

- In addition to other requirements specified herein it is a requirement for the work of this project that the contractor comply with the applicable city waste disposal requirements.
- Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for reuse and or recycling where practical and possible.
- Project Construction Documents: The General Contractor will contractually require all subcontractors to comply with these recycling guidelines. A copy of this “Construction Waste Management Plan” will accompany all subcontractor agreements and require subcontractor participation.
- The “Construction Waste Management Plan” shall be implemented and executed as follows and as on the chart:
  - Salvageable materials will be diverted from disposal where feasible.
  - There will be a designated area on the construction site reserved for materials that can be recycled.
  - Areas shall be marked to designate what recycle materials are to be stored there.
  - Hazardous waste will be managed by a licensed hazardous waste vendor.

4) Communication & Education Plan

- This Construction Waste Management Plan will be posted onsite.

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

5) Motivation Plan

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

6) Expected Project Waste, Disposal, and Handling

The following chart identifies waste materials expected on this project, their expected disposal methods and handling procedures. New items may be added as needed.

Material	Quantity	Disposal Method	Handling Procedure
Land clearing debris		Keep separate for reuse and or wood sale. Separate topsoil and rock for future landscaping use.	Keep separated in designated areas onsite.
Clean dimensional wood and palette wood		Keep separate for reuse by on-site construction or by site employees for either heating stoves or reuse in home projects. May be offered to public.	Keep separated in designated areas onsite.
Plywood, OSB, particle board		Reuse onsite when possible, landfill or recycle off site.	Keep separated in designated areas onsite. Place in “Trash” container.
Painted or treated wood		Reuse, off site recycle, landfill.	Keep separated in designated areas onsite. Place in “Trash” container.
Concrete		Recycle when possible.	
Concrete Masonry Units		Keep separate for re-use by on-site construction or by site employees.	Keep separated in designated areas onsite.
Metals		Recycle off site when possible. Separate copper	Keep separated in designated areas

Material	Quantity	Disposal Method	Handling Procedure
		wire when possible.	onsite. Place in "Metals" container.
Paint		Reuse onsite.	Keep separated in designated areas onsite
Insulation		Reuse, landfill.	
Flooring		Reuse, landfill.	
Carpet and pad		Reuse or recycle with carpet manufacturer	
Glass		Glass Bottles: recycle locally.	Keep separated in designated areas onsite.
Plastics		Plastic Bottles: recycle locally; be aware of plastics that are acceptable to recycle facility.	Keep separated in designated areas onsite.
Beverage		Recycle locally	Keep separated in designated areas onsite.
Cardboard		Recycle locally	Keep separated in designated areas onsite.
Paper and newsprint		Recycle locally	Keep separated in designated areas onsite.

7) Waste Disposal Company

To be determined

a) Contact:

8) Recycle Hauler

To be determined

b) Contact:

c) Some or all recycle may be hauled by the builder.

9) Possible Recycle Locations and Acceptable Materials

i) Coordinate with companies which are registered with local Municipality that accept materials for recycle; and

ii) Using the above as a resource, a list will be kept indicating local opportunities for recycle of expected materials. New locations should be added as needed.

ANNEX XIV - Guide Traffic Management Plan

GUIDELINE TRAFFIC MANAGEMENT PLAN

1. Need for Plan

During the construction period of the project, considerable vehicular movement of vehicles carrying large amounts of material and machinery near and around the area for the development of the new cells. Given that the access route to the new cells and the existing dumpsite (particularly the location proposed for the dumping during the development of the cells) is the same, there will be additional traffic impacts. This plan has been prepared to mitigate these impacts and provide guidelines for the safe movement of vehicles around the project area where the population is located.

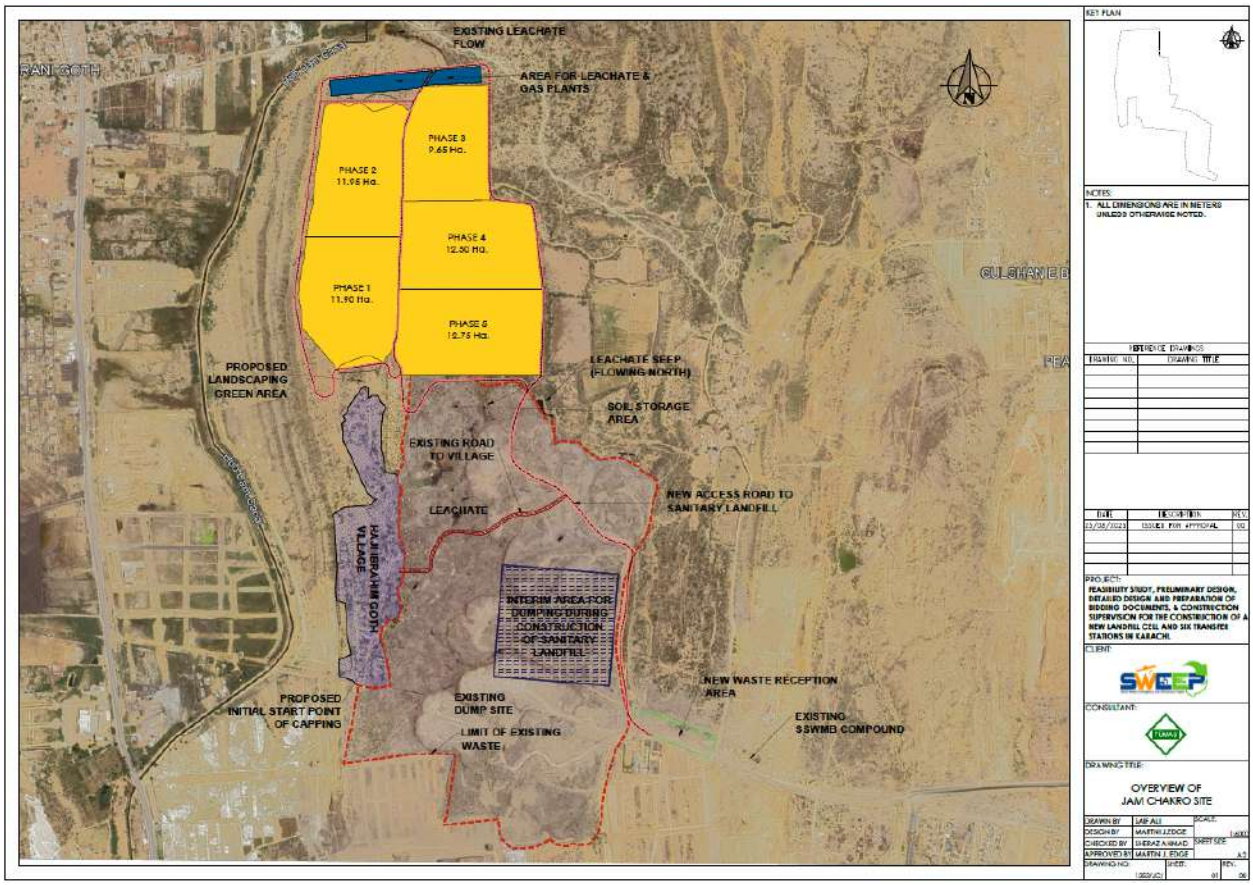


Figure 1 - Overview of Site Development at Jam Chakro

2. The plan

The objective of Traffic Management Plan (TMP) is to define the requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the community resulting from construction traffic.

The TMP will advise and inform site Contractors and external suppliers of equipment and materials of access and entry points along with other key information such tipping areas and wash-out areas. It is intended to compliment and work alongside relevant EMP. The TMP will be classed as “live” and therefore be subjected to updates as required.

The Contractor, at the time of the execution of the project, will prepare a comprehensive TMP in coordination with local traffic police department, SWEEP, emergency services and local administrative department. SWEEP and SC will review and approve the Contractor's TMP. The Contractor's TMP shall include following mitigation measures during its preparation:

- Undertake a road conditions and routes assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project development.
- Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project.
- Spoil dumpsites located close to project site to minimize journey distance and limit movements to site access roads.
- Construction of worker accommodation on site to reduce light vehicle movements relating to travel to/ from the site.
- Provision of bus/minibus services for personnel living in nearby settlements.
- Movements of construction workers will be planned to avoid the busiest roads and times of day when traffic is at its greatest.
- Schedule deliveries and road movements to avoid peak periods.
- Driver training for HGV drivers and refresher course every six months for project drivers.
- Speed restrictions for project traffic travelling through communities (to be agreed with SWEEP).
- Run a safety campaign to improve the people's knowledge of the traffic hazard on their roads, public information and other activities to address the issues.
- Run a pedestrian awareness programme.
- Temporary signage
- Barricading/ fencing where necessary

3. Other Recommendations

It is important to manage public access routes during construction because it can cause delay to local traffic and create a safety hazard both on and offsite. People working and living near the project sites would be annoyed by the emissions, noise, and visual intrusion of queuing vehicles. Furthermore, consultations and information dissemination posters and sessions should be conducted with the community at Haji Ibrahim Goth where their reservations should be taken into account and a mutual way forward agreed upon. Some important factors involved in access routes and site traffic are as follows:

3.1. Public Access Routes

The use of public road for site access may be restricted in terms of:

- Vehicle size, width and type of load
- Time limits
- Parking
- Pedestrian conflicts

Contractor should have consultation with local police or local authority to address these issues and to effectively manage them before the beginning of the construction.

3.2. Site Workers Traffic

Site personnel should not be permitted to park vehicles right on the road; this will lead to disruption in material deliveries. Designated parking areas with appropriate parking space will be needed for this purpose; any plain area near construction site can be used for this purpose.

3.3. Site Rules

- Access to and from the site must be only via the specified entrance.
- On leaving the site, vehicles must be directed to follow the directions given.
- Drivers must adhere to the site speed limits.
- All material deliveries to site must keep allocated time limits.
- No material or rubbish should be left in the loading-unloading area.
- Develop a map for alternate routes showing material delivery services.
- Assign designated personnel on site to receive deliveries and to direct the vehicles.
- Monitor vehicle movement to reduce the likelihood of queuing or causing congestion in and around the area.
- Project vehicles should have a unanimous badge or logo on windscreen displaying that they belong to the project.

4. Contractor's Obligation

The traffic management plan of the Contractor should be safe enough and widening of any access roads and construction of the detours (as applicable and practical) must be completed prior to start of project construction activities so that heavy vehicular transportation for construction activities do not hinder the normal course of traffic lanes. Contractor must ensure that road closures are carried out by a competent person. The Contractor obligation must include the display of traffic signs according to the need to divert the traffic volume and to guide the road users in advance. The traffic sign, traffic light should be placed from any diverting route or road marking.

The Contractor should consider the environmental and social impacts of the traffic during construction. It will be sole responsibility of the Contractor to implement a plan which produces minimum nuisance to the local people and to the environment. Safety of the people should be of prime importance. It will be under Contractor obligation to notify the traffic management plan and its later changes to SC, SWEEP, emergency services and Traffic Police, and the population at Haji Ibrahim Goth.

ANNEX XV - Community Health & Safety Plan

Guide Community Health & Safety Plan

1.1 Background

The presence of the settlement Haji Ibrahim Goth right next to the landfill site requires additional health, safety, and security risks and impacts on the community to be assessed and minimized in line with the requirements of ESS4.

A Map of the development proposed at the landfill site, along with the location of the community is provided below:

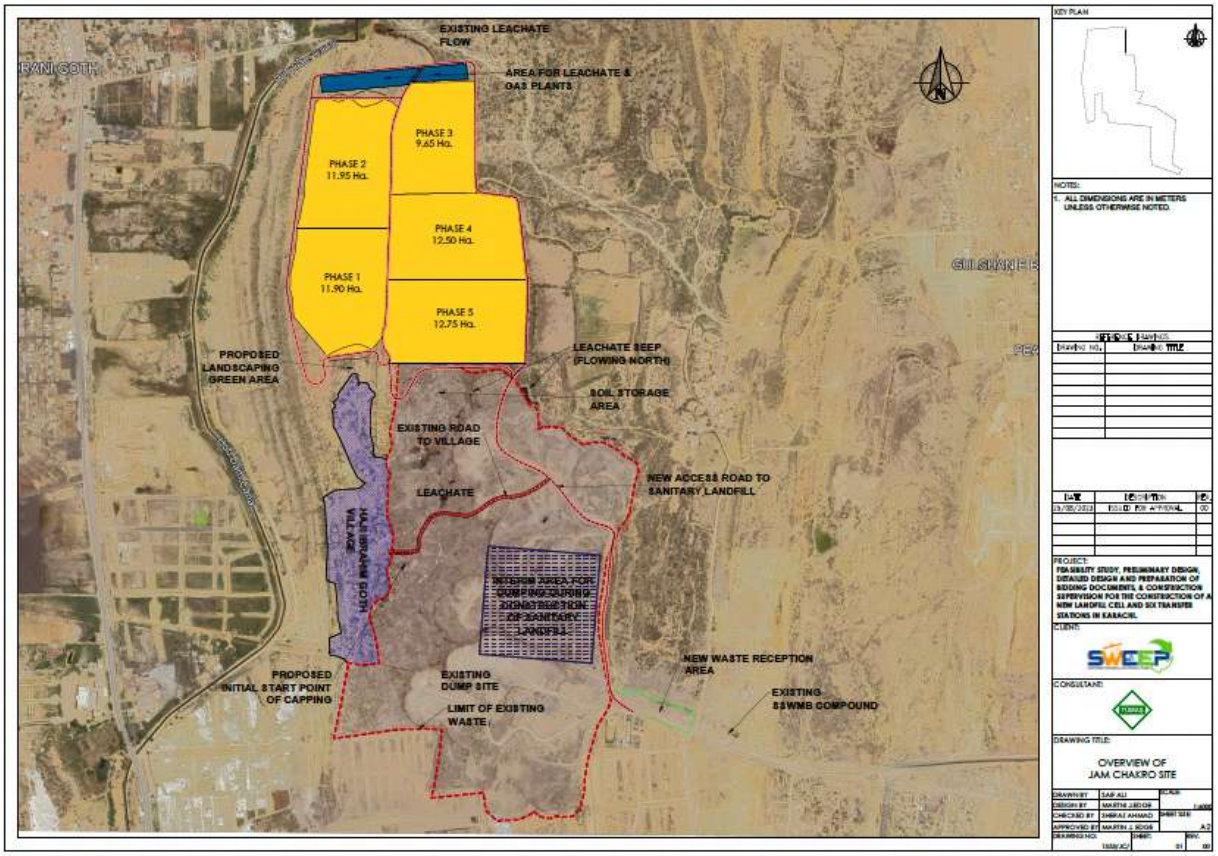


Figure 1 - Overview of Development at Jam Chakro Landfill Site

1.2 Scope & Applicability

The main areas of ESS4 are highlighted below with respect to community health & safety are highlighted below:

1. **Infrastructure and equipment design and safety** – Measures have been taken into account during the design of the landfill cells and associated construction to minimize risks on the population, where the major structural element to be constructed close to the community is the ring road and the embankment which is roughly 50 meters away from the closest house of Haji Ibrahim Goth.
2. **Safety of services** – The project does not involve any as such direct services to be provided to the community at Haji Ibrahim Goth.
3. **Traffic and road safety** – An access road will be built from the existing entry to the dumpsite, carve its way through the existing dumpsite, and then encircle the proposed cells, making its way back down to the origin. Measures have been taken into account to ensure that risks from traffic and road safety to the community is maintained.

4. **Ecosystem services** – The cells are proposed for development on virgin land, where there is no such removal of vegetation or wetlands, that provide any ecosystem services to the community.
5. **Community exposure to health issues** - The shift of landfill operations from the existing dumpsite to the proposed cells will in itself decrease potential health issues as the area of the population exposed is reduced from 900 m along the existing dumpsite, to 130 m along the proposed cells. Further measures have also been incorporated to reduce the risk of health issues from the proposed development.
6. **Management and safety of hazardous materials** – landfill gas and the generation of leachates are the two main hazardous materials foreseen to pose a risk to community health and safety, where appropriate mitigation measures have been taken into account to ensure that the risk from these aspects are minimized.
7. **Emergency Preparedness & Response** – The identification of emergency events and the appropriate responses and procedures to be implemented at each stage forms an important part in ensuring that residual risks of the project are also minimized.
8. **Security Personnel** – Where armed security personnel are proposed, the abuse of power and authority, especially against people of the community may pose a risk, where appropriate mitigation measures have been included.

1.3 Risks & Mitigations

Each of these items defined as applicable above, with respect to the proposed development of cells at Jam Chakro, and the community at Haji Ibrahim Goth are further expanded upon below:

1.3.1 Infrastructure & Equipment Design & Safety

As identified above, the closest structural element to the population is the embankment of the ring road that will be developed, where this has to be developed on the western valley of the landfill site to enclose it between the two hills on the East and the West.

As such, the mitigation measures devised for inclusion here comprise of:

- The design of landfill slopes should consider seismic loading conditions. Stability analysis should be performed to ensure that the slopes can withstand potential ground shaking. Furthermore, at the base of the embankment and the area between it and the population, a considerable tree plantation is proposed to get rid of soil erosion and provide additional support as a barrier (further details provided in the tree plantation plan).
- Seismic conditions have been considered while designing landfill leachate collection and treatment system, gas collection system and liner/barrier systems along with the general topography of the area that slopes away from the population towards the north.
- The project is located in Seismic Zone 2B, where 2B (upper limit of moderate damage) represents the peak horizontal ground acceleration from 0.16g to 0.24g. In this zone, the designing of various types of structures shall be done on the basis of Peak Ground Acceleration, where the Building Codes of Pakistan have been taken into account while designing the infrastructure.
- The road widening will be to a standard that is suitable for movement of high-capacity waste carrying vehicles.
- Work areas outside the project site, especially where machinery is involved, will be barricaded, and will be constantly monitored to ensure that local residents, particularly children stay away.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project.
- Vehicle speed will be regulated and monitored to avoid excessive dust emissions.

- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area.
- Proper drainage system to provide in order to prevent ponding of rainwater on roads in line with climatic or weather events.

1.3.2 Traffic & Road Safety

With an access road proposed from the entrance of the site and around the landfill cells, traffic and road safety will be of paramount importance to ensure impacts do not spill out onto the community. For this, the following mitigation measures have been proposed:

- Most importantly, the current paths used by the waste pickers and vehicles for the dumping of waste shall not be used to avoid any chance of accidents. During the development of cells, the waste will also be dumped at the very beginning of the existing dumpsite to ensure minimal interaction between construction machinery and the people at the settlements.
- Local communities especially the resident of Haji Ibrahim Goth will be briefed on traffic safety, especially women who are the main care providers to children.
- Speed limit of 20 km/hr will be maintained by all project related vehicles and night-time driving of project vehicles will be limited where possible.
- Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.
- Contractor must take proper safety measures (placing warning tapes around excavations) to avoid people, especially children, accidentally falling into excavations.
- All the working platforms must be cordon off with special care by well-trained skilled workers.
- Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.
- PIU SWEEP should ensure the contractor staff working in the project are well trained and educated in the Health, Safety and Environment (HSE) hazards associated with their duties, and that of the public, in the project area.
- Women's residing in Haji Ibrahim Goth who will be working in salvaging items from existing dumpsite will be briefed on traffic safety prior to start of construction activities.
- Traffic diversions will be planned in such way that it does not create traffic congestion or hinders the movement for the vehicles that are still be working on dump site.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project.

A separate traffic management plan has also been developed and added as an annexure to the ESIA report which touches upon further measures and the roles and responsibilities of all involved in ensuring traffic safety.

1.3.3 Community Exposure to Health Issues

As identified above, the shift of landfill operations from the existing dumpsite to the proposed cells will in itself decrease potential health issues as the area of the population exposed is reduced from 900 m along the existing dumpsite, to 130 m along the proposed cells. Prolonged impacts from noise and vibrations from construction and operations at the site may have detrimental impacts on the community, where mitigation measures are provided below:

- Impose speed limits on construction vehicles to minimize noise emission along areas where sensitive receptors are located (residential areas, etc.).

- Limit noisy construction-related activities during the night, where such activities should be restricted to daylight hours.
- Provide prior notification to the community on schedule of construction activities.
- Whenever feasible, schedule diverse noisy activities (e.g., earthmoving) to occur at the same time, since less-frequent noisy activities would be less irritating than frequent less-noisy activities.
- Use equipment with built in noise abatement, especially pavement breakers, crawler cranes, excavators, and concrete cutter.
- It shall be ensured that generators, vehicles, and other potentially noisy equipment used will be in good condition.
- The use of pressure horns shall not be allowed especially near the community.
- Movement of all project and personnel vehicles shall be restricted within work areas.
- All the equipment and machinery used during construction phase should be well maintained and in compliance with SEQS.
- Grievance redress mechanism to deal any public complaints related to noise is established
- Vibration measurement will be carried out during construction phase by the contractor near the settlements as well as all the sensitive receptors in the AOI.
- Timing of the construction works to be conducted during the recommended operational hours, to reduce vibration levels to sensitive receptors (especially all the educational institutes) and residential properties in the AoI.
- Residents and occupants in all the buildings including offices, hospitals, school, and religious places of to be pre-warned of high vibration events and any operations being undertaken outside recommended hours.
- The vibration from major construction activities such as excavation, compacting, drilling, etc. are considered intermittent and short-term, and likely to be tolerated if prior warning is given to potentially affected residents.
- The equipment operators to be made aware by the contractor of potential vibration issues problems and of techniques to minimize vibration effects during construction works near to the sensitive receptors especially educational institute and medical facility.

Table 1:[1]Typical Vibration Levels at Distances (Peak mm/s)

Plant Item	Peak Vibration (mm/s), Distance from Source			
	10m	20m	50m	100m
15ft roller	7.0 to 8.0	3.8	1.5	0.8
7t compactor	5.0 to 7.0	3.0	1.2	0.6
Dozer	2.5 to 4.0	1.6	0.7	0.3
Backhoe	1.0	0.5	0.2	0.1

- Based on the predicted peak vibration levels described in above table, it is expected that vibration would be barely perceptible at sensitive receiver locations within over 50m for most construction activities i.e. Haji Ibrahim Goth.
- According to British Standards of Noise and Vibration, humans are particularly sensitive to vibration with the threshold of perception typically being in the range of 0.14 to 0.3 mm/sec Peak Particle Velocity (PPV) and levels above this may cause annoyance. However, significantly higher levels than this can be tolerated for single short-term events and do not cause annoyance or disturbance to humans. Further, there is no historical building or masonry structure within 150 m of the earmarked landfill site to sustain damage from construction vibrations.

The operation of the landfill may also attract presence of pests such as rats, cockroaches, flies, ants, and other pests in the immediate area along with various other vectors such as feral cats, dogs, birds, and other animals. These pests can freely move around the area and

[1] Source: Environmental Noise Management Manual-Roads & Traffic Authority, NSW, Australia, 2001

may find their way to the community at Haji Ibrahim Goth. Since these pests are known to be carriers of diseases, they may trigger the sudden occurrence of illnesses and unacceptable conditions among people of weak resistance and children. Each type of vector can live and multiply at a landfill and is potentially of concern to site operators, regulators, public health professionals and the general public. Mitigation measures against all these items are provided below:

- The most effective way to control vermin and disease vector generation is the application of daily soil cover which will be placed before the end of the day. Waste will be covered all the time except tipping face where it will be worked. Due to large quantities needed for daily cover, and the additional requirement required for intermediate and final cover, long-term planning should be done ensure availability of the materials.
- There should be no ponding water on the landfill property except as designed for runoff storage or sedimentation. Sedimentation ponds can, however, aid vector reproduction if not designed and controlled properly so as to minimise stagnant water, nutrient build-up, and plant growth.
- On-site landfill site personnel will be trained and must monitor the levels of key vectors on a daily basis as part of daily management. A simple monthly site walk-over can provide a baseline of vector activity so changes can be noted and translated into action. Observations of various droppings, sightings, tracks, insect counts, etc are useful indicators of activity. Written reports from regular walk-over assessments should be kept on file so changes that occur over time and in response to control measures can be assessed.

Furthermore, the generation of leachates and landfill gas will also serve as potential items that will impact community health, however, they have been touched upon in the next sub-section.

1.3.4 Management & Safety of Hazardous Materials

The major hazards from the proposed development to the community would be the generation of leachates and landfill gas. The risks posed by each are provided below:

Landfill Gas

Landfill gas is composed of a mixture of hundreds of different gases. By volume, landfill gas however contains 45-60% methane and 40-60% carbon dioxide, including small amounts of nitrogen, oxygen, ammonia, sulfides, hydrogen, carbon monoxide, and non-methane organic compounds.

The risks posed landfill gas are described below:

Explosion hazards

Landfill gas may form an explosive mixture when it combines with air in certain proportions. This is made possible if the following conditions are met:

1. Gas Production – the landfill is producing gas and contains chemicals that are present at explosive levels
2. Gas Migration – The gas must be able to migrate from the landfill, which is made possible through underground pipes or natural subsurface geology which may provide pathways for landfill gas.

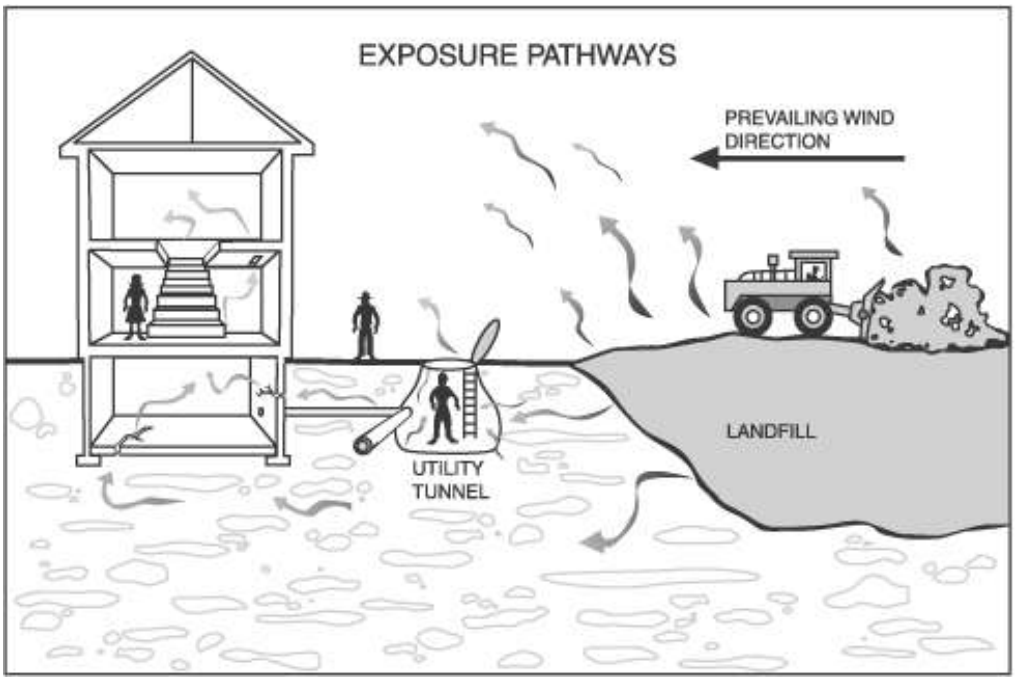


Figure 2 - Potential Exposure Pathways of Landfill gas

3. Gas Collection in Confined Spaces – The gas may collect in a confined space to concentrations where it may explode (confined spaces include manholes, or subsurface areas like basements).

The concentration at which a gas has the potential to explode is defined in terms of its lower and upper explosive limits (LEL & UEL) , which measure the percent of a gas in air by volume, where at concentrations below the LEL and above the UEL, a gas is not explosive. However, an explosion hazard may exist if a gas is present in the air between the LEL and the UEL and an ignition source is present. As such, methane and other landfill gas constituents such as ammonia, hydrogen sulfide are flammable and as such pose explosion hazards.

Odors & Low-Level Chemical Exposures

The odors associated with landfill gas stem from processes driven by bacteria or chemicals and can originate from both operational and closed landfills. These odors have the potential to disperse into the neighbouring communities. Common culprits for landfill odors encompass sulfides, ammonia, and specific non-methane organic compounds (NMOCs) if they exist at elevated concentrations. Additionally, certain waste types, such as manures and fermented grain, can also contribute to landfill odors.

Mitigation Measures

- A gas treatment plant will be setup with all its necessary piping network and infrastructure to treat and safely discharge the gases that emits from the landfill, where risks from landfill gas are expected to be greatly minimized.
- Periodic GHG monitoring will be carried out during operation phase of the project and accordingly, necessary design changes will be incorporated, if required. The monitoring will include methane and hydrogen Sulfide gases where monitoring will be conducted at the wells and at the residential/ sensitive receptors within the AOI.
- Gas collection wells will be installed in landfill, and it will design in such a way that when two meters of waste layer is deposited in the first cell a 30m x 30m grid of perforated gas recovery pipes will be installed and will be brought up as waste filling progresses. Gas

collection system is designed from bottom up to avoid emission during landfill operation and to avoid drilling through the garbage when the cell is filled with waste.

- The gas well will be extended upwards as waste filling progresses until final level is reached, at which point a steel gas dome is installed at the top of the well. Each gas collection wells/domes will be connected to collection strings and each string will lead to a main collection pipe at the manifold that can be regulated with a separate valve based on the quality of gas.
- The design of landfill gas treatment plant will cater the issue of Odor and air pollution, mitigating adverse effect on surrounding communities through the adequate coverage of wastes.
- PIU SWEEP shall ensure that during operation phase of the project, if there are changes in the baseline ambient air quality based on monitoring results, then quantitative assessment will be carried out for flaring and necessary design changes will be incorporated to avoid air quality impacts from flaring.

A preliminary assessment of potential gas generation has also been made over an assumed 10-year operating lifespan under a design capacity input of 5,000 tons per day from 2026 to 2035 with a total amount of 18,250,000 tons, where the yearly estimated generation is provided below:

Table 2. - Provisional Gas Generation Estimates

Year	Waste amount [m]	TC-content	Collection rate	Gas Production (Qt)	Gas collection (Qa)	Energy (Qeff)	Plant dimension	Accum. Energy	Potential emission
a	Mg/a	kg/Mg Mf	%	Nm³/h	Nm³/h	kWh	kW	MWh	l/m²/hour
Year 1	1,825,000	250	0.5	0.0	0	0	0	0	0
Year 2	1,825,000	250	0.5	2,800	1,400	49,062	5,600	13	58
Year 3	1,825,000	250	0.5	5,411	2,706	94,807	10,825	39	111
Year 4	1,825,000	250	0.5	7,845	3,923	137,460	15,694	76	162
Year 5	1,825,000	250	0.5	10,116	5,058	177,229	20,231	124	208
Year 6	1,825,000	250	0.5	12,233	6,116	214,309	24,463	182	252
Year 7	1,825,000	250	0.5	14,206	7,103	248,882	28,413	249	293
Year 8	1,825,000	250	0.5	16,046	8,023	281,118	32,094	325	329
Year 9	1,825,000	250	0.5	17,761	8,881	311,175	35,525	409	366
Year 10	1,825,000	250	0.5	19,360	9,681	339,200	38,719	500	399

The gas generation increasing factor is assumed to be 5% due to thermophilic conditions (about 60°C). The methane concentration within the landfill gas is assumed to be 50%. Since MSW is currently received mixed, without separation of the organics, then the Total Organic Content (TOC) has been assumed to be 250 kg/ton of input. Gas capturing efficiency was predicted at 50% during the operating life of active waste deposition.

Treatment by flaring would start in the 1st year to capture low-quality gas with a gas flare capacity of 3,000 Nm3/h and a ratio of 1:5. Thereafter, as gas quality improved flares with a capacity of 10,000 Nm3/h and a ratio of 1:6 (from 1,600 Nm3/h to 10,000 Nm3/h) will be installed.

Leachate

Leachate generation depends on a variety of factors, such as Incident precipitation, evaporation, the extent of the waste surface that is open and exposed, the rate at which the site is covered and capped; and the permeability and water holding capacity of the waste material. The Design Consultant in its feasibility report estimated leachate generation of 650 m^3 for a 1 in 2 years storm. It has been calculated assuming an exposed waste surface of 2.5 acres (1 ha.) the maximum leachate generation, excluding potential reductions through absorption by waste and evaporation. This can readily be stored within the base of any of the Cells on a temporary basis.

The general risks from leachate generated from wastes are due to its normally high organic contaminant concentrations and high ammoniacal nitrogen. Pathogenic microorganisms and hazardous substances that might be present in it are often cited as most dangerous, but pathogenic organism counts have been found to reduce rapidly with time in the landfill, so this only applies to fresh leachate. If generated leachate not properly treated, it could alter the physiochemical parameters and heavy metal concentration in soil and groundwater.

Mitigation Measures

The **primary** method of leachate treatment shall be by leachate recirculation to the waste mass, given the prevailing climatic conditions and the fact that estimated leachate quantities are low.

Re-infiltration shall be achieved by a combination of:

- mobile tanker and spray bar in the active waste deposition area; and
- by re-infiltration tubes/injection wells where waste deposition has been completed and reached final level.

A ring main will be developed around the landfill Cells comprising HDPE DN100 which will supply re-infiltration connections installed at 50 meters intervals. The re-infiltration pumps shall be located at the leachate tanks in the re-infiltration pumping chamber. There shall be a minimum of two submersible water pumps. A local PLC station will supply the pumps with electricity. Pumps in leachate tank shall be rated for protection class EX2.

Re-infiltration units will supply the connection/distribution points where tube connection (Storz-B) will allow a controlled distribution of leachate during operation. The distribution at the surface will be carried out via fire-fighting hoses and perforated HDPE pipes (DN65).

Re-infiltration pumps shall have a capacity of 10m³ per hour and a head of 90m. The outlet piping is of DN95 and connected with the ring-piping system build of HDPE DN100 and supplies the re-infiltration tubes, installed at 30 meters spacing within the waste disposal area and the ring main around the cell margins. The power is 9.5 kW each and a total quantity of 2 x 4 pumps is required to permit an alternating operation and continuous service and maintenance programme without interference of the re-infiltration operation.

Re-infiltration units will supply the leachate at the required spots onto the landfill body and will serve the connection/distribution points where tube connection (Storz-B) will allow a controlled distribution of leachate during operation. The distribution at the surface will be carried out via fire-fighting hoses and perforated HDPE pipes (DN65). The re-infiltration pumping chamber is located within the leachate collection tank. The re-infiltration unit is adjusted with a minimum of two submersible water pumps. A local PLC station will supply the pumps with electricity. Pumps in leachate tank shall be rated for protection class EX2.

A SCADA system will record and illustrate the flow of each pump (flowmeter ex-protected), as well the amperage and pump operational hours, in order to understand the volume of leachate

managed as well as pump service and maintenance needs. Leachate levels in the tanks will also be monitored via level sensors which will activate/deactivate pump operation based upon leachate levels.

Local Control Panels (LCPs) at each tank permit the manual control and operation of the pumps. A central control panel for all leachate pumps is located in the PLC Container at the landfill gas. The signals from this centralized panel will be transferred to the central SCADA unit located in the Operations Room of the Administration Building.

It is not anticipated that other methods of leachate treatment shall be required, given:

- the prevailing climatic regime.
- the rapid waste input rate (5,000 tons per day).
- Limited size of areas opens during waste filling; and
- Rapid rate of closure of completed cells.

Should leachate re-circulation not prove to be completely effective as a leachate management process, then it will be necessary to consider other forms of treatment that might be more appropriate, particularly if treated leachate is required to be discharged off-site.
The simplest alternative form of treatment, other than recirculation, is the provision of shallow evaporation ponds to take advantage of the prevailing climatic conditions. There is sufficient area at the southern margin of cell 6 to develop such ponds, each with an area of 200 m2 (20 x 10 m) and with a maximum depth of 2 m (holding capacity with 0.5 m freeboard is 300 m3).

Currently, the community is already residing next to the dumpsite where these hazardous items are generated and is already directly facing impacts from them. With the development of the sanitary landfill cells, these impacts and the community's exposure to these impacts should be reduced drastically as is. Nevertheless further mitigation measures have been highlighted to add and ensure that the community health and safety risks are low.

1.3.5 Emergency Preparedness & Response

During the construction and operation of the landfill, there may be emergency situations that arise, requiring immediate response and interventions. The community's preparation against these emergencies and their response could be the difference between the risk being high and being low. Mitigation measures planned here include:

- During construction, the contractor, and during operations, the SSWMB and the operator to develop an Emergency Response Plan (ERP) using the guide plan attached as an **Annex-XVI** for disasters related to the landfill site in collaboration with the Fire Fighting Department, Local Police, Nearby healthcare providers, and Provincial Disaster Management Authority (PDMA).
- Regular training sessions will be conducted to educate staff, employees, and the population at Haji Ibrahim Goth about the emergency procedures and plans.
- A designated responsible person will be assigned to oversee the implementation of the ERP.
- Emergency contact numbers will be prominently displayed to ensure swift action during emergencies.
- Firefighting systems will be regularly calibrated and maintained.
- Routine drills will be conducted to ensure preparedness and response effectiveness.
- Following development of the detailed emergency response plan, the community will be provided training on the types of emergency events that may arise, how the contractor/ operator will alert the community, and how they are to respond to it. These

training sessions will take place once at the inception of the construction and operation stages, with refresher sessions provided every quarter.

1.3.6 Security Personnel

With the presence of a sizable population present at Haji Ibrahim Goth right next to the site, the deployment of security personnel with arms during construction and operation for the protection of site and construction materials will be required. The abuse of power by these security personnel is an issue that will have to be proactively dealt with. Nevertheless, mitigation measures that may be adopted here include:

- Conduct training, equipping, and monitoring of such security workers in line with Good International Industry Practices and applicable laws, along with on how to deal with the community.
- No use of force to be allowed in providing security except for preventive and defensive purposes in proportion to the nature and extent of the threat.
- Background checks to be done on security personnel prior to hiring to ensure there are no past transgressions.
- Review any and all allegations of unlawful or abusive acts of security personnel and take action as necessary to prevent recurrence and, where necessary, report unlawful and abusive acts to authorities.

ANNEX XVI - Emergency Preparedness & Response Procedures

GUIDELINE EMERGENCY PREPAREDNESS AND RESPONSE PLAN

1.1 PURPOSE

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

i. Ensure all personnel and visitors to the office/job sites, along with the population at Haji Ibrahim Goth, are given the maximum protection from unforeseen events during the construction and operation of the landfill cells.
ii. Ensure all personnel are aware of the importance of this procedure to protection of life and property.

1.2 EMERGENCY PREPARATION AND RESPONSE MEASURE SCOPE

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

i. Construction Accident
ii. Road & Traffic Accident
iii. Hazardous material spills
iv. Structure collapse or failure
v. Trauma or serious illness
vi. Sabotage
vii. Fire
viii. Environmental Pollution
ix. Loss of person
x. Community Accident

1.3 RESPONSIBILITIES

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

Table 1: Emergency Response Team

Action Group	Responsibility
Emergency Coordinator	▪ Overall control of personnel and resources. ▪ The Emergency Coordinator will support and advise the Site Safety Supervision as necessary. ▪ Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.
Site Safety Supervision (Emergency Commander)	▪ Overall responsibility for activating emergency plan and for terminating emergency actions. ▪ Be alternative of emergency response chairpersons. ▪ Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth. ▪ Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger. ▪ Notify outside authorities if assistance is required. ▪ Carries the responsibility for coordinating actions including other

Action Group	Responsibility
	organizations in accordance with the needs of the situation. ▪ Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency. ▪ Establish and appoint all emergency organization structure and team. ▪ Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency. ▪ Ensure resources available to purchase needed emergency response equipment and supplies. ▪ Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan. ▪ Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency. ▪ The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.
Security Team	▪ Ensure that the exit route is regularly tested and maintained in good working order. ▪ Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized personnel and equipment may enter, prevent access to the site of unauthorized personnel. ▪ Assist with strong/activation of services during an emergency. ▪ Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.
Rescue & Medical Team	▪ Protect the injured from further danger and weather. ▪ Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital. ▪ Remain familiar with the rescue activities and rescue apparatus. ▪ Assist outside medical services personnel when they arrive
General Administration Team	Response to support any requested general facilities for assisting Emergency Response Team in their work.
Government Relation Team	▪ Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team. ▪ Coordinate emergency plan with the government authorities, local community.
Environment Team	In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.
Department Heads	▪ Call up of personnel into the safe location for protective life and property. ▪ Take immediate and appropriate action while Emergency Response Team is being mobilized. ▪ Keep in touch with the Emergency Commander ▪ Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary. ▪ Provide and maintain emergency equipment of their responsible

Action Group	Responsibility
	areas.
Other Staff and Employees	▪ All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team. ▪ Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.

Emergency Calls

Contractor and Operator will post at sites and issue to all staff and workers emergency Contact Card.

1.4 ACCIDENT REPORTING PROCEDURES DEFINITIONS

Incidents
An incident is an unplanned event or chain of events, which hash or could have caused injury or illness and/or damage (loss) to people, assets, the environment, or reputation.

Injury
An injury is categorized such as cut, fracture, sprain, amputation etc., which results from a single instantaneous exposure.

Lost Time Injuries (LTI's)
Lost time injuries are the sum of Fatalities, Permanent Total Disabilities and Lost Workday Cases but excluding Restricted Work Cases.

Lost Workday Cases
A Lost Workday Case is any work-related Injury which renders the Injured person temporarily unable to perform any Regular Job or Restricted Work on any day after the day on which the injured was received. In this case "any day" includes rest day, weekend day, scheduled holiday, public holiday or subsequent day after ceasing employment.

Note: This definition deviates from OSHA guidance, which considers restricted work as a lost workday case.

A single incident can give rise to several Lost Workday Cases, depending on the number of people injured because of that incident.

Medical Treatment Case (MTC)
A Medical Treatment Case is any work-related injury that involves neither Lost Workdays nor Resident Workdays, but which requires treatment by, or under the specific order of, a physician or could be considered as being in the province of a physician.

Medical Treatment does not include First Aid even if Physician or registered professional personnel provide this.

Near Miss
A Near Miss is an incident which potentially could have caused injury or Occupational illness and / or damage (loss) to people, assets, the environment, or reputation, but which did not.

Permanent Disability
Permanent Total Disability is any work-related injury, which permanently incapacitates an employee and results in termination of employment.

Regular Job
A Regular Job is one, which has not been established to accommodate an injured employee. It should be an existing job or task within the Contractor's or Operator's organization, which the injured is deemed competent to perform.

Restricted Work Case (RWC)
A Restricted Work Case is any work-related injury, which results in a work assignment after the day the incident occurred that does not include all the normal duties of the person's Regular Job. The restricted work assignment must be meaningful and pre-established or a substantial part of a Regular Job.

Reportable Cases are:

- Fatality;
- Permanent Total Disability;
- Permanent Partial Disability - Lost Workday Case;
- Restricted Workday Case; and
- Medical Treatment Case.

1.5 PROCEDURE

Emergency situation and injuries to person can occur at any time or place either on Project site or elsewhere. The most two common types of emergencies on site are fire and serious accident.
The supervisor in the field of safety and health at work shall keep a record of the OH&S measures on the site which are entered in the Register of coordination as necessary.

All injuries regardless of whether it is a LTI, RWC, LWC, and MTC arising out of work are required to be verbally reported to the immediate Supervisor. If the Supervisor is not available, he shall report to H&S Officer. The Accident Reporting Procedure is as follows:

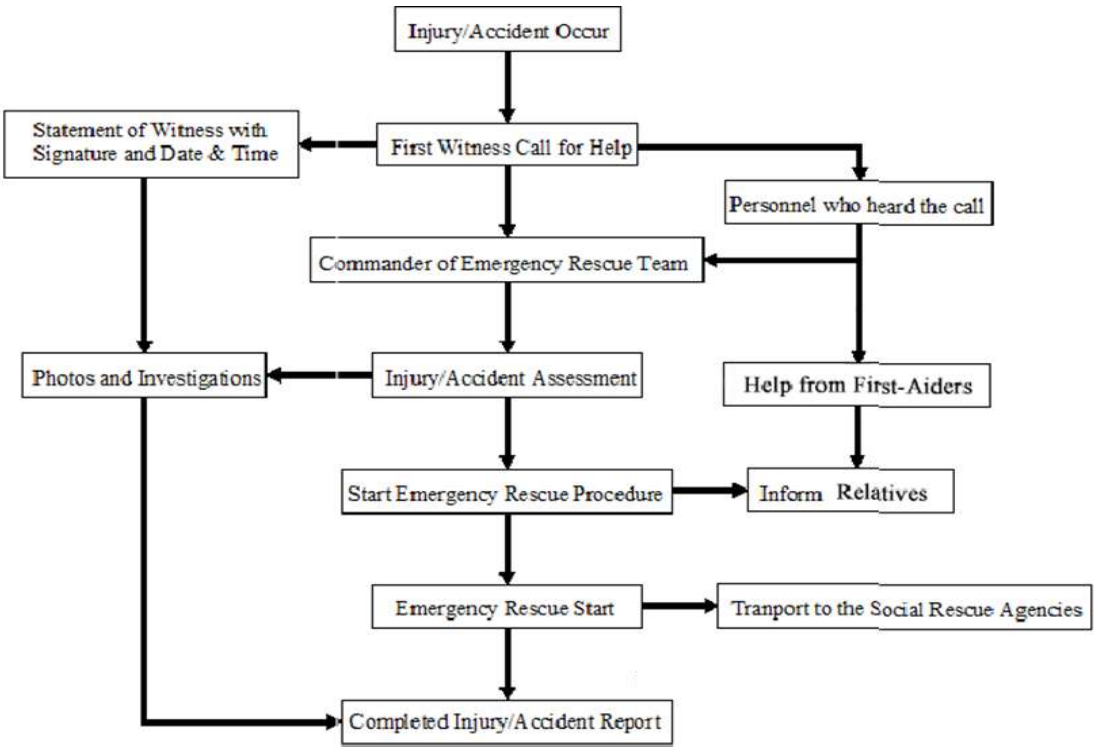


Fig. 6.5-1: Accident Reporting Procedure Scheme

In Case of Injury/Accident at Work
All workers shall have Social Insurance and facilities on the site. After the injured (if any) has been taken to the hospital, the emergency rescue team shall notify the Site Office and the Contractor's Representative as soon as possible. The H&S officer shall inform the next of kin with the contact means collected in personnel registration when employ prior to his commencement of construction activity on site. Statements from witnesses with signature, date and time shall be taken. Photographs of the area where the incident occurred, and any other relevant items are to be taken. The Contractor's Representative will assist in the investigation. The completed accident report form will be sent to the Site Office as well as the Employer's Representative in time. It will be done within 24 hours of the accident.

Transport
Where someone has suffered injury or illness at work necessitating his removal to his home or to a hospital or other similar institution, the Bidder (Contractor) shall promptly provide an appropriate means of conveyance for the one.

The first aider shall accompany the injured or ill one to a hospital or other similar institution whenever the circumstances so justify.

1.6 COMMUNICATION WITH AUTHORITIES / PRESS AT SITE

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

1.7 FIRST AID PERSONS

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

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

1.8 GENERAL ADMINISTRATION TEAM

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

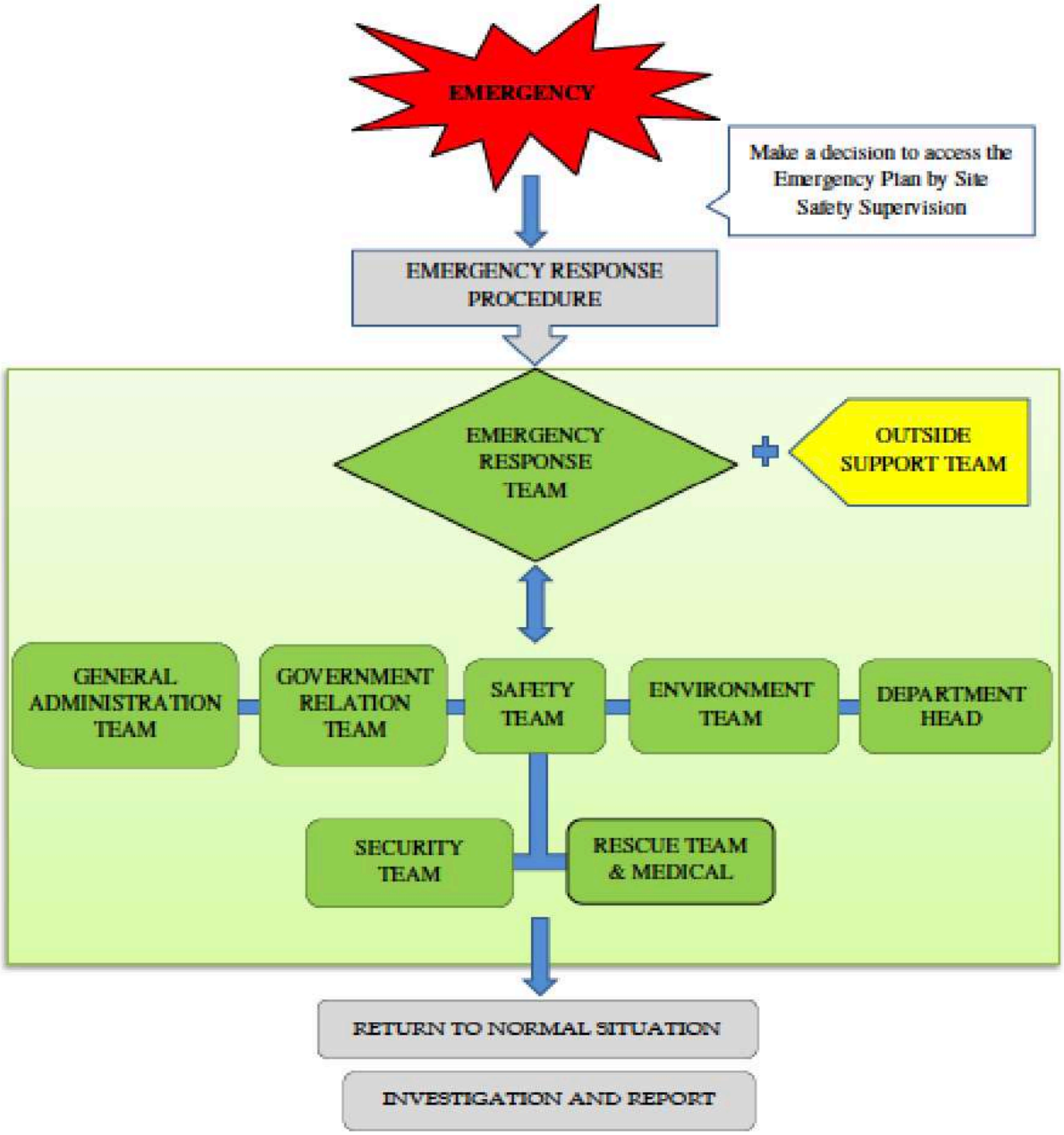
1.9 SECURITY TEAM

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

1.10 EMERGENCY COORDINATOR

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

advised of the emergency as soon as practical after the event.



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

1.11 EVACUATION PROCEDURES

As far as the Evacuation Plan is concerned, meeting points will be defined next to either the Hub Canal or the main entrance of the landfill. Evacuation routes will be kept unblocked and defined. Vehicles from SSWMB will be called to carry out the transport to local health facilities.

The following scheme shows the Evacuation Response Procedure to be followed:

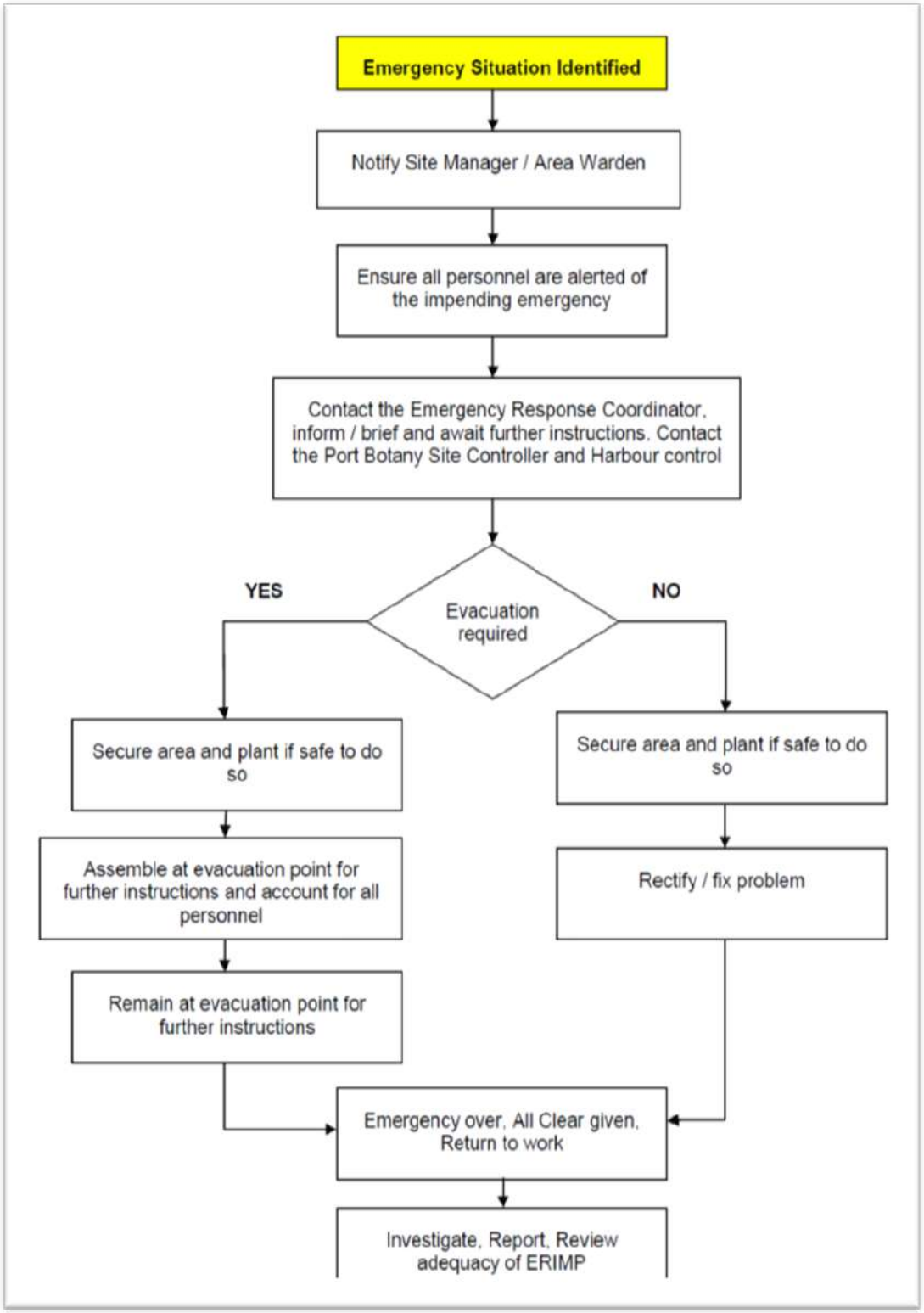


Figure 6.6-1: General Evacuation Response Procedure

1.12 ACCIDENT NOTIFICATION & INVESTIGATION REPORT

TO BE COMPLETED BY IMMEDIATE MANAGER/SUPERVISOR WITHIN 24 HOURS OF OCCURRENCE
NOTE: All incidents and injuries are to be recorded within 24 hours.

PART 1 NOTIFICATION Accident No:

IS THIS WORK RELATED?	☐ Yes ☐ No	If not why?
IS THIS AN INCIDENT OR A Accident?	Accident ☐ Incident	**DATE/TIME REPORTED** Date ( ): Time ( ) :
WHAT WAS AFFECTED?	People: ☐ Asset / Production: ☐ Vehicle Damage ☐ Environment ☐ Reputation	
CATEGORY	☐ Cat. 1 – Client/Consultant employee ☐ Cat. 2 - Contractor/Subcontractor ☐ Cat. 3 – Partner / Customer ☐ Cat. 4 - Non H&SE primacy personnel ☐ Cat. 5 - Non-work related Cat. 6 – Not belong to the work	☐ Field Incident/ Accident ☐ Office Incident/ Accident ☐ Non-Field Accident
AGENT OF INCIDENT	Powered Equipment/Tools ☐Machinery & fixed plant ☐ Mobile plant Transport	Non-powered Equipment/Tool ☐ Outdoor Environment ☐ Human Agencies ☐ Other (specific):
		☐ Chemical Substance ☐ Indoor Environment ☐ Biological Agencies

Accident/ INJURY SUMMARY
DATE / TIME OF OCCURRENCE: Date (d/m/y): Time (24hr) :

FULL DESCRIPTION: *(Describe fully the events that resulted in the incident/injury. Describe what and how it happened. Use separate paper if necessary*
☐ Attachments included

IMMEDIATE ACTIONS TAKEN:

CLASSIFICATION *Complete both boxes using the classification table*

ACTUAL SEVERITY - *What were the actual consequences of this incident? If multiple consequences make multiple selections*

PEOPLE:	ENVIRONMENT:	ASSET / PRODUCTION	REPUTATION:
☐ A - No impact or First Aid Case ☐ B - Medical Treatment Case or Restricted Workday Case ☐ C - Lost Workday Case ☐ D - Disability/Permanent Injury/Illness ☐ E - Fatality	☐ A - No Impact ☐ B - Localised ☐ C - Moderate ☐ D - Significant (local) ☐ E- Significant (widespread)	☐ A - Zero Effect or Slight Damage or Loss ☐ B - Minor Damage or Loss ☐ C - Local Damage or Loss ☐ D - Major Damage or Loss ☐ E - Extensive Damage or Loss	☐ A - No /Temporary Local Impact ☐ B - Local Short Term Impact ☐ C - Local Long Term Impact (manageable outcomes) ☐ D - Local Long Term Impact (unmanageable outcomes) ☐ E – International impact

POTENTIAL SEVERITY (worst credible outcome) *Realistically, could this incident have had a worse outcome?*

PEOPLE:	ENVIRONMENT:	ASSET / PRODUCTION:	REPUTATION:
☐ A - No impact or First Aid Case ☐ B - Medical Treatment Case or Restricted Workday Case ☐ C - Lost Workday Case ☐ D - Disability/Permanent Injury/Illness ☐ E – Fatality	☐ A - No Impact ☐ B - Localised ☐ C - Moderate ☐ D - Significant (local) ☐ E - Significant (widespread)	☐ A - Zero Effect or Slight Damage or Loss ☐ B - Minor Damage or Loss ☐ C - Local Damage or Loss ☐ D - Major Damage or Loss ☐ E - Extensive Damage or Loss	☐ A - No /Temporary Local Impact ☐ B - Local Short Term Impact ☐ C - Local Long Term Impact (manageable outcomes) ☐ D - Local Long Term Impact (unmanageable outcomes) ☐ E - International Impact

☐ All incidents and near misses shall be investigated for a potential severity classification of 'C' or higher, Root Cause Analysis shall be undertaken

REPORTING PARTY DETAILS

PERSON REPORTING INCIDENT (NAME)	EMPLOYMENT CATEGORY (of person reporting):
	☐ Hydroplan ☐ Casual/Work Experience ☐ Joint Venture Employee ☐ Member of Public/Visitor ☐ Client ☐ Contractor:

LOCATION DETAILS

LOCATION WHERE THE INCIDENT OCCURRED: (Name and address of location and exact whereabouts at the location)	SITE: Point:
	WORKPLACE: ☐ Office ☐ Site (above mentioned) ☐ Travel Other

WITNESS NAME (S):

IMMEDIATE NOTIFICATION	REQUIRED	ACTIONED
Immediate Notification to Hydroplan (refer Incident & Accident Reporting & Investigation Standard)	☐	☐

INJURY DETAILS – *Complete only if Injury/ illness sustained. For multiple injuries/illnesses, duplicate this section*.

FULL NAME OF INJURED PARTY		SEX ☐ Male ☐ Female	OCCUPATION
FULL RESIDENTIAL ADDRESS			DATE OF BIRTH (d/m/y):
DATE HIRED	DATE EMPLOYER NOTIFIED OF INJURY/ILLNESS	EMPLOYMENT CATEGORY (of injured person) ☐ Cat. 1 – Hydroplan employee ☐ Cat. 2 - Contractor / Subcontractor ☐ Cat. 3 – Partner / Customer ☐ Cat. 4 – Non H&S primacy personnel ☐ Cat. 5 – Non-work related Cat. 6 – Not belong to the work	
HOW LONG IN PRESENT JOB: ☐<3 montH&S 3 to 6 mtH&S 6mth to 2yrs ☐ 2yrs to 5yrs ☐ > 5 yrs			

INJURY TYPE: ☐ First Aid Case ☐ Medical Treatment Case Restricted Workday Case ☐ Lost Workday Case ☐ Fatality		
NATURE OF INJURY OR ILLNESS (eg. laceration, fracture, hearing loss, unconsciousness)	PART OF BODY INJURED (back, left wrist, right eye etc	
WHAT WAS INJURED PERSON DOING JUST BEFORE THE INCIDENT? (Please be specific. Identify tools, equipment or material in use)		
WHAT HAPPENED? (How did the injury occur)		
WHAT OBJECT OR SUBSTANCE DIRECTLY HARMED THE EMPLOYEE?		
WHERE WERE INJURIES TREATED? (i.e., name of clinic or location)	WHO PROVIDED TREATMENT? (NAME OF PHYSICIAN OR HEALTHCARE PROFESSIONAL)	
TREATMENT GIVEN? BY:		
HAS INJURED EMPLOYEE RETURNED TO WORK?	☐ Restricted Work ☐ Regular Work No. Days	Fatality Date of death

1.13 INVESTIGATION

Investigation

INVESTIGATION TEAM (NAME): (SIGNATURE):

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____

INVESTIGATION TEAM TO COMPLETE ALL ITEMS BELOW:

Select one or more contributory factor:

☐ 1. Design of Plant Facilities, or Equipment	☐ 7. Plant Equipment Operated Incorrectly	☐ 13. Improper Vehicle Operation
☐ 2. Job Planning, Supervision or Instruction Inadequate	☐ 8. Housekeeping Congested, Incorrect Storage	☐ 14. Environmental Factors, Weather
☐ 3. Rules, Procedures or JHA Not Followed	☐ 9. Incorrect Tools or Mechanical Aids Used	☐ 15. Inattention to Details and Hazards of Job
☐ 4. Rules, Procedures or JHA Inadequate	☐ 10. Incorrect or Lack of Personal Protective Equipment	☐ 16. Action of Fellow Employee
☐ 5 Incorrect Body Position in Relation to Work	☐ 11. Inadequate Knowledge or Skill	☐ 17. Maintenance, Inspection Not Adequate
☐ 6. Guarding or Protective Devices Not Provided or Ineffective	☐ 12. Chemical Exposure, Personal Hygiene	☐ 18. Other

Indicate Immediate Causes (Select from the below list and enter appropriate Numbers) and Explain Reason Selected

A) **Substandard practices:**

☐ 1. Operating Equipment without authorization	☐ 7. Using defective equipment	☐13. Improper position for task
☐ 2. Failure to warn	☐ 8. Using equipment improperly	☐14. Servicing equipment in operation
☐ 3. Failure to secure	☐ 9. Failing to use Personal Protective Equipment properly	☐15. Horseplay
☐ 4. Operating at improper speed	☐ 10. Improper loading	☐16. Under influence of alcohol and/o drugs
☐ 5 Making safety devices inoperable	☐ 11. Improper placement	
☐ 6. Removing safety devices	☐ 12. Improper lifting	

_____

_____

_____

B) Substandard conditions:

☐ 1. Inadequate guards or barriers	☐7. Poor housekeeping, disorderly workplace	☐13. Inadequate ventilation
☐ 2. Inadequate or improper protective equipment	☐8. Hazardous environmental conditions: gases, dusts, smokes, fumes, vapors	
☐ 3. Defective tools, equipment or materials	☐9. Noise exposures	
☐ 4. Congestion or restricted action	☐10. Radiation exposures	
☐ 5 Inadequate warning systems	☐11. High or low temperature exposure	
☐ 6. Fire and explosion hazards	☐12. Inadequate or excessive illumination	

_____

_____

_____

Select one or more root causes:

☐1. Procedures & Safe Work Practices	☐ 7. Materials Control/ Procurement	☐ 13. Contractor Operations
☐ 2. Communications	☐ 8. Leadership Accountability	☐ 14. Training/ Competency
☐ 3. Design	☐ 9. Planning & Workload	☐ 15. Work Environment/ Workplace Layout
☐ 4. People & Behaviour	☐10. Hazard Prevention/ Investigation	☐ 16. Emergency Response
☐ 5. Monitoring & Inspection	☐ 11 Risk Recognition & Assessment	
☐ 6. Management of Change	☐ 12. Supervision/ Oversight	

Indicate Root Causes (select from the above list and enter appropriate Numbers) 10 and Explain Reason Selected.

10. Risk Recognition & Assessment

1.14 CORRECTIVE ACTIONS, REVIEW, AND APPROVAL

CORRECTIVE ACTION

ENSURE THEY ARE ENTERED AND CLOSED OUT IN OMNISAFE		
Action Item Description	**Person Responsible**	**Target Date for Completion**
1.		
2		
3		
4.		
5.		
6.		
7.		
8.		

ATTACHED DOCUMENTS

ALL ATTACHED DOCUMENTS MUST BE SCANNED INTO OMNISAFE	
Document name	**Document name**
1. Identification document (ID).	6. PPE Form List
2. Work contract	7.
3. Regulation for drivers and operators	8.
4. Training records	9.
5. Job ID Form	10.

REVIEW AND APPROVALS (complete at the end of the investigation Phase)

Prepared By:	**Signature**	**Date**
H&S Officer / Rep:	**Signature**	**Date**
Comments:		
Project Manager	**Signature**	**Date**
Comments:		
Hydroplan Officer (Classifications C and above)	**Signature**	**Date** / /

Categorization Table

The categories are defined in the table below:

INCIDENT AND ACCIDENT CATEGORISATION TABLE	
Category	**Includes injuries, illnesses, environmental incidents, and damage to or loss of assets, production, or reputation**
Category 1 Company Employees	Personnel working directly for the Company (permanent staff, casual staff, contracted staff, seconders, and agency personnel)
Category 2 Contractors and Subcontractors	Contractor and subcontractors working for or managed on behalf of a customer or a joint venture.
Category 3 Partners and Customers	Personnel other than Category 1 or 2 personnel assigned to work with the Company or a joint venture. This includes partner and customer personnel working under shared premises, shared systems and reporting within a project or alliance structure H&S has primacy.
Category 4 Non-H&SE Primacy Personnel	All personnel other than Category 1 personnel working on a project, *Improve* contract or joint venture where the Company has a role, but does not have H&SE primacy.
Category 5 Non-Work Related	Accidents or incident at the Company controlled work location deemed to be non-work related (ref. OSHA Standard 1904), including those involving visitors and members of the public, and; The Company personnel with non-work related injuries/ illnesses that might have potential to be aggravated at work, or otherwise trigger return to work processes (exempt from investigation)

Work Related (Category 1, 2, 3, 4) / **Not Work Related** (Category 5)

Further explanation of these categories, and definition of H&SE primacy is provided in the H&SE Incident and Accident 0 Reporting and Investigation Standard.

1.15 SUGGESTED CONTENTS OF EPRP

The Contractor should further build upon the EPRP based on the guidelines provided in the above sections. The suggested structure of the EPRP is listed below:

1. Purpose
2. Applicable Scope
3. Preparation Basis
4. Emergency Response System
   - 4.1 Generals
   - 4.2 Emergency Response System
   - 4.3 Responsibilities
5. Major Safety Risks
6. Precautionary Measures
   - 6.1 Training and Exercise
   - 6.2 Hazard Source Monitor
   - 6.3 Alert Action

6.4 Management Measures
7. Control Measures
7.1 Response
7.2 Response Procedures
7.3 Emergency Response
7.4 Emergency Completion and Restoration
8 Emergency Response Report and Settlement
9 Supporting Measures
9.1 Communication
9.2 Emergency Team
9.3 Funding for Emergency
9.4 Provisions and Resources
10. Records

ANNEX XVII - Detailed Grievance Redress Mechanism

1. GRIEVANCE REDRESS MECHANISM

1.1 Introduction

Grievance Redressal Mechanisms (GRMs) have become increasingly important and an integral part for development projects around the globe where environmental, health, safety, and social adverse anticipated and unanticipated impacts resulting from project activities are likely to happen. A Grievance Redressal Mechanism is a tool of communication and coordination among project staff, communities, and other stakeholders who are directly affected by projects (in this case that of the Solid Waste Emergency & Efficiency Project – SWEEP) to address and mitigate the concerns arise during project implementation.

The GRM is intended to provide a way to reduce risk during project implementation, offer communities an effective avenue for expressing concerns and achieving remedies, and promote a mutually beneficial engagement with citizens and communities. Local people need a trusted way to voice and resolve concerns linked to project activities, and PIU SWEEP need an effective way to address community concerns. The GRM also helps the SSWMB to meet the specific commitment included in the Stakeholder Engagement Plan for SWEEP to develop and operationalize such a system, prevent and address community concerns and risks, and assist larger processes that create positive social change.

The GRM given below includes procedures, roles, and functions to facilitate the due process of grievance resolution by proposing an effective and prompt grievance response system to be established before project implementation. This GRM has been developed on top of the existing complaint resolution system of the SSWMB, however, includes measures and practices to differentiate the project GRM from that of the SSWMB. The GRM will enable the PIU SWEEP and SSWMB to address specific grievances and resolve complaints through corrective actions, allow systematic identification of emerging issues and trends, facilitate preemptive engagement to provide transparent and credible processes acceptable to all parties, and ensure outcomes that are seen as fair, effective, and lasting by stakeholders.

1.2 Review of the Existing SSWMB Complaint System

SSWMB operates a complaints system, which comprises several complaint registration channels including:

1. A dedicated telephone helpline (1128)
2. The SSWMB's website and social media pages (that provide direct telephone numbers for central and regional offices as well as email addresses for relevant officials). The social media pages are updated regularly and allow social media users to send messages directly or use an email address displayed on the website and social media pages to file complaints or give suggestions.
3. A smartphone application (SSWMB's Citizen' Application for android and iPhone users) where citizens can log in to provide suggestions and complaints on all SWM related issues. Using the application, complainants can also upload pictures, videos, audio files, or even handwritten text files in support of their complaints.

The SSWMB employs staff at its command-and-control center who are tasked with the registration and management of complaints.

While the SSWMB's complaints system is primarily focused on service-related complaints regarding the Board's operations, a dedicated GRM for SWEEP, described below, will be built on top of the existing complaints systems of the SSWMB, such that complaints concerning project-supported investments and activities may be received through existing channels and relayed by existing staff, however, these will be registered separately, managed under the SWEEP GRM, and tracked by the Grievance Redress Committee (GRC) until resolution.

1.3 SWEEP GRM - Overview

The Project has developed a dedicated GRM, to receive and resolve all complaints and grievances related to project-supported activities. A GRC has already been notified, comprising relevant staff from the SWEEP PIU, with the Project Director at its head and the Stakeholder Engagement and Gender Specialist as the secretary. Other than the GRC members, the Committee may also utilize existing resources at the SWEEP-PIU and SSWMB to address and resolve grievances. Available SSWMB staff at the command-and-control center will be tasked to operate and manage key interfaces such as dedicated telephone lines and email accounts set up to receive complaints, who will then relay to the pertinent SWEEP personnel to settle grievances and provide feedback related to project activities. The existing SSWMB team will be provided training to manage project-specific communications and grievances, which will require response and redressal procedures that are distinct from normal complaints on services. The existing SSWMB team may be supplemented with additional resources using project financing if needed. The design of the GRM will continue to be strengthened in light of the feedback provided during the stakeholder consultations and grievances received to better address the envisaged objectives.

The GRM employs the available complaint registration channels that are part of the existing system used by SSWMB, as well as dedicated project-specific interfaces, and also builds on top of them, as described below:

- **Helpline: 1128** SSWMB's Complaint helpline where all project-specific communications and grievances are to be recorded, tracked, and managed in the GRM database. The helpline will also be used for SWEEP complaints.
- **SSWMB's Citizen Application.** Complainants may register on the application to lodge complaints or provide feedback on project-supported activities, which will be filed in the dedicated sub-portal of SWEEP.
- **Dedicated email:** complaints@sweep.gos.pk Any complaints or grievances received at other email addresses used by the SSWMB for complaints will be routed to the dedicated email address.
- **Online Complaint Application via the website (sweep.gos.pk)**
- **Social Media pages** of SWEEP (registering complaint process and links), with project-related communications and grievances, routed to the SWEEP GRM and GRC
- **Telephone numbers**: 021-99217787-88**.** Call and complaint numbers already in use by SSWMB will also be used to receive project-related communications or complaints, which will then be recorded in the SWEEP GRM.
- **In-Person registration of complaints at project offices (PIU and site offices).** All communications will be shared with the GRC and entered into the GRM database by the dedicated staff of SWEEP-PIU.
- **On-site complaints register and complaints boxes** will be placed at all sub-project sites prior to the construction of the project. The supervision consultants engaged for specific subprojects will ensure that qualified staff of contractor/s is tasked with and available on-site to receive verbal complaints, and shared them with the PIU.

1.4 Grievance Redress Procedure/ Mechanism

A set of procedures for receiving, recording, and handling complaints has been defined in the following subsections. This includes procedures for recording, registering, and sorting grievances; conducting an initial assessment of grievances, referring grievances to appropriate levels or persons, determining the resolution process, making decisions, including parameters and standards for accurate and consistent decision-making, notifying complainants and other affected parties of eligibility, the resolution process, and outcomes, along with tracking, documentation, monitoring, and evaluation.

1.4.1 Assignment of the Role of a Focal person as the Grievance Officer

This grievance officer will be the person assigned to receiving and following up on complaints through a structured process as explained in the following sections. Project-related complaints, as they arise, shall be addressed by the Grievance officer, the role of which shall be played by the Social Safeguards Specialist. This Grievance Officer shall report to the Project Director of the SWEEP PIU.

1.4.2 Step 1: Receipt, Log, and Acknowledgement of Complaint/ Grievance

As part of the GRM, grievances from the stakeholders or their representatives may be communicated through any of the channels/mediums highlighted above. All grievances communicated in any of these mediums shall be recognized and recorded in the database, which the PIU SWEEP will have access to. Once the grievance is recorded, a grievance number shall be allocated and communicated to the aggrieved within 24 hours of receipt. In case the grievance is assessed to be out of the scope of the GRM, a communication towards the same shall be made to the complainant, along with an alternative mode of redressal suggested. As part of this acknowledgment, a tentative timeline for the redress of the grievances shall be identified, in keeping with the process below. This acknowledgment shall be provided on the same day the grievance is received.

A separate log in the database will be maintained to analyze information about grievance and conflict trends, community issues, and project operations to anticipate the kinds of conflicts that might be expected in the future, both to ensure that the grievance mechanism is set up to handle such issues and to propose organizational or operational changes.

1.4.3 Step 2: Initial Review, Examination, and Investigation of the Complaint/ Grievance

Once the grievance is received and recorded, the Grievance Officer (from the SSWMB, contractor, or personnel responsible for resolving the grievance). The Grievance Officer and concerned department shall then undertake an inquiry into the specifics of the grievance, with the aim to determine and analyze the cause of the grievance and subsequently identify suitable resolution measures. Depending on the sensitivity of the issue, a site inspection can be undertaken to check the validity and severity of the grievance. For this purpose, the Grievance Officer will also undertake discussions with the aggrieved concerned and external stakeholders. The inspection will be undertaken within three days of the receipt of the grievance.

1.4.4 Step 3: Resolution of Grievance

Based on the case investigation, the Grievance Officer, in consultation with the concerned department/s, shall identify a suitable resolution to the issue which will not be more than 14 working days. Should the complaint resolution demand more time, then the same shall be conveyed to the complainant along with the issues being faced. Grievances that require assistance from a different department will be referred to the GRC. At the conclusion of the action to solve grievances, the complainants will be informed of the outcome within 48 hours along with satisfaction with the action taken.

The GRM will also include a system for re-lodging complaints should they remain unsatisfied, which will be escalated to the Head of the GRC. Anonymous complaints will also be received and entertained by the PIU staff. These complaints will be entertained based on the evidence attached as well as any documentation provided. Since complainants have chosen not to provide contact information in this type of complaint submission, they may not be able to receive responses, notifications, or alerts.

Grievances that are beyond the capacity of resolution at the GRC level will be forwarded directly to the local government department representative and the relevant service providers. PIU SWEEP will be following up on such complaints and forward the entire information to the complainant in the due course of time. The same approach will be adopted for the complaints pertaining to gender-based violence.

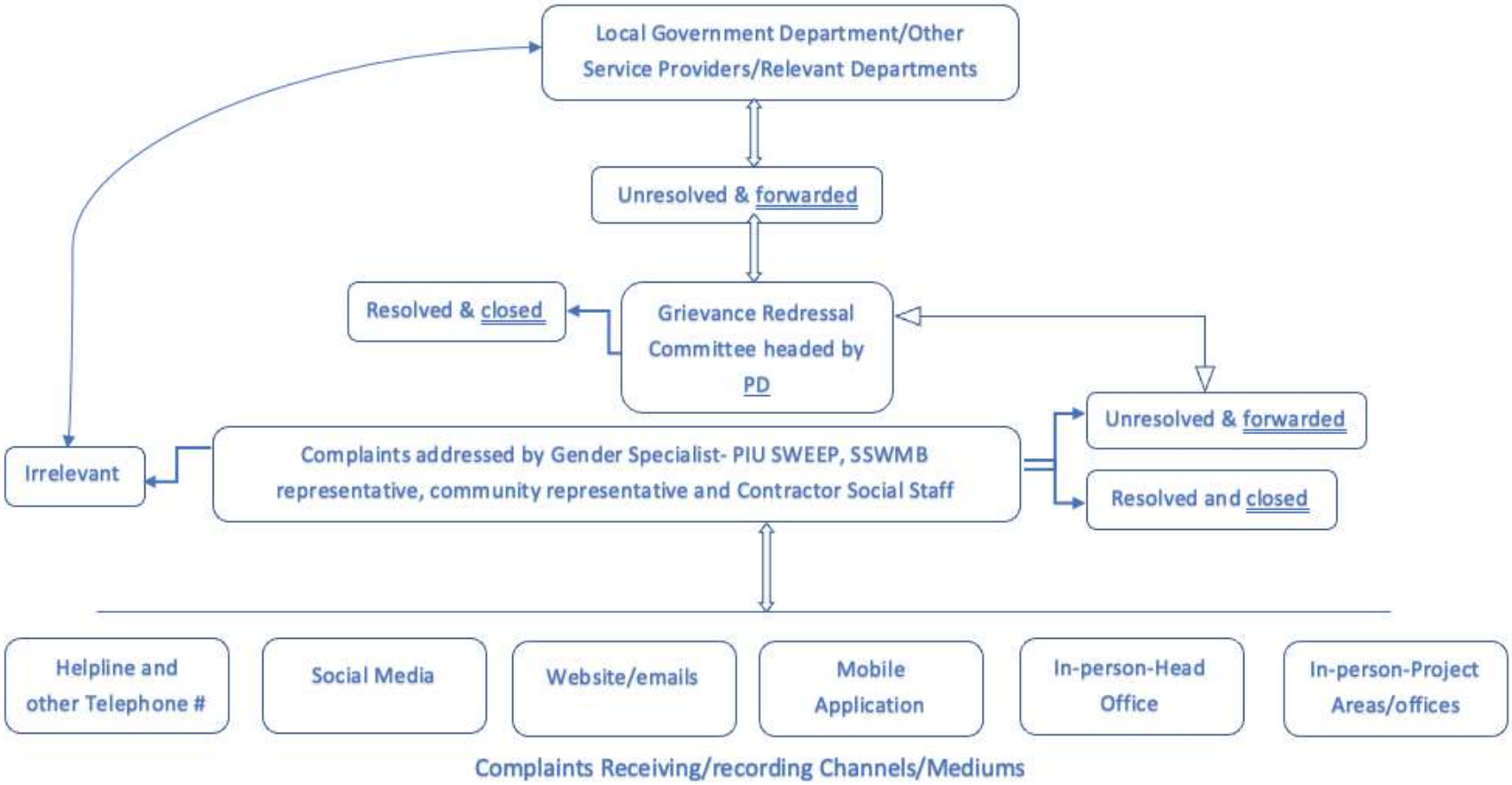
Major grievance/issues/required strategic direction and decisions. The mechanism is reflected in the flow chart given below:

1.5 Grievance Redress Committee (GRC) under SWEEP

Role	Designation
Head of the GRC	Project Director SWEEP
Director GRC	Deputy Project Director SWEEP
Secretary to GRC	Stakeholder Engagement and Gender Specialist
Member	Deputy Director Communication
Member	Community Engagement and Resettlement Specialist

Note: Deputy Project Director or Deputy Director Communication SSWMB will chair the Committee in the absence of Project Director. Three persons are necessary in the quorum for conducting the meeting and the committee meeting cannot be conducted without chair. The Secretary to the committee will be responsible to keep all records confidential. Record may be share after the approval of Project Director SWEEP with the World Bank or any stakeholder.

Nomenclature of GRC



1.5.1 Audit, inspection, and physical verification/Enquire Grievance Record

All grievance record is auditable, and each grievance may be audited by stakeholders or any nominated staff at the SWEEP PIU with the permission of Project Director SWEEP. The record will be maintained at the SWEEP-PIU level, if a team member/others required a record will produce a record with the approval of the Project Director SWEEP.

1.5.2 Timeline for Resolution of Complaint

- The committee will finalize the decision within a 14-day period and assess progress on its decision
- Categorization of grievance by Assistant (for GRM) to Secretary GRC (Within 2 days of receipt)
- Assignment of complaint to relevant department/ Personnel for redressal of complaints (Within 3 days of receipt)
- Submission of complaint status to GRC (fortnightly)
- Updated status of the complaint by the relevant department /personnel and submission to PD SWEEP (Monthly)

1.6 Complaints of Gender Based Violence, Sexual Exploitation & Abuse/ Sexual Harassment & Violence Against Children (GBV, SEA, SH, and VAC)

Gender-based violence (GBV) is a violation of human rights. Nearly six in ten women around the world suffer some kind of violence in their lifetime, whether physical or sexual (UN Women, 2019b). Although countries have been encouraged by international and regional legal entities to take steps to fight the problem, GBV continues to occur worldwide in many forms, ranging from domestic violence to sexual abuse, to more severe forms such as honor killings, acid attacks, and other forms of femicide. The global prevalence of GBV indicates that the issue is yet to fully be tackled, which has far-reaching consequences. Studies reveal that GBV leads to physical injuries, disability, and death, and victims also suffer mental and psychological disorders. According to a World Bank study (Nata Duvvury, 2013), some women fear GBV more than war or cancer.

The PIU SWEEP is focused on addressing any GBV, SEA, and SH related grievances across all project-supported activities and subproject sites. A survivor-centered approach will be adopted under which the survivor's safety, confidentiality, choices, needs, and well-being will remain central. The SEA/SH and VAC complaints will be addressed in the following manner:

Accessibility: The SEA/SH and VAC GRM will be accessible to all potential complainants from affected persons and workers at subproject sites. Complainants can lodge complaints using multiple access points (SSWMB's Citizen's Application, phone, email, complaints boxes, in-person, etc.) to register complaints. Adequate information about the existence and operations of GBV complaints will be provided to the communities in local languages.

Safety: The safety and security of the survivor, his/her family, and the people who have assisted them to register a complaint, must be the number one priority for all actors. Individuals who disclose an incident of GBV are often at a high risk of further violence from the perpetrator(s) or from others around them. The survivor's physical and psychological safety

as well as that of their family must always remain a priority, and survivors must be involved in all decision-making related to their case including proceeding with legal action.

Confidentiality: Confidentiality would be the prime priority and will be maintained, as much as possible, with respect to any GBV/SEA/SH and VAC complaint, and only those who need to know about such a complaint will be advised of its existence. Information gathered about the allegation will not be shared with persons or entities unless there is explicit permission granted by the complainant. Confidentiality should cover all information in a complaint that may lead to the identification of a specific incident or those affected by the allegation. This applies to the survivor and witnesses, but also the identity of the alleged perpetrator. Confidentiality is key to protecting survivors' and witnesses' safety.
Information-sharing will take place on a strictly need-to-know basis, limited to essential information, and based on pre-established information-sharing protocols which are in line with best practices for the handling of GBV/SH/SEA/VAC cases.
Reports of grievances to the World Bank and PIU shall only include an anonymized summary of allegations based on pre-established information-sharing protocols.

Survivor-centered approach
All prevention and response actions must balance the respect for due process with the requirements of a survivor-centered approach under which the survivor's safety, confidentiality, choices, needs, and well-being remain central.
Respect: The survivor's rights, needs, and wishes will be respected at all levels, and all actions will be taken with her/his consent or the consent of the parents/legal guardians in case of a minor.

Non-discrimination: Survivors of violence will receive equal and fair treatment regardless of their age, gender, race, religion, nationality, language, ethnicity, socio-economic status, or any other characteristic.

Considerations regarding children and persons with physical and/or intellectual disabilities: When the survivor is a child, the best interest of the child is the governing principle. Children are considered incapable of providing consent because they do not have the ability and/or experience to anticipate the implications of an action, and they may not understand or be empowered to exercise their right to refuse. A child is anyone under the age of 18 under national and provincial laws who cannot give free and voluntary consent. Additional considerations and protective safeguards may also apply where the complainant or survivor is a person with physical and/or intellectual disabilities.

1.7 Procedures of Addressing Grievances on GBV, SEA, SH & VAC

The GRM for GBV, SEA, SH, and VAC will require a dedicated and specific system to receive, manage, and resolve such complaints. The (i) Stakeholder Engagement and Gender Specialist and (ii) Community Engagement and Resettlement Specialist, at the SWEEP PIU will be central to this system as *the focal points for all complaints and grievances related to GBV, SEA and SH*. The PIU staff will be responsible for tracking and managing such complaints, and will be provided training from a certified and reputable organization focusing on issues of GBV and VAC. The system will rely on designated *GRM operator(s) for GBV, SEA, SH, and VAC,* who will actively coordinate with staff managing the various complaint channels (among the SWEEP PIU, SSWMB, and supervision consultants) for receiving and lodging such complaints. The designated staff will be provided adequate training on handling and documentation of complaints related to gender-based violence, sexual exploitation and

abuse, and sexual harassment, and covering referral mechanisms to related service providers. All grievances related to GBV, SEA, and SH will be managed by a *dedicated GBV, SEA, SH and VAC committee* specifically set up for this purpose. The members of the committee will also need to be well-trained to manage such complaints.

GRM Operator for GBV, SEA, SH, and VAC: The GRM Operator will be responsible for: (i) receiving, categorizing, and logging complaints; (ii) referring survivor/s who contact through the GRM to social safeguard specialist SWEEP; (iii) notifying designated representative of SSWMB (iv) forwarding the case to SEA/SH and VAC Committee (if the survivor or in the case of a minor his/her parents or legal guardians, choose to file a formal complaint); (v) following up with the survivor and updating case status in the GRM. All complaints, communications, or any reported incidents related to GBV, SEA, SH, and VAC will be immediately flagged to the focal points at the SWEEP PIU.

GBV, SEA/SH and VAC Committee: The committee will comprise of four individuals, at least one of whom will be a woman. The following members will be part of the Committee to discuss and resolve such complaints:

- Stakeholder Engagement and Gender Specialist, SWEEP- PIU
- Personnel from the Solid Waste Management Board (SSWMB) at LFSs and GTS
- A representative from the community,
- Personnel from Social Team of the contractor
- Community Engagement and Resettlement Specialist, SWEEP- PIU
- Focal person from the service provider the survivor is referred to, or a trained GBV or VAC professional from one of the service providers.

The SEA/SH and VAC Committee will be responsible for:

(i) Assessing the complaint to establish whether an act of SEA/SH or VAC has been committed.
(ii) Confirming whether the alleged perpetrator is associated with the Project; and
(iii) Agreeing upon a plan of action including sanctions to be imposed, in consultation with the employer of the alleged perpetrator.

1.7.1 Response Protocol

Step 1: A survivor may either directly report an incident using any of the means (phone, email, office address) to access GRM, or choose to report to an individual whom she/he trusts such as a family member, a friend, another member of the community, a service provider, or community or religious leader.

Step 2: Upon receipt of a complaint, the GRM Operator will register the case in the GRM. The GRM Operator/s will inform the PIU focal Points, who will in turn inform the World Bank of any SEA/SH or VAC complaint/allegation, within 48 hours of receiving such a complaint. When the allegation is received directly from the survivor or parent/legal guardian in the case of a minor, the GRM Operator/s will record their account of the incident and assist them by referring them to GBV service provider(s) for support immediately. If the complainant is not the survivor, the complainant should be encouraged to ask the survivor to come forward by explaining to them the potential benefits of doing so, either alone or with the person reporting to the GRM. If there is a genuine concern about the safety of the survivor, the GRM Operator may try to directly approach them, and refer them to the relevant GBV service provider.

The GRM Operator/s will refer any survivor reporting abuse or violence through the project grievance mechanism to a relevant service provider, regardless of whether the perpetrator is

known to be associated with the project or not. The reason for this is that it may not be possible to know the specific details about the perpetrator at the time the complaint is launched, or at the time that support services start; and once they begin, a survivor should continue to receive care and have access to them. Further, due to increased awareness activities in the project-affected communities, survivors may seek services through the project, whether the perpetrator is associated with the project or not.

The GRM Operator should have knowledge on:

1. How to access said services,
2. whom to contact,
3. Financial support that may be provided, and
4. Available options for assistance within and outside of the GRM.

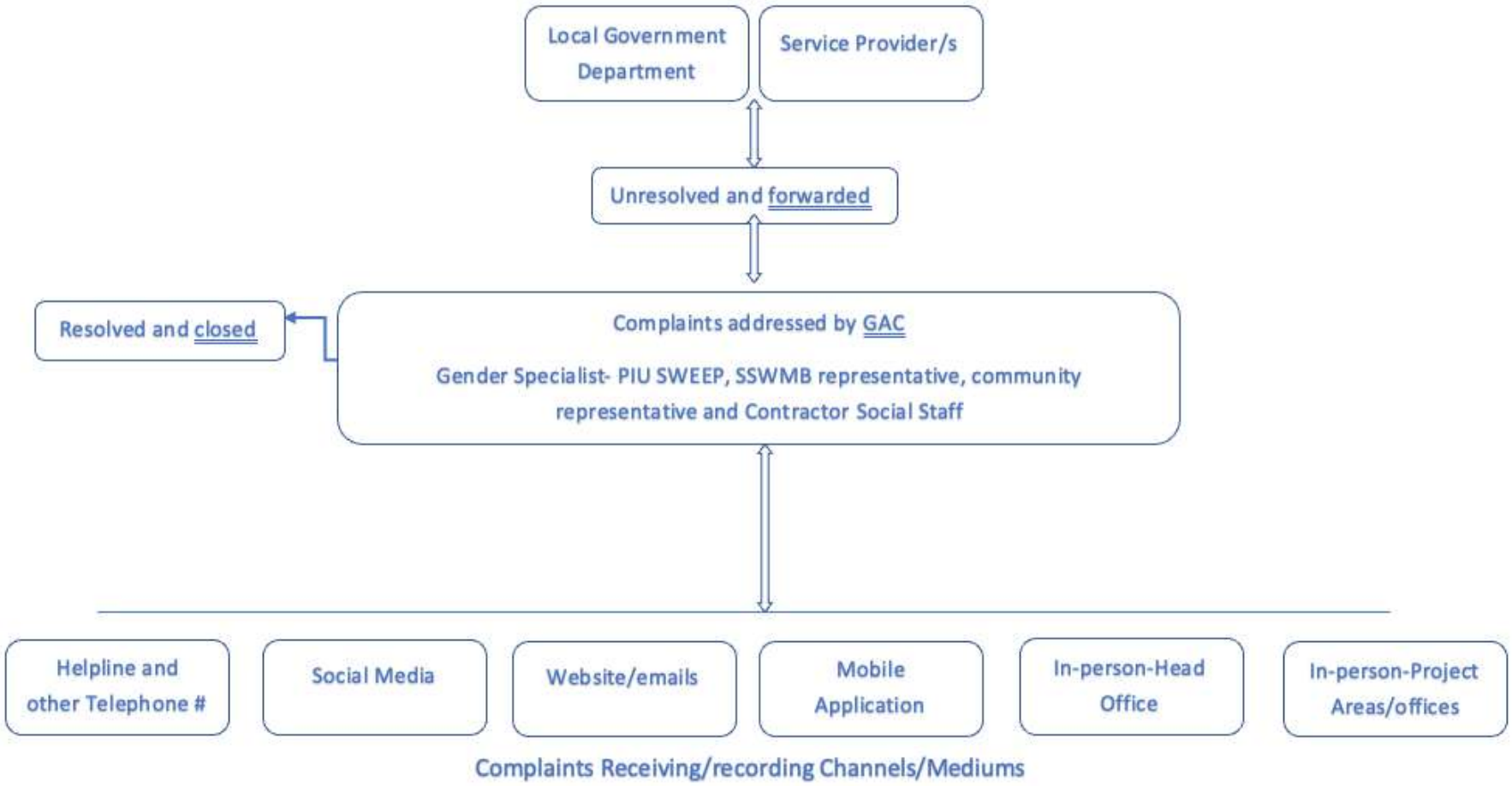
Upon receipt of a complaint and prior to referral or any third-party disclosure of the case, the GRM must ensure that consent is taken from the survivor. For this purpose, a standard form may be used as appended.

Step 3: If the survivor or parent/legal guardian in case of a minor wishes to file a formal complaint, the GRM Operator will send the case to the SEA/SH and VAC Committee. As mentioned above, the Committee will review the available information and assess if it constitutes an act of SEA/SH or VAC. Further, it will establish whether there is a link with the project. If the findings reveal that an incident has taken place by an individual associated with the project, the Committee will inform the appropriate party/ employer (i.e., the contractor, consultant, or SSWMB) of the alleged perpetrator of the allegation. The Committee will share their recommendations with the employer of the perpetrator, and a course of action (including disciplinary action) will be agreed upon within two weeks of receiving the complaint. Subsequently, the employer will be responsible to take the agreed disciplinary action within 30 days of the receipt of the complaint. Any sanctions imposed (please refer to Gender Action Plan- CoC) should be proportionate to the violation; and in accordance with the national/provincial legislation, the employment contract and the CoC. In instances where it is necessary to report the case to local authorities in line with national or provincial laws, the Committee will refer the case with the consent of the survivor or parent/ legal guardian, for further investigation and criminal proceedings.

Step 4: Where the survivors decide to file a formal complaint, it is important to keep the survivors or parents/legal guardians of minors informed about the progress of the case. In such instances, the GRM Operator will inform the survivor when the case has been sent to SEA/SH and VAC Committee for review, and when the matter has been sent to the employer for disciplinary action. Alternatively, the survivor or parent/legal guardian may decide to approach the employer directly or pursue legal action through a referral partner.

Step 5: Once the necessary disciplinary action has been taken, or legal action has been initiated the case will be closed in the GRM. The results of the process, whether it is sanctions imposed by the employer or initiation of legal proceedings, will be logged in the GRM. PIU SWEEP Social Safeguard Specialist, Representatives of SSWMB and the World Bank will be informed of the closure of the case, as per the agreed communication protocols.

Nomenclature for addressing Complaints Gender Action Committee (addressed in Gender Action Plan)



ANNEX XVIII -
Consultation Session Invite

EMC PAKISTAN PVT. LTD.

ENGINEERING & MANAGEMENT EXPERTS

Date: 06 May 2022

Reference: **Solid Waste Emergency & Efficiency Project (SWEEP)**

Subject: **Stakeholders Consultation Workshop for Environmental & Social Assessment for New Landfill Cell at Jam Chakro & Six Transfer Stations throughout Karachi**

Dear Concern,

The Government of Sindh is receiving support from the World Bank for prioritized interventions in Solid Waste Management, under the umbrella of two mega projects: CLICK (Competitive and Livable Infrastructure for the City of Karachi) and SWEEP (Solid Waste Emergency & Efficiency Project).

The CLICK project, started in 2019, will focus on supporting upstream policy and regulatory work, and institutional capacity strengthening of the Sindh Solid Waste Management Board (SSWMB), along with the development of sector strategies and public awareness. The SWEEP project, initiated in March 2021, will focus on improving solid waste management services in Karachi, through the incremental upgrading of infrastructure for collection, transfer, final disposal, and treatment of solid waste in Karachi.

The subject project: the development of a new sanitary landfill cell at Jam Chakro and six transfer stations through the city of Karachi, will be executed by the SSWMB under the SWEEP Project. Consequently, for the subject project, an Environmental & Social Impact Assessment of the project is required prior to the commencement of any works, which the Sindh Solid Waste Management Board has awarded to EMC Pakistan (Private) Limited.

As part of the Environmental & Social Assessment Studies, stakeholder consultation is a vital and mandatory requirement to ensure the involvement of all potential stakeholders, to ensure the incorporation of their concerns and perspectives into the design and implementation of the project.

In view of the above, it is requested to please depute relevant person/official representing your department/organization to attend the Stakeholder Consultation workshop organized on 12th May 2022, at 10:30 AM, at Khorshed Mahal Hall at Avari Towers Karachi, to obtain feedback and suggestions on the project from relevant stakeholder. Lunch will be served to all participants after the session.

For further details and any clarification needed, please contact, ***Mr. Syed Omar Arif****, ESIA Project Coordinator, from EMC Pakistan at office No. 0213-4311466 & Cell No. 0333-3314454.*

Thanking you in anticipation and looking forward to your presence at the event.

Yours Truly,

Syed Nadeem Arif
Managing Director

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SOLID WASTE EMERGENCY & EFFICIENCY PROJECT
LOCAL GOVERNMENT DEPARTMENT
GOVERNMENT OF SINDH

No. PD/PIU/SWEEP- LG / 2022/139 Date: 06/05/2022

To,

M/s EMC Pakistan PVT. LTD
Address: Suite No. 502,503,5th Floor, Anum Estate,
Main Shahrah-e-Faisal, Opp. Duty-Free Shop, Karachi, Pakistan.
Tel: (92-21) 34311466, 34321717
Email: mail@emc.com.pk, nadeem@emc.com.pk

Subject: Stakeholders' Consultation Workshop Environmental & Social Impact Assessment & Preparation Of Environmental & Social Management Plans For The Construction Of A New Landfill Cell & Six Transfer Stations In Karachi.

The Government of Sindh has received financing from the International Bank for Reconstruction and Development (IBRD) (the Bank) in the form of a credit towards the cost of the Solid Waste Emergency & Efficiency Project (SWEEP). The Government of Sindh will implement the Solid Waste Emergency and Efficiency Project (the **Project**), through Sindh Solid Waste Management Board (SSWMB).

The SWEEP project, initiated in March 2021, will focus on improving solid waste management services in Karachi, through the incremental upgrading of infrastructure for collection, transfer, final disposal, and treatment of solid waste in Karachi.

The SWEEP will implement material measures and actions so that the Project is implemented in accordance with the Environmental and Social Standards (**ESSs**). This Environmental and Social Commitment Plan (**ESCP**) sets out material measures and actions, any specific documents or plans, as well as the timing for each of these. The SWEEP is responsible for compliance with all requirements of the ESCP even when the implementation of specific measures and actions is conducted.

The SWEEP will also comply with the provisions of any other E&S documents required under the ESF and referred to in this ESCP, such as the Environmental and Social Management Framework (ESMF), Environmental Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP), Resettlement Framework (RF), Resettlement Plan (RP), Labor Management Procedure (LMP), Gender-Based Violence/Sexual Exploitation and Abuse and Violence Against Children (GBV/SEA and VAC) Action Plan, and Stakeholder Engagement Plan (SEP), and the timelines specified in those E&S documents.

In this regard, the development of a new sanitary landfill cell at Jam Chakro and six transfer stations will be executed under the SWEEP. Consequently, for the subject project, an Environmental & Social Impact Assessment of the project is required prior to the commencement of any works, which the Solid Waste Emergency & Efficiency Project has awarded to your firm **M/s EMC Pakistan (Private) Limited.**

As part of the Environmental & Social Assessment Studies, stakeholder consultation is a vital and mandatory requirement to ensure the involvement of all potential stakeholders, to ensure the incorporation of their concerns and perspectives into the design and implementation of the project.

In view of the above, you are requested to please provide the final list of Stakeholders/participants to this office and issue invitation letters department/organization to attend the Stakeholder Consultation workshop to be organized on 12th May 2022, at 10:030 AM.

Zubair Ahmed Channa, PAS
Project Director
Solid Waste Emergency & Efficiency Project

Copy for information to:

- The P.S to Chairman, P&D Board, Govt. of Sindh, Karachi
- The P.S to Secretary Local Government Development, Govt. of Sindh, Karachi.
- The P.S to Chief Economist, P&D Board, Govt. of Sindh, Karachi
- Master File

ENVIRONMENTAL & SOCIAL IMPACT ASSESSESMENT & PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

12 May 2022

Stakeholder Consultation Workshop		
S. No.	**Time**	**Activity**
Inaugural Session		
1	10:30 AM	Arrival / Registration & Introductions
2	11:00 AM	Address by Mr. Zubair Channa (Project Director – SWEEP)
3	11:15 AM	Address by Mr. Nadeem Arif (Managing Director – EMC)
4	11:30 AM	Tea Break
Technical Session		
5	12:00 PM	Briefing of Subject Project and Project Components
6	01:00 PM	Consultations & Questions and Answer Session (Floor open for discussion)
7	02:30 PM	Closure of Session & Concluding Remarks
8	03:00 PM	Lunch

ANNEX XIX - Consultation Session Attendance Sheet

STAKEHOLDERS' CONSULTATION WORKSHOP

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT & PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
01	Tq J Muhammed	Assistant Director	SSWMB	0334-3747277	
02	Dr. Amna Alizai	DDG.	GSP	0345 2288796	
03	Amber Noor	GIS Specialist	CRAB	03321137699	
04	RAFIA ICHAN	GENDER SPECIALIST	EMC	0333-3626482	
05	DR. KANEEZ FATIMA	Environmental Sociologist	University of Karachi	0333-2195231	
06	Aflab Mujadid Ismail	Director MPH.	KMC	03002524020	
07	Nisar A Soomro	E.D II	SSWMB	03082113163	
08	NAILA ITAC	Dep Dir	DURP&SP	03332301086	
09	Eng P Sadaf	CEO LE	SHEHRI	0300 8297362	
10	Shamsul Haq Memon	TECHNICAL EXPERT	EMC		

STAKEHOLDERS' CONSULTATION WORKSHOP
ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT &
PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS
FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
11	Mussawir Qureshi	HSE Specialist	SWEEP	0312-3979229	
12	Miss Laiba	Assitant	Sweep	0331-3499837	
13	Muhammad Nawaz	SSS	SWEEP	03337073147	
14	Dr. Qaudeer	Professor	Karachi University R.F.S	0333-2174799	
15	Miss Nasreen Pasahat	PS to PD	SWEEP	0300-2016506	
16	Dr. Shahzada	Specialist ISWM	SWEEP	03442498895	
17	KHALID HUSSAIN LAGHARI	RESEARCH OFFICER	WWF-PAKISTAN	0345-3587698	
18	M. Riaz Gill	RGBS	SSWMB	0336-3061673	
19	Bilal Butt	Manager Admin	Landhi Association of Trade & Industry LATI	0334-0035517	
20	Faisal Waheed	Project Manager	Geo-Pro	0300-3994274	

STAKEHOLDERS' CONSULTATION WORKSHOP
ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT & PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
21	Ghulam Nabi	AD (HR)	SSWMB	0321-2649746	
22	G.A Mangrio	DD South	SSWMB		
23	Rehmatullah Lashari	D.D Korangi	SSWMB	03028246477	
24	TARIQ ALI NIZAMANI	ED (HR)	SSWMB	03323009734	
25	DR. MEHMOOD ALI	Associate Professor	NED UNIVERSITY	0331-2200722	
26	Wali Muhammad Qureshi	Deputy Dir	Women Dev: Deptt.	0321-2308850	
27	FARHAN LODHI.	Sr. Environment Specialist	SSWMB	0317-1008657	
28	Huma Haleem	-	SWEEP	-	
29	Fahad Ali Bhatti	-	SSWMB	03332442700	
30	Syed Arshad Abbas	PD (FEC) Male		021-8266465	

STAKEHOLDERS' CONSULTATION WORKSHOP
ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT &
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(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
31	G. Abbas Memon	Deputy Director (PEC) West.	SSWMB	0333-7178339	
32	Rafiul Haq	Ecologist	CRAB	03413784441	
33	Liaqat Ali Ahmed	Solid waste Mgt. Admin & HR	CRAB	0301-8447048	
34	Mr. Aimen	Admin	C.P	0317-2644690	
35	Mustafa Rashid	Account	C.P	0313-2738288	
36	Ghulam Kibria		NEEH	03123443380	
37	Rizwan Jaleel	Sr. Stakeholder officer	Team fund	0333-2852311	
38	Masood Adil	DD	SSWMB	03112061414	
39	Zahra Ahmed.	Environmental Specialist	KNIP	0321-7155475	
40	Zahid Farooq	Joint Director.	URC	03332885136	

STAKEHOLDERS' CONSULTATION WORKSHOP
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(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
41	Dr Yasmin Nerris	HOD Env. Resch Centre	Bahria University	0345 2424832	
42	Mughal Sheriff	AP Env. R. Centre	Bahria University	03472207590	
43	Sohail Ahmed Bhutto	Asstt. Director (tech)	PDMA Sindh	0333-6640482	
44	M. Kamran Arbi	V. President	SITE Association	0322-2076268	
45	Iftekhar Ahmed	Deputy Director	Energy Department	03332452648	
46	Uzma Bano	Gender Specialist	KNIP	0333 2334413	Uzma Bano
47	Zulfiqar Laghari	Sr. Social Specialist	CLICK	—	Zulfiqar
48	M. AQIB	Sr. Env Sp	CLICK	03002108169	
49	Ijaz H. Khilji				
50	Danish Kasholi	Head of Karachi Programme	IUCN	0333 3335769	

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(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
51	Dr. Shahid Amjad	Prof. HoD	IEM. IOBM	03002714260	
52	Nisar Ahmed Solangi	Director (Admin)	Social Welfare Deptt:	03003418820	
53	Nilofer Bakhai	Retired	Shehri	0333-2168499	
54	Saeed Ahmed Sethar	Govt. Servant	Shehri	0300 8722476	
55	Sayed Waseem Shah	Program Manager	HANDS	0301-2697406	
56	Syed Aftab Ali Shah	Director GTS	SSLO NTD	03213276525	
57	Mubarak Ali	DD (Tech.)	SINDH EPA	0345-2494458	
58	DR NUZHAT KHAN.	FORMER DG NIO	—	0333. 2247187.	
59	Khair Bano	Env. Specialist	ICWRSIP	0333-3145667	
60	Athar Hussain Mari	Env. consultant	ICWRSP	0321-2452690	

STAKEHOLDERS' CONSULTATION WORKSHOP
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(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
61	SABIR HUSSAIN	Director M&E	SSWMB	03333740792	
62	Muhammad Ahmed	Div OPS Dist Ew	SSWMB	03332308103	
63	Almas	D.D. Media	SSW MB.	0345 2425844	
64	Muhammad Saleem Jatbani	Sr. Chief Env	DCPLL	0300-2772713	
65	M. Sohail Rabtcha	Sr. reporter	SAMAA	0321-8976184	
66	Dr. Abdul Samad	DMO	Dialysis Pathology	03003332831	
67	Dr. Salma Hawa	Head of Dep.	Earth & Env. Sc., Bahria University	0324-2300713	
68	M. Irfan	Asst Prof	Bahria University	03331221947	
69	Gyasuddin	DIRECTOR	CERES ASSOCIATES GULF	0345-8229850	
70	Faheem Ahmed	—	CERES ASSOCIATES GULF	—	

STAKEHOLDERS' CONSULTATION WORKSHOP
ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT &
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(12 MAY 2022 @ AVARI TOWERS, KARACHI)

S.NO.	NAME	DESIGNATION	ORGANIZATION	CONTACT NO.	SIGNATURE
71	Beena Devi	CHSEQ.	KE	03468223412	
72	Farooq Bhutto	CHSEQ	KE	0334-3274407	
73	Waqar Hussain	Director (HQ)	SEPA		
74	Nadeem Ashraf	V P	NFEH		
75	Naeem Qureshi	Project	NFEH		
76					
77					
78					
79					
80					

ANNEX XX - Consultation Session Stakeholder's Feedback

THE WORLD BANK

SWEEP Solid Waste Emergency and Efficiency Project

ENVIRONMENTAL & SOCIAL IMPACT ASSESSESMENT & PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Bilal Butt

Designation: Assistant Manager Admin.

Department: Landhi Association of Trade & Industry.

Feedback/ Comments/ Concerns on Project Information Disclosed

Session was soo much informative. If the Project Properly launch ~~and~~ with in the city Lets Karachi All the steps told by Mr. Zubair will implimented in through this Project. This will be the best thing happen to the city.

Sindh Solid Waste Management Board

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Zulfiqar Ali Laghari

Designation: Sr. Social Development Specialist

Department: Click Programme

Feedback/ Comments/ Concerns on Project Information Disclosed

* Sweep will cover the all districts/DMCs or only some selected sites? In my suggestion that city central sites/landfill will affect the environment/ also affect the local communities

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: MUHAMMAD AQIB

Designation: SR. ENV SAFEGUARDS SP

Department: CLICK PROGRAM

Feedback/ Comments/ Concerns on Project Information Disclosed

Good project for Sindh. Pls consider;

1) Project's Sustainability

2) Proper engineering desgin of Land fill sites & GTS, to be ensured pls.

3) Rs 1000 fine for an open garbage truck is bit low. Revise plenty rates please.

4) Lastly, don't Know if that is under your mandate but last month I visited an irrigation canal near Jamshoro, where PAK ARMY has a canal crossing set-up — there is a container with your Logo and considerable amount of SW issue. Pls consider clearing that as it a nuisance for drinking water.

Thanks!

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Dr. Salma Hamza

Designation: Head of Department.

Department: of Earth & Environmental Sc., Bahria University Karachi campus.

Feedback/ Comments/ Concerns on Project Information Disclosed

Discussion and informations shared during the workshop are valuable.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Liaquat Ali Qamar

Designation: Admin & Solid waste Manager

Department: CRAB

Feedback/ Comments/ Concerns on Project Information Disclosed

- Session was very much informative,
- Discussed various issues and do hope that solutions will be found. In Sha Allah.
- Separate vehicle for each category of waste and
- collection should be regular

12/5/22

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: M. KAMRAN ARBI

Designation: VICE PRESIDENT

Department: SITE ASSOCIATION OF INDUSTRY

Feedback/ Comments/ Concerns on Project Information Disclosed

- Please look into the possibility of making green belts around GTS sites for beautification & mitigation of environmental impacts.
- Sharing an estimated timeline of project implementation would bode well.
- Suggest to also focus on Child Health & Education, and prevention of their exploitation and abuse among the affectees & neighbours of GTS sites & landfill sites.
- Measures should be taken to safeguard Hub Dam Canal that provides water to Karachi, from contamination due to close proximity with Jam Chakro landfill site.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: زاہد عارف

Designation: اسسٹنٹ ڈائریکٹر

Department: URC KMC. ادارہ برائے شہری تحقیق کراچی

Feedback/ Comments/ Concerns on Project Information Disclosed

آپ کی کنسلٹنٹ میں شہری سالڈ ویسٹ کا تجربہ
کو شامل کیا جائے۔
لینڈ فل سائٹ۔ GTS کے حوالے سے اگر مزید
کوئی پروگرام ہو تو ہم اس کا حصہ بن سکتے ہیں

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Eng P. Sadiq

Designation: CEO Limeng

Department: Representup Shehri

Feedback/ Comments/ Concerns on Project Information Disclosed

1- At Sonce – Single Use Plastic
2. Restart AKUH / JPMC Incinerators
2. GTS Time line – Jan 2024
4. How will SSW – financial sustainability ?
5. Gutter Baghicha – Supreme Court – enchroachment
6 – Future presentation should show financial plan.

P. SADIQ.
12/5/2022

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Mushal Shaif

Designation: Asst. Professor

Department: Environmental Research Center
Bahria University Karachi

Feedback/ Comments/ Concerns on Project Information Disclosed

A sugestion for study must be include life cycle Assessment (LCA) for Jam chakro landfill site.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Uzma Bano

Designation: Gender Specialist

Department: KNIP

Feedback/ Comments/ Concerns on Project Information Disclosed

Beside technical aspects Solid waste ~~is a~~ Plan need a Behavior change issue as well kindly include Behavior change strategy in your Project as well

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Mohammad Naeem Qureshi

Designation: President

Department: NFEH.

Feedback/ Comments/ Concerns on Project Information Disclosed

Need completion of this landfill Cell and garbage transfer Stations in this cell/ recomendation should be part of assesments / Projects

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: KHALID HUSSAIN LAGHARI

Designation: RESEARCH OFFICER

Department: CLIMATE & ENERGY, WWF-PAKISTAN

Feedback/ Comments/ Concerns on Project Information Disclosed

It is suggested to aware & provide information on Plastic waste i.e Categories of Plaste waste as Plastic Bags are the main concern than PET Bottle. Pet Bottle are Easily recycleabale.
Plastic Bags should be banned & there must be Separate Bins for throwing waste according to Labeling i.e Separate Bins for Food waste, Hazardous waste etc.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Dr. Mehmood Ali.

Designation: Associate Prof.

Department: Env. Engg Dept., NED University Karachi.

Feedback/ Comments/ Concerns on Project Information Disclosed

1) Environmental concerns are methane gas and leachate (contaminates ground water). These issues need to be addressed.

2) Related plastic waste (bags) → can be utilized in road construction OR. Pyrolysis process can be used to convert it into liquid oil → for its utilization in road construction with bitumen. or valuable chemicals can be extracted from liquid oil or naphtha (mixture of hydrocarbon).

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Syeda Nusrat Burhandi
burhandi_dr@yahoo.com 0333-2168499 - 0333-2168499

Designation: Retired Secretary Govt. of Sindh and Former Project Director Solid Waste Mgt. Project U.N.D.P

Department: Planning & Development Department Govt. of Sindh

Feedback/ Comments/ Concerns on Project Information Disclosed

1- Copy of Project Framework may have been provided - Hard copy becomes easy to go through Papers sitting behind are unable to see it properly

2- This is an integrated project which involves many other institutions at community level

3- Local Bodies system should be the first priority at grass Root level

4- Awareness is a major part.

5- The garbage can be used for energy working on this is must - segregation must

6- Projects are Normally Launched but Normally are not maintained afterwards - Industries wastage and Hospital wastage need special care in dumping - P.I.D. covered franchisation may be Discarded

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Sohail Ahmed Bhutto.

Designation: Deputy Director (technical)

Department: Provincial Disaster Management Authority (PDMA) Sindh.

Feedback/ Comments/ Concerns on Project Information Disclosed

⇒ To review the challenges of SWM in a manner that involves all stake holders.

⇒ Planning the waste process technology upon understanding the composition of waste generated.

⇒ The Correct Knowledge on the amount of waste generated be Collected.

⇒ Promoting door to door Collection of waste by subsiding waste Collection and Promote the waste segregation from house holds.

⇒ Tackling of Sanitary waste by adequate allocation of funds for its appropriate handling.

⇒ Modern technology / research based project should be emphasized to enhance the Solid waste managment.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Aftab Mujadid Isran

Designation: Director MPH.

Department: Karachi Metropolitan Corporation.

Feedback/ Comments/ Concerns on Project Information Disclosed

- Solid waste / garbage should not be burnt to secure people from hazardous gasses and adverse climate effect.

- Land fill sites should be bordered with trees and forestation.

- Need to develop new model replicate existing model for waste collection and reuse / recycle on scientific methods.

Cont:-2.

12/5/22

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Ijaz Hussain Khilji

Designation: Independent Consultant

Department: A-I Consultants
1st Floor, IEP Bldg.

Feedback/ Comments/ Concerns on Project Information Disclosed

1. The rehabilitation of waste Pickers restoring their livelihood needs to be worked in detail
2. The GTS sites need to be protected from Waste Pickers.
Moreover they are near to the populated areas, the hazardous effects need to be mitigated.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Syed Ziaudoli

Designation: _____

Department: Private (CERES).

Feedback/ Comments/ Concerns on Project Information Disclosed

what will happen to millions of tons waste piled up at Jam Chakro site in Karachi, what will be the fate of that waste. Thanks.

Sindh Solid Waste Management Board

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SWEEP Solid Waste Emergency and Efficiency Project

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Farooq Ahmed Bhutto

Designation: DM

Department: Corporate HSEQ. K Electric

Feedback/ Comments/ Concerns on Project Information Disclosed

My Feedback / comments are against GTS Kindly take care of R E Sub stations, Towers and Corridors. due to Safety issue and access of maintance team as and when required.

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Dr Abdul Samad

Designation: Divisional Medical Officer

Department: Pakistan Railways, Cavalry Division

Feedback/ Comments/ Concerns on Project Information Disclosed

Very enlightening session, important information shared on Landfills and CTTS and mechanism of garbage collection, transport and treatment of solid waste.

One suggestion SSWMB may launch initiative of culling of canines at public places. Against that organisation may oppose.

12/05/2022

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Muhammad Faisal Khan

Designation: Project Manager

Department: Hydrogeology (Geo-Professionals). GEO-PROFESSIONALS.

Feedback/ Comments/ Concerns on Project Information Disclosed

The workshop was fantastic and well-put. It exceeded my expectations! I was really happy that even with having some experience in design and communication, I learned a lot from the workshop. Now, that is also our responsibility to educate our self first and then our family to how to clean Our home, Street & City. That is very good act on Section of Sindh Govt to manage and rectify that problem with world bank. We need to engage more stakeholders who are from the infrastructure of Sindh. So that we can also manage it by increasing Population.

Thank You So Much.

Sindh Solid Waste Management Board

EMC PAKISTAN PRIVATE LIMITED EMC

THE WORLD BANK

SWEEP Solid Waste Emergency and Efficiency Project

ENVIRONMENTAL & SOCIAL IMPACT ASSESSESMENT & PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Dr. Omm-e-Hany

Designation: Professor, Institute of Environmental Studies, Karachi University

Department: Institute of Environmental Studies

Feedback/ Comments/ Concerns on Project Information Disclosed

- Still waiting for the action and reaction to be taken in our location (KDA, Scheme 33)
- Trust should be build b/w the Householder of Garbage collector, because each one is worried that if the person is available, Next day, Next week to continue the services.
- The salary or the payment of worker should be included in K.Electric bill or any other bill (utility).
- Penelity, shald be imposed on the "Thela Wala" and even the chicken and meat seller, who don't have registered shops, to take proper action to dispose their waste.
- More Importantly Project shold proceed practically not only on Computer or any Soft ware. E-waste what to be done to E-waste when it not recyclable

Sindh Solid Waste Management Board

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12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: Dr. Yasmin Nergis

Designation: Sr. Prof. (Head of ERC)

Department: Environmental Research Center, Bahria University Karachi campus.

Feedback/ Comments/ Concerns on Project Information Disclosed

Project will be benificial for solve the problem of future waste. (Appreciatable)

* Hospital waste, Industrial waste may be classified for future plan.
* private Sector should be taken a part to solve the problem.
* Billing of collection waste should be clear for future for trust building
* Framework regarding continuity in future
* waste transportation in the night time
* As a Human being what we doing awareness program.
* contamination issues should be analyze.

Sindh Solid Waste Management Board

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SWEEP Solid Waste Emergency and Efficiency Project

ENVIRONMENTAL & SOCIAL IMPACT ASSESSESMENT & PREPARATION OF ENVIRONMENTAL & SOCIAL MANAGEMENT PLANS FOR THE CONSTRUCTION OF A NEW LANDFILL CELL & SIX TRANSFER STATIONS IN KARACHI

12 May 2022

Stakeholder Consultation Workshop – Feedback Form

Participant Name: DR. KANEEZ FATIMA

Designation: Ass. PROF. / Advisor to SEPA

Department: University of KARACHI, Department of Sociology,

Feedback/ Comments/ Concerns on Project Information Disclosed

* It is a very good step taken by SSWMB.
* Environmnt & Social Considerations where dislocation, displacemnt, resettlemnt gender involvemnt, is very positive response and step, but unless & until each aspect has a detailed plan for implementation; all the work done by the departments will be useless.
* Experts, consultants are engaged but during implemntation their involvemnt should be made compulsory.
* Sustainibility to be made sure for the plants / Recycling process.

Sindh Solid Waste Management Board

EMC PAKISTAN PRIVATE LIMITED EMC

ANNEX XXI – Sub-Project Assessment Consultations Report

SWEEP ESIA Package 02
Development of Sanitary Landfill Cells at Jam Chakro
Project Consultations Report

The purpose of this report is to highlight the different sorts of consultations conducted as part of the sub-project, along with their pertinent details. Consultations conducted can be categorized into two broad categories:

1. Consultations with Project Affected Parties (Primary Stakeholders)
2. Consultations with Other Interested Persons (Secondary Stakeholders)

1.1 CONSULTATIONS WITH PROJECT AFFECTED PARTIES (PRIMARY STAKEHOLDERS)

The consultations conducted with the primary stakeholders can also be divided into three main categories:

1. Consultations with the Community at Haji Ibrahim Goth
2. Consultations with Non-Governmental Organizations & Training Institutes
3. Consultations with Industries & Developments near Jam Chakro

Details on the different consultations carried out with each of these groups is provided below:

1.1.1 Consultations with Community at Haji Ibrahim Goth

Engagement with the community was extensive, where the consultations conducted helped to not only establish a baseline of the existing conditions, but also in the overall development of the project in a manner that would be acceptable to the community. At different stages of the sub-project design and development, the same was disclosed to the community, their queries answered, and their opinions and feedback incorporated into the project wherever possible.

A list of the consultations conducted with the community at Haji Ibrahim Goth for the development of the engineered landfill cells is given below:

Table 1 - Consultations with Community at Haji Ibrahim Goth

S#	Types of Consultation/ Meeting	Dates	Number of Participants (males)	Number of Participants (females)
1	Initial Visit of Jam Chakro to meet SSWMB staff and village influential, teachers, volunteers	15 April 2022	15	6
2	Pre-Census consultations	20 June 2022 to 30 July 2022	22	4
3	Consultations with village elders, political workers, and volunteers	13 July 2022	12	-
4	Haji Ibrahim Goth Household Census Survey	1 August 2022 to 10 August 2022	710	615
5	Haji Ibrahim Goth Commercial Census Survey	11 August 2022 to 15 August 2022	29	-

6	Consultation with Educational Institutions	30 September 2022	2	8
7	Consultation with Healthcare Facilities	30 September 2022	2	-
8	Follow up of census	13 Oct 2022	12	2
9	Cut-off date information declaration	26 Nov 2022	67	5
10	Focused group discussion with male and females on gender-based violence issues	28 Nov 2022	16	32
11	Pre-skill trade need assessment consultations	3 March 2023	16	2
12	Skill trade need assessment consultations	13 March 2023	841	226

Detailed descriptions on the consultations conducted and the feedback obtained for each of the visits is highlighted below:

1.1.1.1 Initial Visit of Jam Chakro to meet SSWMB staff and Key Individuals in the Village

Date

15 April 2022

Participants

15 Males, 6 Females.

Objective

The objective of this initial meeting and consultation was to conduct scoping & preparatory surveys to lay the foundations for further surveys and engagements to be conducted for the assessment moving forward.

Information Disclosed

It was at this point in time where initial consultations and introductions were being conducted, that the community was highlighted on the objective of the assessment team, the scope of the consultations, and an indication of a development proposed in the area that would cater to the current problems they are facing from the operations at the open dumpsite.

Details

An initial Social Reconnaissance survey was carried out of the site for the scoping purpose by the team. During this visit, the team met with different people including the village elders, shop keepers, waste pickers, social workers, teachers, and traders, providing clear ideas about the ground situation, the environment the living conditions and the livelihoods of the people.

Key individuals in the community at Haji Ibrahim Goth along with the SSWMB personnel were identified at site who would later continue to serve as representatives of the community and the operations at the site.

The team learnt about the presence of waste pickers at Haji Ibrahim Goth, who mostly come from interior Sindh, and largely depend on garbage collection make their living. Village elders present in the community act out in the best interests of the community and serve as pillars of strength for the community.

The team also met with the local staff of Sindh Solid Waste Management Board (SSWMB) present at the dumpsite and learnt about the mechanism and operations of the dumpsite along with working conditions. During dumping, it was observed how waste pickers rush to the incoming vehicles bringing waste to the site in an effort to secure recyclable materials.

Queries & Responses

Most of the community and individuals consulted gave a positive response to the information provided, and requested for further details, which were agreed to be provided following development of the sub-project and the availability of more information.

Further queries were raised by the SSWMB staff on site pertaining to the overall details of the assignment and the role of the team where the objective and details of the assessment were shared. The staff also suggested that representatives from the community be taken onboard in the assessment moving forward to facilitate in different aspects of the assessment including surveys, and consultations.

Some pictures from these consultations are provided below:

Table 2 – Pictures from Initial Consultations





1.1.1.2 Pre-Census Consultation

Date

20 June 2022 to 30 July 2022

Participants

22 males, 4 females

Objective

The objective of this meeting was to meet with key individuals and local facilitators from Haji Ibrahim Goth who would be aid in the census survey process and go over the process with them.

Information Disclosed

At the time of meeting elders, recruiting local facilitators, and going over the task at hand with them, they were reminded of the proposed sub-project in the area and how the survey was required to obtain firsthand data on the baseline conditions of the people in the area. This would be used to document and compare the living situations of the population before and after the project, and also in case there is any community improvement or development planned down the line.

Details

The team had a preliminary survey of the village before the census and had discussions with the local volunteers and village elders to strategize the work. The main issue was the nature of the village where there are no properly built houses, where the lanes and houses were in the form of huts made up of cloth and plastic without any demarcation, and with 4-5 families living in makeshift compounds.

In order to understand the ground situation, the survey team first consulted with the village elders who helped the team to identify contact persons in each neighborhood of the village. The team also met with the schoolteachers, mosque's imam (pray leader) and some volunteers to develop the strategy. The team was advised to form 6 survey teams and each team had to led by 1 male and 1 female local volunteer to identify houses and head of the families.

Following identification of the local facilitators and gaining their approval to aid us for the survey, the finalized methodology for the census survey along with the approved survey tools were shared with the local facilitators where they were walked through the document and the purpose behind each question being asked. Any queries that arose were answered and any items that were missed out were added. A strategy was also formulated with the knowledge of the area of the locals on how to divide the settlements for the survey and ensure that all houses and persons at Haji Ibrahim Goth are surveyed. Lastly, the survey tool was pre-tested with the help of the local facilitators for a portion of the settlement prior to the detailed survey of the area.

Queries & Responses

The queries raised by these individuals and responses provided by the team are listed below:

Table 3 – Queries & Responses during Pre-Census Consultations

Queries	Responses
The locals showed their concern regarding potential displacement of their houses and shops from the current location in the village	The team explained how the Government shares the same objective in the development of the sub-project, where the involuntary resettlement or displacement of persons at Haji Ibrahim Goth is not feasible. This aspect is a prime factor in project development, where once further information is available it will be shared.
There were concerns about the livelihoods of the waste pickers of Haji Ibrahim goth being affected	As a principle, any livelihoods that are affected by the sub-project, there will be alternate mechanisms defined and implemented to ensure the impact is negated or minimized to the extent possible. A main objective of the census survey was to obtain the details of these persons along with all other people at Haji Ibrahim Goth to ensure that any such measures to be implemented can be accurately based on the current conditions of the people. Further details on this would be shared as they become available.
There were concerns that the sub-project would disproportionately affect the living conditions of the people in the area, where life for them is very hard as is i.e., these people live below the poverty line, depend on water	Despite not having considerable information at this stage, the team still reiterated that the sub-project would be an improvement from the current conditions, where the people are subject to the impacts from the open dumpsite. Instead, once the engineered cells are prepared, impacts in the form of landfill gas, burning of waste, and leachates will be removed, improving the overall conditions in the area.

Some pictures from these consultations are provided below:

Table 4 – Pictures of Consultations from Pre-Census Consultations



1.1.1.3 Consultation with Village Elders, Political Workers, & Volunteers

Date

13 July 2022

Participants

12 males

Objective

The objective of the consultations was to discuss the proposed strategy for the census survey and to mutually agree on dates as to when to conduct this survey.

Information Disclosed

The elders were informed about the following methods to be used for public consultation with project stakeholders in order to ascertain their stakes regarding project implementation, along with the methodology for data collection for the census survey.

Details

The village elders and volunteers warmly welcomed the team and expressed their willingness to cooperate with the survey. The major observations and details provided about the community during the consultative session carried-out are as follows:

- There are about 600-700 households are situated there. Households are mostly kaccha huts or semi-katcha, with an estimated population of 3,400 people.
- There are no civic facilities such as water, electricity, gas, health, and recreation.
- A doctor visits on Friday, in a clinic (made in a container) established by HOPE NGO. This makeshift clinic provides basic treatment and medicines. For serious cases, people have to go to clinics or hospitals in nearby towns, mainly in Manghopir
- Water supply is limited. The village elders have constructed some water tanks where tanker water is stored and people fetch water from these open tanks. The community shares the cost of the tanker.
- There are some solid waste related businesses are going on by waste dealers (known as kabari walas, in local language), charcoal making, tea stalls, and small shops for basic necessities.
- Life is extremely hard for the people living there, conditions are unlivable during the rainy season when vehicles track become muddy for the whole monsoon season, with lots of flies and mosquitos.
- At Jam Chakro garbage dump site, the village has their elders, including the village heads who don't live there but seem to lead the social setup i.e., community is under influence of them to make decisions.
- Al-Khair community school is providing primary school facilities to some 250 children from the community.

Queries & Responses

The queries raised by the individuals at this time and the responses provided by the assessment team are given below:

Table 5 – Queries & Responses during Meetings with Village Elders & Key Persons

Queries	Responses
The locals showed concern over the potential availability of land for the sub-project including the ownership rights to the land for the sub-project. This once again led to the fear of them being displaced for the sub-project.	The team explained how the Government owns the land for the project, which will be confirmed by the Revenue Department for the purposes of the sub-project also. Further, the Government also shares the same objective in

	the development of the sub-project, where the involuntary resettlement or displacement of persons at Haji Ibrahim Goth is not feasible. This aspect is a prime factor in project development, where once further information is available it will be shared.
Concern was shown about jobs being generated through the sub-project and not being provided to the people of the community.	The community was re-assured that they would be given priority by contractors and operators for jobs in the sub-project during implementation.

Some pictures of these consultations are provided below:

Table 6 – Pictures of Consultations with Elders & Key Persons






1.1.1.4 Haji Ibrahim Goth Census Survey (Residential & Commercial)

Date

1 August 2022 to 10 August 2022 & 11 August 2022 to 15 August 2022

Participants

739 males, 615 females

Objective

To conduct a comprehensive census survey to identify the population living in Haji Ibrahim Goth, their socio-economic conditions, assets, sources of income, expenditures, education, and health care facilities availed by the local residents and all other pertinent details of their life in the area.

Information Disclosed

Mainly people asked the purpose of the census, in the response to which the team briefed about the potential sub-project in the area that would improve their living conditions by transferring waste operations to the engineered site, be ridding them of the detrimental impacts form the operation of the dumpsite. Furthermore, they were briefed on how their data was being taken to create a database that would monitor their living conditions before and after the sub-project, where if any further provisions are to be planned, then this data would be required.

Details

Data collection was relatively straightforward with the help of the local facilitators and the elders of the village who had pre-empted the survey teams questions and presence to the locals. Furthermore, any questions that the locals had during data collection were recorded and answered.

Queries & Responses

During the survey, various queries were raised by the locals, where these were recorded, and responses provided:

Table 7 – Queries & Responses from Census Survey Consultations

Queries	Responses
There were concerns that the sub-project would disproportionately affect the living conditions of the people in the area, where life for them is very hard as is i.e., these people live below the poverty line, depend on water	Despite not having considerable information at this stage, the team still reiterated that the sub-project would be an improvement from the current conditions, where the people are subject to the impacts from the open dumpsite. Instead, once the engineered cells are prepared, impacts in the form of landfill gas, burning of waste, and leachates will be removed, improving the overall conditions in the area.
There were concerns about the livelihoods of the waste pickers of Haji Ibrahim goth being affected	As a principle, any livelihoods that are affected by the sub-project, there will be alternate mechanisms defined and implemented to ensure the impact is negated or minimized to the extent possible. A main objective of the census survey was to obtain the details of these persons along with all other people at Haji Ibrahim Goth to ensure that any such measures to be implemented can be accurately based on the current conditions of the people. Further details on this would be shared as they become available.

Queries were raised on the potential development of healthcare facilities under the project	It was explained to them that while this is not explicitly planned under the sub-project, however, their concerns and requests were recorded and will be shared with the governmental body in charge of the sub-project. The census survey, nevertheless, would aid in making this possible by recording the current conditions.
Requests were made by the locals to aid in the improvement of civic facilities and overall conditions of Haji Ibrahim goth	It was explained to them that while this is not explicitly planned under the sub-project, however, their concerns and requests were recorded and will be shared with the governmental body in charge of the sub-project. The census survey, nevertheless, would aid in making this possible by recording the current conditions.
Concern was shown about jobs being generated through the sub-project and not being provided to the people of the community.	The community was re-assured that they would be given priority by contractors and operators for jobs in the sub-project during implementation.

Some pictures of these consultations are provided below:

Table 8 – Pictures from Census Surveys



















1.1.1.5 Consultation with Educational Institutions & Healthcare Facilities in the Area

Date

30 September 2022

Participants

4 Males, 8 Females

Objective

This was done to aid in the development of the profile of people at Haji Ibrahim goth through obtaining a different perspective and assessing the facilities available. This was done by organizing a meeting with the administration and schoolteachers of the Idara Al-Khair school in the area, and the healthcare workers who operate a clinic in the area.

Information Disclosed

The sub-project details at the time along with the objective of the assessment was shared with the people at the school and the health care facilities along with the purpose of the consultations i.e. to obtain further first-hand data on the conditions of the people at Haji Ibrahim Goth and their living patterns.

Details

There is an NGO named Idara Al Khair with the sole aim to provide basic education of primary and secondary levels to the underprivileged children. The campus 2 of Idara Al Khair is situated inside the village of Haji Ibrahim Goth and almost all the village children, in case if they are interested, can join the school and get primary education.

During the meetings with the staff and teachers of the local Al-Khair School, the team was told that the majority of residents living inside the village of Haji Ibrahim Goth are illiterate, education is not the first priority among these people and they prefer to have their children to work and make money instead.

Al Khair Campus 2 is a well-built school consisting of 9 rooms with an enrollment ratio of about 350 students and 10 teachers are working there to provide better education for children.
The In charge of the school complained about the shortage of attendance due to the lack of interest towards education among the parents and children of the village. The children get religious education, reading and learning of the “Quran” inside the local mosque right beside the boundary wall of Idara Al Khair School Campus 2. There is a hand full of students who enroll in the secondary branch of Idara Al Khair because campus 2 only provides education up to primary level.

The Idara has 8 campuses working in the surrounds of Deh Jam Chakro in different villages providing free of cost education to the children, they have shortage of facilities like teachers, furniture, and others, despite these limitations the NGO is working hard and making a difference in the society.

The doctor informed at the healthcare facility highlighted that a private dispensary opens only once in a week. This dispensary is in a container and is run by HOPE NGO in collaboration with PARCO. It was established as a small setup in premises of Idara Al-Khair school in 2006 in initially days. For time being, it had been shifted to near the village. There are two staffs include a trained doctor and paramedical staff have been deputed who visit on every week of Friday.

The doctor advised the team that there is considerable OPD patients on every Friday and mainly suffering from major diseases like skin problems, gastro enteritis in children, besides anaemia, fever, flue and asthma etc. The Dr check the patients and prescribe medicines. Some medicines are given to patients, free of cost.

The concerned authorities include Government and civil society organization should take measures and introduce projects for betterment of area people and improve their living standard.

Queries & Responses

The queries raised by the school and the health care facilities along with the responses provided by the team are listed below:

Table 9 – Queries & Responses from Consultations with Educational Institutions & Healthcare Facilities

Queries	Responses
When the project will be implemented, will any sort of recycling of materials be carried out? As this can serve as an alternative source of income for the waste pickers at Haji Ibrahim Goth	Currently that is not planned, however, the suggestion will be shared with the client. Furthermore, should there be any livelihood loss under the sub-project, it will be adequately catered for and negated through different measures.
What happens if the locals or any person in the area has a complaint about the construction or operational activities.	A detailed Grievance Redress Mechanism will be established under the project where people can register their complaints through different channels and methods, where all complaints will be reviewed and dealt with accordingly.
Will the sub-project conduct any awareness raising sessions on the importance of education?	These can be carried out during sub-project implementation to increase awareness amongst the locals on the importance of education and it's benefits in the long run.
Will the project introduce proper healthcare facilities in the area as that is a requirement?	Currently that is not planned, however, the suggestion will be shared with the client. Nevertheless, with the development of the engineered landfill cells, the health risks and impacts on the people should be significantly reduced through engineering controls and measures introduced for all such pollutants.
Are there any schemes planned for livelihood or community improvement in the area?	The development of the cells will in itself improve the conditions of the community. Nevertheless, through the census survey, the people of the village and their conditions has been documented where if any such item is to be implemented, it can be done so easily.

1.1.1.6 Follow up of Census Survey

Date

13 Oct 2022

Participants

12 Males & 2 Females

Objective

Following up the census and registering any new families and households that had settled in the area using the help of the local facilitators, along with any items that were further required following the processing of raw data obtained during the census.

Information Disclosed

The follow up of the census was advised as just that, where some details were required to complete the database of conditions of the persons at Haji Ibrahim Goth.

Details

The remaining information required along with data of newly settled persons in the area was obtained and added to the database of persons at Haji Ibrahim Goth.

Queries & Responses

No queries were raised during this meeting.

Pictures from these consultations are provided below:

Table 10 – Pictures from Consultations during follow-up of Census Survey







1.1.1.7 Cut-off date meeting

Date: 26 Nov 2022

Attendees

67 Males & 5 Females

Objective:

To explain the cut-off date and introduce further details on the SWEEP Project.

Information Disclosed

The SWEEP Project was introduced at this time, along with the potential involvement of the World Bank as a financier for the project. The application of the World Bank's Environmental & Social Framework was also described, where any and all impacts arising from the sub-project would be dealt with in a manner in line with the ESF. It was also highlighted at this time, that the waste pickers in the community will be faced with livelihood losses as part of the project, where feedback was taken onboard on what can be done to negate these impacts as part of the Livelihood Restoration Plan.

Details

The initial census count in August 2022 was documented 713 residential households and 63 commercial structures. A subsequent confirmation survey conducted in October 2022 refined this count. A cut-off date for any consideration of entitlement from the sub-project was set in November 2022, resulting in a final count of 3,448 residents, residing in 723 makeshift/thatched houses in the vicinity, along with 63 commercial structures.

Following this confirmation, meetings were held with the Key Informants and the elders of the village, where they were apprised of the establishment of the cut-off date, and what that would entail for the community. Their feedback was taken onboard on how to disclose the pertinent information to the other members of the community.

Subsequent to these discussions, two main meetings were organized at 2 public places in Haji Ibrahim Goth to announce the cutoff date for any potential entitlements under the project. In these meetings people were explained how there will be no physical displacement or involuntary resettlement involved in the project, but instead livelihood restoration against livelihood loss of waste pickers. It was also disclosed that any entitlements that would be calculated would be against the assets documented for the people who formed part of the census survey. It was also announced that should anyone settle in the area after the cut-off date, then they may not necessarily be entitled to any of the compensations or measures planned under the sub-project.

Queries & Responses

The queries raised by the participants from the community, and the responses provided by the team are provided below:

Table 11 – Queries & Responses from Consultations during Cut-Off Date Meeting

Queries	Responses
The lack of education and skill of the people at the community, particularly the waste pickers was reiterated, along with the concern that the project would permanently disable these people by not allowing them to pick waste for their livelihoods.	One of the prime decisions in the sub-project is to ensure that there is no resettlement and livelihood loss is minimized to the extent possible. Furthermore, given that the World Bank is involved, in line with the ESF, the Livelihood Restoration Plan to be developed will take this into account and ensure that impacts from this are negated or minimized to the extent possible.

Some pictures from these meetings are provided below:

Table 12 – Pictures from Consultations during Cut-Off Date Meeting





1.1.1.8 Focus Group Discussion with male & female on gender-based violence

Date

28 Nov 2022

Participants

16 Males, 32 Females

Objective

To conduct a meeting with the key women in the area also, and understand their issues, while discussing what the sub-project can do to ensure their needs are met also. The meeting was planned with the help of the local facilitators who met with the key women in the community and invited them to the consultations.

Information Disclosed:

The information disclosed here included the details on the sub-project at the time, including the involvement of the World Bank as a financier and the subsequent implementation of the World Bank's ESF, and what that would mean for the community. One of the major underlying themes of the sub-project was also disclosed, where it was to be conducted in a manner that would ensure minimal impacts on the existing community.

Details

The assessment and SWEEP team welcomed all participants and shared details on the new development of the landfill cell that is to be constructed, where design works were currently underway. The benefits of the development were also shared, including advantages and how it will create employment opportunities for the locals.

The project area falls in both urban, semi-urban areas, needs and problems of women are different in nature related to the urban and semi urban areas. As part of the consultations, the female participants highlighted various issues faced in the area including:

- Lack of facilities of safe drinking water;
- Poor sewerage and drainage system;
- Health concerns for self and children;

- Lack of privacy;
- Issues of harassment while fetching water from canal;
- Lack of alternate livelihood sources
- Lack of basic facilities include electricity and gas

Queries & Responses

The major concerns raised by the participants, along with the responses shared by the team are as follows:

Table 13 – Queries & Responses from Consultations during FGDs with Women

Queries	Responses
Will the people at Haji Ibrahim Goth be subject to any sort of physical relocation or displacement as part of the works proposed under the sub-project?	One of the major underlying factors in the design is to ensure that no involuntary resettlement or physical displacement of persons is involved where this will be confirmed once the design is completed and the same shall be disclosed to the community. Furthermore, there also plans being developed by the Government of Sindh to ameliorate the living standards of the community at Haji Ibrahim Goth through focused infrastructural interventions.
Will the privacy of women be disturbed during the project through the influx of labor and other workers into the area?	Measures will be taken to minimize this impact to the extent possible, including hiring local labor mostly, and creating barriers between the community and the construction site, and to use separate routes for the people and the construction sites.
Ideally, the government should also provide some improved facilities to the community in the area following the development of the sub-project, including health facilities and other civic facilities.	While not part of the project, there also plans being developed by the Government of Sindh to ameliorate the living standards of the community at Haji Ibrahim Goth through focused infrastructural interventions.
Some women in the community are already involved in small scale businesses such as making Rali (handmade quilts). However, they do not possess the skills and linkages to be able to sell their items in the open market. Would the project be able to aid these women in creating linkages with the market?	The implementation of the LRP will create linkages between these women and the market, along with working on increasing their marketing skills in stitching and other selected programs. Linkages with other Mina Bazars/District Municipal Corporation run weekly bazars will be developed to promote their products

Some pictures of these consultations are provided below:

Table 14 – Pictures from Consultations during FGDs with Women



1.1.1.9 Pre-Skill Trade Need Assessment Consultation

Date

3 March 2023

Participants

16 Males, 2 Females

Objective

To meet with the local facilitators and describe to them the need for the Trade Need Assessment and how the assessment team would request their aid moving forward.

Information Disclosed

Following the confirmation of the need to develop the Livelihood Restoration Plan, a Training Needs Assessment was identified as a requirement to understand the skills and trainings preferred by the Affected Waste pickers. To be able to successfully execute this, a meeting was conducted with the local facilitators who were explained the task and its purpose.

Details

Following advancements in the sub-project design, and through the inclusion of specific measures, any impacts of involuntary resettlement on the community were negated (i.e. no physical displacement or involuntary resettlement would be involved), however, livelihood loss of the waste pickers at Haji Ibrahim Goth could not be ruled out. The same was then conveyed to the community through similar meetings conducted as that of the cut-off date.
Following this declaration, most of the population exhibited a positive response, citing their gratefulness in ensuring that they would not have to be moved from the area. Some mixed responses were also obtained from waste pickers who did not know on what they would do for their livelihoods if they would be not able to pick waste. As a response to this, the assessment team informed them that a detailed Livelihood Restoration Plan would be prepared that would highlight trainings and skill development programmes that would be implemented under the sub-project, to ensure waste pickers are able to develop other means of earning livelihoods, and ultimately minimizing the livelihood loss impact from the sub-project.

Queries & Responses

The only query raised at this time, along with the response provided is listed below:

Table 15 – Queries & Responses from Consultations during Pre-Skill Trade Assessment

Queries	Responses
Given that livelihood loss has been confirmed, is it a possibility that later on physical displacement will also become a reality?	These impacts have been considered in the overall impact assessment being done for the sub-project, where accordingly, a dedicated Livelihood Restoration Plan has been prepared (as there is no physical resettlement involved and will not become an option moving forward). The plan will feed off of the feedback and suggestions provided in a dedicated training needs assessment conducted for the waste pickers at Haji Ibrahim Goth, where preferred professions and skills will be highlighted by the community for training.

Some pictures of these consultations are provided below:

Table 16 – Pictures from Consultations during Pre-Skill Training Assessment



1.1.1.10 Skill Trade Need Assessment Consultation

Date

13 March 2023

Participants

841 Males & 226 Females

Objective

The waste pickers identified in the census survey were gathered in an area, advised on the sub-project development and the livelihood losses involved due to the cut off from waste picking activities moving forward. To deal with this impact in line with the World Bank mitigation hierarchy, a trade needs assessment was arranged to understand the preferred skills for development under the LRP.

During the need assessment survey, the team consulted 1,067 people including males and females and noted down the community concerns and got feedback for the training assessment survey.

Information Disclosed

The team disclosed the livelihood loss component under the sub-project due to the facility being access controlled, where waste picking would not be viable moving forward. The team also described the guidelines to minimizing this impact present in the World Bank's ESF, i.e. the development and implementation of a Livelihood Restoration Plan.

As part of the development of the plan, the trade needs assessment was planned to gauge an understanding on the preferred options for skill development amongst the waste pickers. The team described how this would enable waste pickers to earn better income in the job market, particularly construction industry related jobs, as the surrounding areas have a large number of construction projects.

Details

Following the previous declaration and introduction to the development of the Livelihood Restoration Plan, a needs assessment Survey was planned by the assessment team. During the survey, the team consulted 1,067 waste pickers residing in the area including males and females and noted down the community concern and feedback for the preferred trainings and skill developments.

There were queries raised on the potential linkage between obtaining training/ skill development and the potential of these people getting jobs as a result of these trainings. This point was taken up, and as a response to this, further measures were planned and implemented in the development of the LRP including consultations with nearby developments, industries, and NGOs in the area on establishing the potential linkages and hiring of these personnel following training and skill development.

Once these consultations were conducted, the feedback was shared with the community at Haji Ibrahim goth to showcase their concerns had been taken onboard and measures against which planned for implementation under the LRP.

Queries & Responses

Table 17 – Queries & Responses from Consultations during Skill Trade Needs Assessment

Queries	Responses
Given that livelihood loss has been confirmed, is it a possibility that later on physical displacement will also become a reality?	These impacts have been considered in the overall impact assessment being done for the sub-project, where accordingly, a dedicated Livelihood Restoration Plan has been prepared (as there is no physical sement involved and will not become an option moving forward). The plan will feed off of the feedback and suggestions provided in a dedicated training needs assessment conducted for the waste

	pickers at Haji Ibrahim Goth, where preferred professions and skills will be highlighted by the community for training.
Apart from the development of the sub-project, there is also development happening around the area in the form of housing schemes, and buildings, where preference may be provided to the local community as laborers.	As part of the development of the Livelihood Restoration Plan, the nearby construction activities and developments were mapped and consulted. The consultations focused on the potential of understanding the type of workers and skills required, where the same would be provided to the community to make them eligible for these jobs. Part of the LRP implementation will also include creating linkages between the community at Haji Ibrahim Goth and these developers to facilitate the recruiting and hiring process.
Given that there are plenty of people residing at Haji Ibrahim Goth and are nearby the area where the cells are being developed, preference should be provided to the locals for jobs during construction and operation of the sub-project.	Provisions will be added to the contracts of the contractor and the operator, where they will be obligated to hire local labor to the extent possible (unskilled and skilled). The contract document will have a clause to engage local community including women for skilled and unskilled jobs during construction and operations phases also wherever possible.
Given the nature of work the waste pickers at Haji Ibrahim Goth are involved in, daily payments are provided against waste sold. A part of the population echoed that similar sort of remuneration mechanism would be preferred where daily wages are provided rather than specialized works.	The feedback of the community will be taken into account whilst preparing the Livelihood Restoration Plan, where during implementation, the preferred skills/ type of work shall be focused upon for further development.

Some pictures of these consultations are provided below:

Table 18 – Pictures from Consultations during Skill Trade Needs Assessment







1.1.2 Consultations with Non-Governmental Organizations & Training Institutes

Consultation meeting were conducted with different institutions including NGOs to identify and establish the possible linkages to facilitate affected people of Jam Chakro LFS sites. These meetings focused on fostering collaboration and establishing partnerships to aid in the restoration of livelihoods for APs. Additionally, discussions were held regarding the development and implementation of vocational training programs, encompassing tasks such as curriculum design, training methodologies, evaluation frameworks, and program logistics coordination. The capacities of NGOs and Vocational Training Institutes to deliver quality vocational training programs were assessed, and efforts were made to support policy advocacy for APs. Furthermore, strategies were explored to engage stakeholders, influence policy decisions, and emphasize inclusiveness in addressing societal needs.

The following is a list of NGOs and institutes with which meetings were conducted along with the feedback provided:

Table 19 – Consultations with NGOs & Training Institutes

S. No	Organization/Institute Name	Remarks/Feedback
1	ZVMG-Rangoon Wala Trust (vocational center) HOME – ZVMG Rangoon Wala Trust	The Trust has agreed to work for Jam Chakro by providing customized trainings. It will offer a number of trade-specific trainings to empower individuals in acquiring the necessary skills and knowledge. Through these trainings, the Trust

		aims to enhance the employability and livelihood opportunities for the people of Jam Chakro.
2	Initiator Human Development Foundation (NGO) Initiator Human Development Foundation	IHDF has eight years of experience of working with waste pickers, recognizing the importance of their role in waste management and their socio-economic vulnerabilities. The organization aims to provide non-formal education to waste pickers, empowering them with knowledge and skills to improve their livelihoods. IHDF also values the experiences of waste pickers and will incorporate their insights into its programs. Moreover, IHDF will offer socio-psychological counseling to waste pickers, recognizing the potential emotional and mental health challenges they may face. Additionally, health and hygiene sessions will be conducted to educate waste pickers on maintaining their well-being and preventing diseases. IHDF has established links with various organizations, including UNHCR, Red Cross, Women and Children Protection at the Police Station, UNICEF, and PDMA and other organizations working for children and their rights. These collaborations enable IHDF to leverage resources, expertise, and support to further its mission and provide holistic assistance to the beneficiaries it serves.
3	DevCon- An Association for Rural Development (NGO) DevCon – An Association for Rural Development (devconpk.org)	DevCon has agreed to work with Jam Chakro, a specific area, by providing customized trainings tailored to the needs of the local population. These trainings will cover a variety of trades, equipping individuals with the skills necessary to enhance their employment prospects and improve their livelihoods. DevCon has gained valuable working experience in a similar category in the Korangi industrial area. This experience has provided them with insights and knowledge that can be applied to their work in Jam Chakro, enhancing their ability to address the specific challenges and requirements of the area. In addition, DevCon has successfully linked around 4000 workers with factories, creating valuable employment opportunities and contributing to the economic growth in District Korangi. This accomplishment highlights their ability to establish meaningful connections between job seekers and potential employers.
4	The Hunar Foundation (Vocational Training Institute) HUNAR FOUNDATION	THF has expressed its willingness to work at Jam Chakro, indicating its commitment to extend its services and educational programs to the community in that area. The organization aims to provide customized training to cater to the specific needs and aspirations of the individuals in Jam Chakro. By tailoring the training programs, THF can effectively address the requirements of the local population. In addition to providing training, THF also manages transportation and schedules for its students. This ensures that participants have access to the necessary means to

		attend the training sessions conveniently. Furthermore, the organization takes responsibility for managing the training plan and benches, ensuring a structured and organized learning environment for the students. Overall, THF has a commendable track record of delivering vocational programs, and its willingness to expand its efforts to Jam Chakro demonstrates its commitment to reaching and serving marginalized communities. To enhance the paragraph, you could consider providing more information about the specific training programs offered by THF and the impact they have had on the lives of the graduates.
5	MITI- Memon Industrial and Technical Institute (Vocational Training Institute) Memon Industrial & Technical Institute – MITI (wmomiti.com)	THF has expressed its willingness to work at Jam Chakro, indicating its commitment to extend its services and educational programs to the community in that area. The organization aims to provide customized training to cater to the specific needs and aspirations of the individuals in Jam Chakro. By tailoring the training programs, THF can effectively address the requirements of the local population. In addition to providing training, THF also manages transportation and schedules for its students. This ensures that participants have access to the necessary means to attend the training sessions conveniently. Furthermore, the organization takes responsibility for managing the training plan and benches, ensuring a structured and organized learning environment for the students. Overall, THF has a commendable track record of delivering vocational programs, and its willingness to expand its efforts to Jam Chakro demonstrates its commitment to reaching and serving marginalized communities. To enhance the paragraph, you could consider providing more information about the specific training programs offered by THF and the impact they have had on the lives of the graduates.
6	SEF-Sindh Education Foundation (semi-autonomous organization) Sindh Education Foundation (sef.org.pk)	SEF Funded agency to local NGOs on education AALTP Adolescent & Adult learning & Training Program its new program including skills development Program. It can only support through NGOs working for education and for adults and children in nearby areas of Jam Chakro and help in creating linkages with educational institutes for children at GTS sites.
7	SHARP Pakistan - Society for Human Rights and Prisoners' Aid (NGO- UNHCR funded) SHARP PAKISTAN – Society for Human Rights and Prisoners' Aid (sharp-pakistan.org)	Agreed to provide Legal Protection and support liaison for Afghan refugees at GTS with other government agencies and NGOs working for wellbeing of refugees.

8	KVTC- Karachi Vocational Training Centre Vocational Training Centre - KVTC	KVTC work for differently abled persons and children in Karachi they can be engaged for differently abled affected persons of Jam Chakro They agreed to conduct awareness workshops, livelihood engagement and customized vocational training to differently abled persons after basic screening.
9	Vocational Training Institute (Women) VOCATIONAL TRAINING INSTITUTE (WOMEN) – SINDH TECHNICAL EDUCATION AND VOCATIONAL TRAINING AUTHORITY (vtiwbzone.edu.pk)	This institute is near Jam Chakro comparatively than other vocational institutes for women. The institute can customize the vocational training for women can provide holistic module for them.
10	GarbageCAN Sustainable Waste Management (Profitable Organization) https://www.garbagecan.pk/	A sustainable waste management company with a focus on environmentally friendly waste management practices such as reduce, reuse, and recycle. GarbageCAN believe that the garbage CAN be cleaned, and the garbage CAN be recycled.
11	SPARC Society for the Protection of the Rights of the Child (NGO) SPARC - Pakistan's Leading Child Rights Organization (sparcpk.org)	SPARC can provide assistance in education, health and safety and customized vocational trainings to waste pickers specifically children.
12	Health and Nutrition Development Authority (NGO) HANDS: Non-profit organization in Pakistan | Top NGO of Pakistan	HANDS has experience of executing project for waste pickers at Gond Pass (disposal site) a community development project. A consultative meeting was arranged by SWEEP with HANDS regarding their poverty alleviation program for Jam Chakro. HANDS can provide customized vocational training program for waste pickers Jam Chakro.
13	Consultation with Idara Al-Khair Schools	They will provide the facility for vocational trainings for women after school timings and agreed to provide some permanent space women subject to space requested by the LPRIF. PIU SWEEP will ensure a positive and long-term collaboration with the school and LRPIF along with support of Jam Chakro community.
14	Rana Liaqat Craftsmen's Colony https://rlccpk.org/about-rlcc/	RLCC management has agreed to customize vocational trainings for women of their selected trades as proposed by APs of Jam Chakro, they will chalk out detailed plan subject to approval of proposal.

		They have vast experience of using recyclable material by upscaling and selling different items made from recyclable material.

1.1.3 Consultations with Industries & Developments near Jam Chakro

The area around Jam Chakro is experiencing a surge in construction projects, which presents a significant opportunity for both skilled and unskilled laborers. Notable projects such as North Town Residency, North Town Villas, Marva Hill View, and others are currently underway, involving the construction of numerous housing and industrial units. This surge in construction creates a demand for various trades, including masons, electricians, plumbers, carpenters, and more.

The purpose of consulting nearby industrial and residential settings in Jam Chakro is to raise awareness about livelihood restoration for waste pickers and explore potential employment opportunities. This involves sensitizing stakeholders, assessing employment potential, identifying suitable trades for training, and establishing partnerships for the integration of trained waste pickers into nearby settings. The overall goal is to enhance livelihood restoration efforts.

Following business entities were consulted along with visit and informed them about the purpose of consultation:

1.1.3.1.1 Al-Ghafoor Industrial Estate, May 23, 2023

- Meeting with the Contract (infrastructure works) of Al-Ghafoor Industrial Estate was undertaken.
- The project is currently developing major infrastructure and base structures for open plots for industries.
- Hence all the work is undertaken by heavy machinery.
- We need drivers of heavy vehicles as contract basis; however, the work is usually done by sub-contractors.
- It will take time to develop the individual industries and also the hiring in those particular industries.
- It may be possible that future development of industries will create jobs for the locals.

1.1.3.1.2 Sky Clan Global (Stone Cutting Factory), May 23, 2023

- M/s Sky Clan Global is a stone / marble cutting factory and having a huge yard in which cutting machines are installed.
- The team had a meeting with the Manager of the factory.
- While providing a brief about the project and agenda of the meeting, the team asked about the hiring for labor work or any other skilled job.
- Manager said that mostly the work is performed by machines, while occasionally, we require daily wage labor for which we contacted nearby villages.
- The team emphasized that any laborious work in future which requires daily wage workers comes up, the trained persons of Jam Chakro will be prioritized.

1.1.3.1.3 Ali Town Residency. May 23, 2023

- Meeting with the CEO of Ali Town, a residential housing scheme, was undertaken regarding the livelihood restoration of waste pickers.

- CEO is of the view that major infrastructure works of the scheme has been completed and now the plots are for sale. If any plot owner will require local labor for the construction of the its house, he can contact the us or hire directly.
- We can support, if possible, when the construction labor and skilled labor is required, but right now, we do not commit for their hiring under the project as most of the work is done by contractors.

1.1.3.1.4 GFS Builders and Developers, May 23, 2023

- The GFS Builders and Developers are developing North Town Residency – Phase II which is a housing project.
- Meeting with the GFS representatives regarding the livelihood opportunities for Jam Chakro Waste pickers concluded with the follow points:
- The residential scheme is under construction and all the construction work is usually assigned to construction contractor.
- The contractor then only hires their labor for two types of works; a) major construction work in which roads and large infrastructure is built which is usually done by subcontractors via heavy vehicles, so the manual works is not required and b) small daily wage works usually requires when the houses are going to be constructed.
- They have the opinion that if any drivers having heavy vehicle skill can be contracted out with the subcontracted.
- The daily wage workers as well as skilled labor will also be required when houses are to be constructed by owners of the plots. However, it is basically on the need basis.
- If any trained labor work force available in the area, share the details with GFS's Engineering and construction department.

1.1.3.1.5 Hamdard Laboratories Factory, May 23, 2023

- Meeting with the in-charge Hamdard Laboratories was undertaken.
- The facility in-charge was reluctant to provide any information or commitment and said that all the matters were dealt by Human Resource Department.

1.1.3.1.6 NTR Industrial Zone, June 08, 2023

- The NTR Industrial Zone is in its initial development and marketing stage.
- Met with a clerk, who said that the zone is in its initial stage and definitely after its maturity stage when industries will be developed in the zone, there will be many employment opportunities in construction and technical areas such as electricians, masons, pipe fitters, plumbers etc.

1.1.3.1.7 The Pearl Villas, June 08, 2023

- The Marketing Executive informed that the Pearl Villas is a gated community project which will have about 300 housing units and 750 apartments.
- He said, at this stage they are in the marketing and selling stage and development work is going on.
- After that definitely construction phase will be started by main and petty contractors, who will engage skilled and non-skilled laborers, including masons, shuttering contractors, electricians, painters, flooring laborers, carpenters, kitchen makers etc.

1.1.3.1.8 North Town Villas, a project of GFS Builders, June 08, 2023

- One senior official informed that; North Town villas is a project of 650 villas of 120 yards.
- He said that boom of construction industry brings employment to hundreds of thousands of people associated with different trades and skills.
- He said GFS are builders are not involved in construction, which is done by numerous contractors, engaged by the plot owners, so there will be a good opportunity for Jam Chakro waste pickers, if they learn new skills seriously and apply them for their livelihood.

1.1.3.1.9 Marva Hill View Project, June 08, 2023

- They are a project of 300 Bungalows and 650 apartments and are in development stage.
- Site In charge said that he doesn't have any idea that how many trained workers could be absorbed in the project, but definitely this is good intention on behalf of Sindh government to provide technical training to poor waste pickers so that they can improve their life through training and facilitation. However, he said the will welcome this initiative.

1.1.3.1.10 Falaknaz Wonder City, June 08, 2023

- Office assistant said that the project is spread over 450 acres, where 3500 villas and apartment are planned.
- He expressed similar views about employment opportunities for trained waste pickers.

Some pictures of these consultations are provided below:









1.2 CONSULTATIONS WITH OTHER INTERESTED PARTIES (SECONDARY STAKEHOLDERS)

A stakeholder consultation workshop was organized by the SWEEP PIU, and EMC Pakistan which was conducted at Avari towers Karachi on 12 May 2022. All key stakeholders were contacted through letters. The agenda of the workshop was also shared with participants. About 80 people attended this workshop.

The comments, concerns, and suggestions received from stakeholders during the stakeholder consultation sessions has been collated and described below. The comments received from stakeholders were helpful in the screening of potential E&S aspects of the project.

The main issues and concerns that were raised by these stakeholders during the workshops specifically related to the sub-project in focus are given below:

Table 21 - Stakeholder Feedback from Secondary Stakeholders

Participant from Urban Resource Center	□ Fresh garbage is still burnt at Deh Jam Chakro. Condition of the local populace there is worrisome. They are being paid meagre amounts for their services at the landfill. □ Planning for lifting and disposal of animal offal on Eid-ul Adha should be carried out in advance. Worker protection is key as they work in unhygienic environment. Collective slaughterhouses should also be conceived.
Participant from Bahria University	□ Collection and disposal of hospital waste is of importance. Besides major hospitals, numerous small hospitals and clinics operate in the city and they usually through their waste indiscriminately. Their waste collection and disposal should also be ensured. □ Trust deficit will be reduced if the garbage collection is regular. □ How are bills for the solid waste for households expected to be collected?
Participant, Flora Expert	□ Incentive-based solid waste picking and collection should be promoted.
Participant from WWF	□ Prohibition on plastic bags should be enforced. PET bottles are not a problem as they can be recycled. Problem is plastic bag which cannot be easily recycled and is not usually picked by waste pickers. □ Awareness raising sessions should be conducted.
Participant from Geoprofessionals	□ How to lift the heaps of old garbage at Jam Chakro landfill? Or how will the landfill site be reclaimed? □ If the electricity can be produced from the waste, will there be lower electricity prices for the consumers if such electricity available in grid?
Participant, Consultant	□ Informal waste pickers should be incorporated into the project
Participant from Karachi University	□ Project should also aim for sustainability in according with the sustainable development goals SDGs.
Participant from National Forum for Environment and Health (NFEH)	□ There has been some improvement in garbage collection in the city after establishment of SSWMB. □ Segregation at source should be promoted. □ Debris should be regulated as they cannot be thrown indiscriminately. □ Informal waste pickers should be utilized and included in this project.
Participant from Samaa TV	□ Garbage tax can be implemented to made citizens responsible and cautious of garbage issue.

	Landfill sites are approx. 20-25 kms away from existing/proposed GTS sites. Trucks that carried garbage out of city to these landfills, are usually not covered and substantial amount of garbage eventually lands again in the city. This should be rectified.
Participant from National Institute of Oceanography (NIO)	Future planning for increase waste generation, collection and disposal requirements should also be considered. Efforts should be made to formalize the informal garbage collection and disposal sector.
Participant from Geological Survey of Pakistan (GSP)	Considerations for subsurface structure are important before and during construction of GTS and landfill sites.
Participant from Institute of Business Management (IoBM)	Sustainability of the project is important. For project continuity in operations, a robust framework has to be in place.
Participant from Bahria University	Consideration should be given to proximity of Jam Chakro to the Hub River. There have been issues of water contamination in the area. Land fill site should be planned as per international standards.
Participant, Former Secretary, GoS	As it is a foreign aided project, it should be ensured that timelines are met and there should not be cost overruns. This is to save precious foreign exchange of the country which is depleting.

Table 22 - Secondary Stakeholders Consultation Workshop Pictures









ANNEX XXII – SOP for Existing Waste Operations

SOP for Existing Waste Dumping Operations

1.1 Background

As outlined in the report, once the development of the new cells is initiated, the design and execution of closure/ capping works for the dumpsite will be undertaken in parallel. During this time, the dumpsite shall continue to be used for dumping waste generated in the city of Karachi. The dumping operations will be confined to a designated area, which is not proximate to the existing population at Haji Ibrahim Goth. This SOP has been prepared to provide further precautionary measures and practices that may be adopted to reduce the overall environmental risk from the dumping operations while the landfill cells become operational.

A Map of the development proposed at the landfill site, along with the location of the community, and the proposed area for dumping of waste during the development of the landfill cells, is provided below:

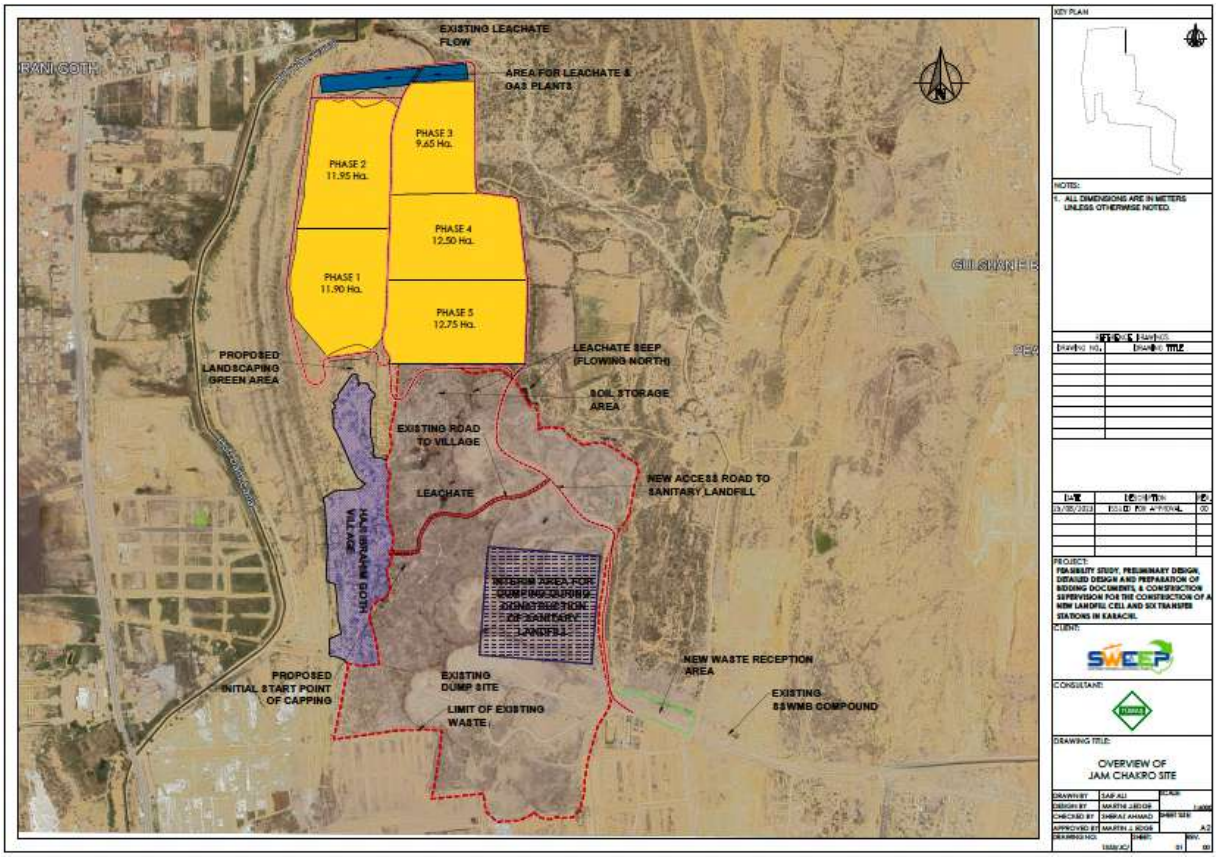


Figure 1 - Overview of Development at Jam Chakro Site

1.2 Identification of Major Areas of Operation

The main areas identified as part of the operations during dumping of waste and the continued use of the site are as follows:

- Reception of Waste
- Placement/ Disposal of Waste
- Housekeeping Operations

An aspect that has been proposed for addition to these items is the effective complaint receipt and response procedure which is also described briefly in this SOP.

1.2.1 Reception of Waste

For the reception of waste the following guidelines will be followed:

Site Access Procedures

1. Purpose of Weighing and Recording

Weighing and recording the quantities of incoming waste is important for the following reasons:

- To obtain reliable information to determine current and future landfill needs;
- To provide a means of checking the volume of waste placed in a particular area of the landfill and indirectly evaluate the amount of cover material required. This information can be used to calculate in place density of the waste; and
- To assist in waste management analysis and planning; measure effectiveness/progress of waste reduction programs; and assist with staff and equipment allocation.

Where all waste coming into the site shall be weighed and recorded.

2. Weighing and Recording Procedures

Signs posted at the entrance to dumpsite and at the weighbridge will inform Customers of site rules and procedures. All incoming vehicles are to proceed to the weighbridge.

3. Inbound Weighing Procedure

For all waste disposal vehicles the weighbridge operator will perform the following procedure:

- Signal Customer to proceed across the 'in' weighbridge;
- Record vehicle identification number (licence plate);
- Ask the driver for and record the waste type and source or origin of the load;
- If possible, carry out a preliminary visual inspection to verify the information given by the driver;
- If a "tare weight" system is used then the weighbridge operator may issue a weight ticket to the driver. The weighbridge operator keeps the top copy of the ticket and gives a carbon copy to the driver;
- The weighbridge operator should then notify the Superintendent of vehicle and any waste inspections that may be required and guide accepted waste vehicles to the approved dumping site;

4. Outbound Weighing Procedure

When a vehicle has been appropriately emptied of waste it is to leave the tipping face without delay and proceed towards the landfill exit. The procedures by the landfill exit depend on whether the vehicle has its tare weight registered with the Operator.

- Tare Weight Registered Vehicles:

If the tare weight of the vehicle is registered with the Operator, and the driver received a weight ticket when entering the landfill, then the vehicle can by-pass the weigh bridge and exit the landfill facility directly. Tare weights are to be subject to verification at the discretion of the Operator.

- Tare Weight Not Registered:

If the tare weight of the vehicle is not registered with the Operator then the following procedures are to occur:

  - Direct outbound vehicle onto the 'out' weighbridge;
  - Input vehicle identification;
  - Issue weight ticket (if applicable) to driver; and
  - Visually check vehicle for loose debris and compliance with site rules before releasing vehicle from the weighbridge.

5. Waste Inspection Types and Rationale

At the Jam Chakro Landfill site there are three possible occasions for inspection of waste material brought to the site for disposal. These three occasions are:

- A preliminary inspection of each load of waste brought to the site 9for example, at the transfer station);
- Spot checks of waste at the Inspection Bay either in the vehicle or after discharge in the bay; and
- At the tipping face after unloading of the waste.

6. Suspicious Loads

Potential reasons why a waste load may be questionable or suspicious, in that it contains unacceptable waste, include:

- Type of waste indicated by the driver is inconsistent with the type of generator from which the load comes;
- Easily observable potentially unacceptable waste on top of the load, or protruding out the side or end of the vehicle;
- The waste emits a smell or noise that suggests the presence of an unacceptable waste;
- Driver or company (if a commercial customer) is known to have previously brought unacceptable waste to the landfill site; and
- The load is packaged or covered in such a way that suggests the type of the waste is being hidden from inspection.

If a traffic controller or equipment operator spots a Customer dumping an unacceptable waste, they should ask the Customer to reload the material and direct them to the Superintendent for the proper disposal of the material.

If the Customer has dumped and left unacceptable waste at the tipping area, and is still on-site, the traffic controller will contact the weighbridge operator of the incident and direct the Customer back to the tipping area to retrieve the unacceptable waste.

7. Preliminary Waste Inspections

The Operator will post, at the entrance of the site, a sturdy, durable signboard that indicates what wastes are acceptable at the landfill and which types of wastes are not acceptable. To enforce the disposal of only acceptable waste, each load of waste entering the landfill site should undergo a cursory level of inspection. The weighbridge operator will carry out the preliminary inspection by:

- Asking the customer the type of waste they wish to dispose;
- The origin of the waste;

- Informing the customer of unacceptable wastes and recyclables;
- Brief visual preliminary inspection of load;

It should be noted that many vehicles accessing the site will be enclosed and a visual inspection may not always be possible. If the preliminary inspection indicates only acceptable waste, then the vehicle may proceed to the tipping face area.

If the preliminary inspection clearly indicates that a load contains unacceptable waste, or the Customer volunteers information that indicates the load contains unacceptable waste the weigh bridge operator will inform the Customer the waste cannot be accepted at the site and may refer the driver to alternate, approved facilities or the waste will be disposed in the Emergency Bay. The weigh bridge operator is to complete a Waste Inspection Form.

If the preliminary inspection suggests (i.e. is not conclusive) unacceptable waste is present in a load, or the Customer volunteers information about questionable wastes, then the weigh bridge operator will direct the Customer for a Detailed Waste Inspection. The weigh bridge operator is to explain that a technician or supervisor will inspect the load and provide assistance for the correct disposal method.

If the driver does not wish to have the load inspected and is refused entry, the weighbridge operator should fill out a Waste Inspection Form. The form is also to be filled out if an inspection is conducted in the Emergency Bay. A copy of a Waste Inspection Form is provided at the end of the report.

8. Spot Check Waste Inspections

Spot check waste inspections may appear to be random to the customer, but they actually involve a structured, consistent and planned procedure. The procedure may target certain types of waste vehicles, waste types, waste generators and waste from geographic or municipal sectors. Each inspection may be targeted to provide:

- Compliance of governmental regulations and guidelines;
- Enforcement of acceptable wastes;
- Information on recycling efforts, and any hazardous waste diversion program;
- Information on material bans and measurement of public participation in such programs;
- Maintenance of a strict compliance reputation with customers;
- Historical data of due diligence practiced at the site;
- Preventative measure to protect site personnel, and;
- Continuous waste audit of material.

The Operator will perform regularly scheduled spot check inspections of waste at Jam Chakro Landfill site as part of the regular activities of operating the site. One of the main purposes of conducting regular spot checks of waste is to enforce the acceptable waste categories of the landfill site, and thereby minimizing the environmental and health impacts of disposing of unacceptable wastes at the site.

The Operator is to devise a format for conducting regular waste inspections. The Operator will consider the following in devising the inspection format:

- Type of vehicles or materials to be selected for inspection;
- Frequency of inspection (e.g. every tenth vehicle);
- Location of inspection (tipping face area or Emergency Bay);
- Date, time and duration of inspection; and
- Landfill personnel to be involved with inspection.

The Operator is to perform Regular Spot Check Waste Inspections at least once per week.

9. Detailed Waste Inspection Procedure

A Detailed Waste Inspection is to occur if the weighbridge operator notices suspicious, questionable or unacceptable waste during the preliminary inspection at the weigh- bridges, or other appropriate landfill personnel believes a load contains such waste. A Detailed Waste Inspection is also carried out as part of a regular Spot Check Waste Inspection program.

The first component of a Detailed Waste Inspection is to properly inform and direct a customer to the inspection area. The following initial steps are to be followed:

1. Inform Weighbridge operator of inspection event;
2. Indicate which vehicle is to be inspected;
3. Weighbridge operator notifies driver that the load is to be inspected, and notes inspection on weight ticket;
4. Weighbridge operator directs driver to Inspection; and
5. Weighbridge operator notifies inspection staff that vehicle is proceeding to Inspection

Once a vehicle has been directed for inspection the following procedures are to be carried out in conducting the detailed inspection:

- Offer the driver the opportunity to observe the inspection;
- If possible and safe to do so, inspect load in vehicle. If necessary, have driver empty load from vehicle:
- Visually divide the load into front, middle and rear sections;
- Inspect each of the three sections using suitable tools (e.g. rakes, shovel, forks) being careful not to use bare hands. As necessary, use equipment to move and spread load to provide a good understanding of the type of waste. Besides looking for visual indications of unacceptable waste, also be aware of unusual odours or noises emitted by the waste. Check labelling of containers for indications of unacceptable waste;
- Stake and mark problem area or materials, if found, for pictures;
- Take different pictures of waste from various angles and views and note description of each picture;
- Separate subject material from load. Do not move unknown materials;
- Contact management and secure the area should a serious problem occur;
- Complete a Waste Inspection Form. Provide a copy of the completed form to the driver, send another copy to the Employer, and maintain the original of the form in the Operator's on-site files;
- If no unacceptable waste is found then thank driver for his time and notify him that he can proceed to the tipping face; and
- If unacceptable waste is found during the inspection notify the driver, and indicate on the Waste Inspection Form the reason(s) why the load did not conform to the regulations.

A Waste Inspection Form is to be filled out for every Detailed Waste Inspection, whether or not a load of waste is accepted or refused. A copy of a Waste Inspection Form is provided at the end of this report.

10. Waste Inspection Documentation

The Operator is to accurately and orderly maintain a set of originals of all waste inspection documentation, including Waste Inspection Forms and photographs, at the site office. Any off-site storage is to be first approved in writing by the Employer.

Copies of all Waste Inspection Forms are to be forwarded to the Employer on a weekly basis.

The Operator is to maintain and provide the Employer with a monthly and yearly summary of waste inspections.

Health and Safety

1. General

The Operator shall be responsible for all aspects of Site Safety and shall ensure public safety both within the Site and in areas adjoining the site. The operator shall take all necessary measures to safeguard the health and welfare of the persons entitled to be on the Site and shall ensure that the landfill operations are carried out in a safe manner.

The Operator shall comply in every respect with the provisions of any relevant statutory requirements as may be considered applicable to the landfill operation. Adequate provision of safety equipment, including as appropriate safety helmets, goggles, ear protectors, safety belts, safety equipment for working in ditches and drains and enclosed places subject to landfill gases, rescue equipment, fire extinguishers, first aid equipment, and other necessary safety equipment shall be made available at the Site at all times.

Safety equipment, ladders and all means of access, lighting, signs and guarding equipment shall be inspected and maintained regularly. Lights and signs shall be kept clean and easy to read. Equipment that is damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced immediately.

The Operator shall provide and enforce the wearing of safety helmets, and where necessary eye goggles, ear protectors, safety harnesses and other personal protection equipment for all personnel. When work is being carried out over water (particularly in the leachate treatment pond), the Operator shall provide and ensure the use of life-vests and all other necessary life saving equipment.

The Operator shall provide, erect, maintain and finally remove when ordered notices, 1.5 m x 1.0 m in size warning of the presence of the landfill, danger and restricted entry. These signs shall be erected on all existing footpaths and at points of entry likely to be used by the public.

2. Equipment for Waste Inspections

For inspections of waste, other than preliminary non-contact inspections at the weighbridge, the following equipment is to be used.

Personal Protective Equipment (PPE)

- Hard hat
- Safety boots (with steel toe and sole)
- Durable rubber gloves
- Eye protection (goggles or safety glasses)
- Dust masks (should provide suitable respiratory protection)
- Coveralls (disposable if necessary)
- Safety vest

Safety Equipment

- Fire extinguisher
- First Aid kit
- Tissues

Inspection Equipment

- Inspection forms
- Rake, shovel, small spade, farm type 3 tine pitch fork
- Small pails or other suitable containers to store samples
- Spray paint, flagging tape, wood stakes
- Camera (digital)
- Measuring tape
- Watch/ time piece (to record length of inspection, start time)
- Clipboard
- Pens, pencils

3. Waste Inspection Training

Waste inspection training is to be given to new personnel and as a refresher to current inspectors. Safety procedures for waste inspection should be reviewed on a regular basis. Inspectors should be informed of potentially new materials suspected in the waste and preventative measures required when inspecting loads. Operators performing waste inspections should be provided with information in new material ban/waste reduction programs and the level of compliance required for each program.

4. Personnel Accidents

In the case of minor on-site personnel accidents or injuries, first aid shall be administered, as appropriate, by facility personnel. In the case of more serious injuries, emergency response personnel are to be notified. All accidents are to be sufficiently documented in order to aid in future accident prevention. As well, appropriate authorities will be contacted with regards to noticeable accidents and injuries. Key staffs are to be designated and trained in first aid and will be responsible for coordinating any response to serious personnel injuries.

For non-minor injuries where waiting for outside medical attention is necessary, the injured should be moved. Key first-aid staffs are to be trained in the use of the medical equipment and material.

In the event of a fatality, all site activities in the immediate vicinity of the fatality will be suspended and the area will be cordoned off, pending removal or proper examination of the deceased by a suitably qualified medical practitioner. Site personnel will be expected to fully cooperate with the medical practitioner and police.

An emergency contact list is to be established and posted in prominent locations, including with the weigh bridge operator. The list is to include telephone numbers for the following:

- Local medical facility;
- Ambulance service;
- Fire department;
- Police;
- Employer;
- Senior Operator personnel (including mobile phone); and
- Operator’s central office.

1.2.2 Waste Placement

1. Introduction

Waste will be spread in layers (maximum thickness, 50cm) at the working face and compacted daily. Where practicable, the waste will be deposited in only a small working area and covered daily to render it less accessible to pests and vermin. As and when waste vehicles discharge their waste, landfill operational equipment (bulldozers and compactors) on site will spread and compact the waste. Waste compaction will help create a more stable surface for vehicles to travel across the site with ease to discharge waste safely.
The tipping face shall be limited to a width sufficient to accommodate five (5) delivery vehicles at any one time. The Operator will monitor compaction rates by undertaking accurate surveys of the active waste disposal areas to monitor the achieved *in situ* density of compacted waste.

2. Placement of Initial Lift of Waste

For the placement of the initial layer (lift) of waste at the Jam Chakro Landfill site, the following procedures and considerations are to be followed:

- The minimum thickness of the initial lift should be 0.5 metre layer of select waste at the base and at least an additional 1.5 meters of waste above that:
- A light or medium sized bulldozer or tractor is to be used to push and level the waste for the initial lift. Equipment operators should take extreme care in levelling the waste. The operator should not attempt to drive over the leading edge of the lift. The landfill compactor shall NOT be used to compact the initial lift;
- The initial lift will be compacted over time from the weight of the waste placed over it as the landfill is utilized;
- The Operator will continue to cover the interim dumping area, progressing first across the width (east-west axis) of the landfill and then once one lift of waste is complete, to progress northward in the footprint of the area;

3. Tipping Face Operations

The tipping face is the active part of the landfill where waste is placed and compacted on a daily basis. The location of the tipping face within the landfill changes as more waste is added. As waste accumulates in the landfill the tipping face also proceeds higher in elevation along with the level of the waste.

Tipping Face operations consist of the following primary tasks:

- Removal of Daily cover;
- Preparation of the Tipping Face and the Site Road;
- Relocation of Direction Signs;
- Notification to the Superintendent and the weighbridge operators when ready to accept RCVs;
- Directing RCVs at the Tipping Face;
- Spread Waste to 0.500m thick
- Compact Waste to required density (usually 3 or more passes with compactor);
- At the end of the day, apply daily cover with permeable material;
- Arrange for following day's tipping location; and
- Shut down plant and equipment.

4. Traffic Control at Tipping Face

The Operator is to monitor waste delivery cycles to provide equipment and staff to effectively handle peak daily volumes. Data from the computerized weighbridge program indicating traffic flow patterns will assist the Operator with equipment and staff planning.

After weighing at the 'in' weighbridge, waste delivery trucks will be directed either to the active tipping face or to discharge waste at the waste picker area if to be subject to material recovery (by waste pickers). The landfill compactor operator is to push the waste into the landfill and up the slope as needed and clear the tipping area for more vehicles. The equipment operator can minimize the impact of volume surges by handling excess waste during lower volume deliveries.

The Operator will deploy a spotter with visible clothing and radio contact to direct traffic on the site during operations. Also, signages will be placed at vantage points to direct incoming vehicles to appropriate parts of the site.

Traffic control at the tipping face is very important in order to provide safety to personnel and avoid damage to vehicles and equipment. The presence of heavy equipment (e.g. landfill compactor) that frequently go in reverse, up to several vehicles disposing of waste, and the presence of landfill personnel directing traffic make the tipping face area a potentially dangerous work environment. Accordingly, traffic control at the tipping face is a serious matter. Procedures at the tipping face are to include the following:

- Vehicles using different means of unloading are to be segregated at the tipping face where necessary to minimize turnaround time. Verbal directions from traffic controllers are to coordinate movement within the actively used area of the landfill and to ensure that the designated tipping areas are clearly defined. Vehicles will be directed to the appropriate tipping face and location by a traffic controller;
- Traffic controllers are to wear the appropriate Personal Protective Equipment (PPE) at all times, including a reflective vest;
- Persons are never to stand behind a vehicle or heavy equipment;
- Stay 10 m to 15 m in front of a vehicle while it backs up to the unloading area. A traffic controller must be able to see both sides of the truck to maintain the appropriate clearance from other parked vehicles and must ensure there is no one walking behind the truck;
- Ensure that vehicles and heavy equipment maintain safe operating distances, minimum of 3 m separation between vehicles, more if weather conditions dictate;
- A traffic controller is to communicate his/her location to the equipment operator if work activity changes;
- Equipment operators are to be aware at all times where traffic controllers and other persons on foot are situated around them;
- Instruct customers when and where to uncover and unload waste;
- Traffic controllers and equipment operators are to communicate regarding placement of loads at the tipping face;
- Ensure that there shall be only one vehicle being directed back to the tipping face for unloading at any one time;
- Customers that require extra time to un-tarp or prepare a load for placement are to conduct such activities away from the immediate tipping face area in order to maximize efficient unloading of other vehicles;
- Inspect and instruct all loads that require unloading by hand and direct customer where to unload;
- Co-ordinate, between customers, traffic controllers and equipment operators when unloading special wastes;

- Traffic controllers are to inspect any suspicious loads, first notifying the equipment operator and again when inspection is completed. Notify the weighbridge operator of any non-acceptable waste;
- Visually inspect all loads after dumping, before releasing the driver, to verify that the wastes are acceptable. A Waste Inspection Form shall be completed; and
- Ensure that all loose material is picked up from staging area.

5. Spreading and Compaction of Waste

The traffic controller shall direct incoming traffic such that all wastes are unloaded in the designated working area. Systematically placing the loads from right to left or left to right will assist the landfill compactor operator with spreading and compacting the waste. The Operator must increase the in-situ density of the solid waste delivered at the site, through compaction, to meet the required density for the designed life span of the site. Compacting the waste is intended to maximize waste density to best utilize the landfill's available air space. Compaction also helps minimize daily cover requirements, reduces the chance of differential settlement, minimizes leachate production, enhances the structural stability of the landfill, reduces the potential for fire, reduces problems of infestation by vermin, flies, pests and birds, and minimizes odour problems.

The spreading and compaction of waste shall include:

- Attempt to push only the amount of waste the equipment can push without excessive wheel slippage. Excessive wheel slippage will damage the previously compacted layer;
- The operator should progressively raise the blade of compactor/bulldozer as it travels up a slope of waste. The operator should maintain an average waste layer thickness of 50 cm;
- Distribution and co-disposal of different types of waste on the tipping face is considered a means of improving compaction. When regular waste is co-disposed with wastes such as ash and sludge, the in-place density of the overall waste mass is increased. In addition, sludge fills air voids between compacted waste particles and reduces frictional resistance in the waste, resulting in better compaction;
- Waste placement, spreading and compaction is best achieved by pushing waste up slope;
- After the operator has pushed and spread a layer of waste over the entire slope area, the operator will compact the waste with a minimum of three passes;
- Waste deposited in the landfill is to be compacted to a minimum density of 700 kg per cubic metre (target density is 870 kg per cubic metre);
- When dealing with low density waste that rebounds after compaction such as brush, leaves, tree trimmings, agricultural wastes, and low-density plastics, special measures are to be taken to ensure that they are compacted sufficiently. In order to achieve maximum densities, lightweight materials will be spread in layers approximately 30 cm thick. They will be compacted with a minimum of 3 passes of the compactor and covered immediately with compacted regular waste;
- The operator should maintain a smooth tipping face slope and horizontal surface to ensure minimum daily soil is required and to promote surface water drainage;
- The operator will adhere to the profile specified by the design of capping and closure works, once it becomes available;
- Whenever possible, wet waste and dry waste from different vehicles are to be mixed; and
- During periods of above normal precipitation, the Operator should reduce the tipping area and slope to reduce the infiltration of water and thereby reduce the generation of leachate.

Bulky wastes typically consist of household appliances (stoves, refrigerators), tires, wood pallets, rolls of fencing, auto bodies and large automotive parts, furniture, and some industrial waste. The Operator should visually and/or physically check the bulky waste to ensure that it is safe and the equipment will not be damaged. Bulky wastes should never be placed so as to cause damage to the leachate collection system. As a guide, bulky wastes should not be placed within 3.0 metres of the Leachate Collection System.

6. Fill Sequence Plan

The Jam Chakro Landfill site must be filled with layers of waste that extend over the working area of the cell in maximum 2.5 metre high lifts. After the first initial lift of waste is placed over the working area to the specified height, the second lift of waste shall be placed starting again at the edge of the tipping area.

Daily Cells and Cover

Cover material is available from various on-site sources, along with the possibility of utilizing excavated waste overburden soil material from other areas. On-site cover material is available from various locations on the site within the landfill property boundary. The daily covering of the landfill will be carried out with low permeability soils or alternative daily cover (ADC); this will reduce the amount of run-off/rainwater that infiltrates the landfill.
Daily cover shall be placed over waste in each completed cell. The purpose of this cover is to:

- Reduce vectors - Fly eggs cannot emerge through 15 cm of soil. This also reduces the attractive-ness for rats and birds;
- Litter control - No waste is exposed after operating hours;
- Fire control - Glass left exposed to the sun can ignite other wastes. Daily cover also controls atmospheric oxygen and provides a fire barrier between cells;
- Reduce odours;
- Promotes runoff - Reduces infiltration of surface water that produces leachate;
- Provides a medium for vegetative growth;
- Controls the movement of leachate and gases.

Daily cover shall not have any protruding waste, except for the occasional litter embedded in the surface. This protruding waste shall not exceed 10 percent of the cover area.

1.2.3 Housekeeping

1. General Requirements

A well thought-out housekeeping plan will:

- Protect the public and surrounding environment from nuisance effects of landfill operations;
- Enhance public perception and acceptance of the landfill site; and
- Control such nuisances as noise, dust, litter, odour, rodents, insects and scavenging birds.

2. Vector and Vermin Control

Landfill sites attract vectors and vermin because of the presence of food waste and standing water. Vector and vermin include rodents, birds, flies, and mosquitoes.

Methods to be undertaken by the Operator to avoid or reduce vector and vermin concerns include the following:

- Minimize the exposed area of the tipping face;
- Compact waste as specified;
- Apply daily cover at the end of each working day;
- Cover up large loads of organic waste as they are dumped at the tipping face; and
- Grade the site to minimize unnecessary sources of standing water (e.g. depressions, excavations).

Additional methods to be considered for vermin and vector control if the above methods seem insufficient are as follows:

- Adjust the grading pattern of the daily cover;
- Increase the density of the daily cover;
- Increase the thickness of the daily cover layer; or
- Use of insecticides and/or rodenticides.

The Operator should inspect and record weekly the vector and vermin conditions.

3. Litter Control

The uncontrolled spread of litter at a landfill can be a persistent operating, environmental and public nuisance when not controlled. Wind is the primary cause for fugitive litter around a landfill site. The Operator is to minimize, through active management as necessary, windblown litter at the site, and avoid the off-site migration of litter.

To control the spread of windblown litter, the Operator is to implement the following remedies:

- Maintain a minimum tipping area to provide efficient vehicle unloading and equipment operation;
- Lift height at the tipping face should not exceed equipment capabilities to spread, compact and cover wastes;
- Ensure the tipping face is adequately covered with a layer of cover material at the end of each working day;
- Perform, on a daily basis, hand picking of litter that goes off-site; and
- Implement fencing to collect litter, as necessary.

The main control for windblown litter begins at the tipping face through the rapid spreading and compacting of refuse, and placement of daily cover over all exposed refuse at the end of each working day.

As part of efforts to avoid windblown litter, the Operator can require Customers entering the landfill to tarp their loads to prevent litter from blowing off. The Operator may use discretion in this requirement (e.g. loads that contain only heavier non-windblown waste do not need to be trapped).

The Operator should check the weather reports for current wind direction, speed and forecasted changes to direction and speed. Short- and long-term forecasts provide valuable information for the Operator to adjust the litter control methods to respond to anticipated weather conditions.

Types of fencing that can be implemented to capture litter include interim fences and portable fences, which are described as follows:

- Interim fencing is placed in a position to catch litter from the long-term prevailing wind direction. The fencing is situated near the active disposal area but located so that it will not need to be moved for a period of 3 months or longer. It may consist of nylon mesh, wooden slot fencing, or wire-mesh material; and
- Portable litter fences are designed to be moved on a daily or even more frequent basis to capture litter downwind near the active tipping face area. The fences, which are often built in manageable-sized sections, can be mounted on wheels for easy movement, or moved by lifting or skidding. Properly placed screens will collect the majority of ground drifting litter. They are effective only if they are kept clean.

4. Noise Control

Noise at landfill site comes from two sources: landfill operations, and vehicles delivering waste to the landfill. Generally, faulty equipment such a malfunctioning exhaust system can cause noise levels which exceed the designed noise levels for a piece of equipment. The Operator is therefore to perform regular maintenance on all mobile and plant equipment and make immediate necessary repairs to correct the source of the noise.

Vehicle traffic noise can be reduced by: reducing speed limits on designated haul routes; notify drivers of defective equipment that is producing excessive noise; providing on-site traffic rules to minimize vehicular noise; and ensure the hours of operation are strictly obeyed.

5. Dust Control

Dust within and around the landfill site can be a source of annoyance, harm and discomfort to site staff and nearby residents. The combination of vehicle movements on temporary and un-surfaced (without bitumen coating) roads and light winds can create and spread dust. High winds may also create dust problems.

The Operator shall implement the following housekeeping practices to achieve dust control: maintain dust control equipment at the site; schedule staff and equipment for dust control; designate haul routes for both delivery vehicles and on-site equipment; clean paved road surfaces by sweeping or flushing; stockpiles or dormant areas of the landfill should be vegetated and take special procedures for dust producing wastes.

6. Scavenging

Scavenging will only be permitted at the designated picking area constructed for this purpose. Scavengers will be trained with reference to how they should operate at the interim waste area.

7. Odour Control

The landfill will be operated in a manner that will minimize the odour attributable to waste or associated items. Operational procedures typically involve placing suitable cover material over the waste in a timely manner, and proper maintenance of the leachate management system.

Odours will first be minimized by ensuring the immediate deposition of waste on delivery, the adequate compaction of deposited waste, placement of sufficient cover material over the waste, and appropriate operation of the leachate collection and treatment system. The sizes of the tipping areas are to be kept as small as is practical in order to reduce the exposure of odour-causing material. Completed sections of the tipping face are to be covered with soil or other suitable cover material as operations progress throughout the day.

Customers are to pre-arrange with the Operator the delivery of very malodorous waste to the landfill site. The weigh bridge operator is to advise personnel at the tipping face, by 2-way radio, that such waste is entering the landfill so that steps can be taken at the tipping face to appropriately place and cover the waste immediately. In addition, necessary regard will be given to prevailing and actual wind conditions and direction.

8. Fire and Smoke Control

The Operator is to operate the site in a manner that will minimize the threat of fire and smoke. The Operator is to provide safety equipment that is readily available to deal with the incidence of fire. Portable fire extinguishers are to be located in all buildings. In addition, every site vehicle, including mobile plant, is to carry a minimum of one fully charged fire extinguisher. The fire extinguishing equipment must be selected based on the anticipated type of fires and on the size and degree of hazard which may affect their use.
Fire extinguishers are to be visually inspected regularly, and hydrostatically tested according to the test schedule recommended by the manufacturer. Units are to be replaced with fully charged units after each use even if the contents were only partially discharged.
Mobile plant is to be maintained in good condition and be equipped with features to avoid generating open sparks and catching fire.

Controlled burning is not permitted on the site at any time without the consent of the Employer.

Smoking is prohibited in all areas of the site, with the exception of a designated area within the Administration Area. “No-smoking” signs are to be posted in prominent locations throughout the site.

The Operator is to inspect all fuel tanks on site on a weekly basis to ensure that they do not represent a fire risk. “No smoking” signs are to be posted in fuel storage areas.
All site personnel will be trained in the appropriate procedures for reporting and controlling fires. The training will specifically include the use of the equipment described above and the following procedures:

Building Fires:

- Determine the location, nature, extent, and possible cause of fire;
- Notify site personnel, including the Operator’s senior on-site person. Personnel at the tipping area and other parts of the site which are distant from the fire area will maintain continuous contact with supervisory personnel;
- Isolate the affected area. Take steps to keep all unnecessary people away from the fire;
- Attempt to extinguish the fire only when and if it is safe to do so;
- Notify fire, police or rescue personnel, if necessary;
- Notify the Employer as soon as possible; and
- Once the fire is extinguished, complete a report including the fire’s cause, items that hindered or accelerated the fire, damaged incurred, actions taken, personnel involved, any personnel injuries, and repairs required.

For surface fires:

- If the burning material is known to be non-hazardous and the seat of the fire is visible, small fires can be controlled using fire extinguishers, water, or may be smothered with soil. Only specially trained personnel will be allowed to remain near large fires;

- Sufficient supplies of inert cover material are to be maintained adjacent to the tipping area in order to smother any wastes found to be burning. The application of cover material limits the applicability of oxygen to smouldering or burning waste;
- If the fire spreads or the nature of the burning material is not known, cordon off the area and evacuate the vicinity;
- The Operator's senior personnel will provide the local fire department with relevant information about the situation and will assist the fire department in coordinating the extinguishing procedures; and
- After the fire has been extinguished and when practical, the materials involved will be removed to a separate, cleared area of the landfill. The waste will be spread and monitored for signs that it may reignite. When it is deemed safe, the waste will be returned to the tipping face for disposal.

For subsurface fires:

- Subsurface fires are to be handled in conjunction with the fire department. The strategy for controlling subsurface fires is based on starving the fire of oxygen;
- Cover any fissures or other sources of oxygen flow with loose cover soil in order to seal the affected area. Do not excavate waste or cover material in order to gain access to the burning materials because this will help to feed oxygen to the fire;
- Remediation efforts may include drilling to gain access to the affected area and introducing water or another suppressant to extinguish the fire; and
- In the event that the fire is too deep seated or poses a great risk to the landfill, a specialty contractor may be retained. One method is to suffocate the fire with liquid CO2. This can involve drilling to the level of the fire, lining an access channel with steel casing, and flooding the affected area with liquid carbon dioxide.

Scrub fires:

- Notify the appropriate authorities immediately, in addition to the contacts listed above in Building Fire Procedures;
- Control the fire through the use of fire extinguishers, sprayed water, or loose soil;
- Remove all undergrowth or litter from the area that may burn; and
- If tipping operations are at risk, move the active face to a safe, alternative location on the site.

Fires in incoming waste:

- From time to time, vehicles may deliver loads that are smouldering or actively burning to the landfill. When such a "hot load" is discovered:
- Direct the driver to discharge the load in the Emergency Bay. The Bay is to be kept clear of vegetation, debris and flammable waste material;
- Spread the waste and extinguish the fire using fire extinguishers, water sprayed from a bowser, or loose cover soil; and
- Monitor the "hot" waste for signs of smouldering or fire. When the threat of re-ignition has passed, move the waste to the active face for disposal.

After extinction, the cause of all fires will be investigated, and steps are to be taken to prevent recurrence. A record of the investigations and preventative actions will be maintained at the site office.

9. Vehicle Breakdown

Vehicle breakdowns within the landfill site shall be addressed quickly, particularly when the free flow of traffic is affected. Disabled vehicles will be reported to the senior on-site Operator

personnel immediately. A disabled vehicle is to be removed to a suitable area where it will not interfere with traffic or landfill operations. The vehicle owner will be responsible for removing the vehicle from the site and is to remove the vehicle within 24 hours or the Operator will have it removed at the owner's expense.
The Operator is to take all reasonable precautions to prevent damage to the vehicle and shall indemnify the vehicle owner accordingly.