Environmental Impact Assessment

Project Number: 51036-002
June 2021

Pakistan: Khyber Pakhtunkhwa Cities Improvement Project

Mingora Solid Waste Management Facility Development

Main Report

Prepared by Project Management Unit, Planning and Development Department, Government of Khyber Pakhtunkhwa for the Asian Development Bank.

Environmental Impact Assessment

Project Number: 51036-003
June 2021

PAK: Mingora Solid Waste Management Facility (SWMF) Development

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

CURRENCY EQUIVALENTS

As of 6th June 2021 Currency Unit – Pak Rupees (Pak Rs.)

Pak Rs 1.00 = $ 0.00649 US$1.00 = Pak Rs. 154

CONVERSIONS

1 meter = 3.28 feet

1 hectare = 2.47 acre

Acronyms

ADB	Asian Development Bank
ADC	Alternate Daily Cover
AD	Anaerobic Digestion
AIIB	Asian Infrastrcutre Investment Bank
AIP	Access to Information Policy
AMSL	Above Mean Sea Level
BC	Before Construction
BOQ	Bill of Quantities
CORDEX	Coordinated Regional Downscaling Experiment
COVID	Corona Virus Infectious Disease
CSC	Construction Supervision Consultant
DC	During Construction
DO	During Operation
DTRO	Disc Tube Reverse Osmosis
EA	Executing Agency
EDCM	Engineering Design Construction Management
EGL	Existing Ground Level
EHS	Environmental, Health, and Safety
EIA	Environment Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
GER	Gross Enrollment Rate
GFI	Ground Fault Interrupter
GoP	Government of Pakistan
GRM	Grievance Redress Mechanism
HDPE	High Density Polyethylene
IA	Implementing Agency
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IWMS	Integrated Waste Management System
KP	Khyber Pakhtunkhwa
KPCIP	Khyber Pakhtunkhwa Cities Improvement Project
KP-EPA	Khyber Pakhtunkhwa Environmental Protection Agency
KPI	Key Performance Indicator
LAA	Land Acquisition Act (of 1984)
LARP	Land Acquisition and Resettlement Plan
Leq	Equivalent sound pressure level
LFS	Landfill Site
LGE&RDD	Local Government, Elections and Rural Development Department
LHW	Lady Health Worker
LULC	Land use/Land cover
MBT	Mechanical & Biological treatment
MGD	Million Gallons per Day
MRF	Material Recovery Facility
MSF	Material Sorting Facility
MSWLF	Municipal Solid Waste Landfill
NCS	National Conservation Strategy
NEP	National Environmental Policy

NEQS	National Environmental Quality Standards
NER	Net Enrollment Rate
OHS	Occupational Health and Safety
O&M	Operation & Maintenance
PAP	Project Affected Persons
PC	Public consultation
PCC	Plain Cement Concrete
PCOs	Public Call Offices
PDD	Planning & Development Department
PEPAct	Pakistan Environment Protection Act 1997
PEPC	Pakistan Environmental Protection Council
PESCO	Peshawar Electric Supply Company
PGA	Peak Ground Acceleration
PMU	Project Management Unit
PPE	Personal Protective Equipment
RCC	Reinforced Cement Concrete
RDF	Refuse Derived Fuel
REA	Rapid Environmental Assessment
RFP	Request for Proposal
RO	Reverse Osmosis
RP	Resettlement Plan
SDDA	Swat District Development Authority
SOPs	Standard Operating Procedures
SS	Suspended Solids
SPS	Safeguard Policy Statement
SSEMP	Site Specific Environmental Management Plan
SWMF	Solid Waste Management Facility
TPD	Tonnes per day
TMA	Tehsil Municipal Administration
TMP	Traffic Management Plan
UC	Union Council
USEPA	United States Environmental Protection Agency
WACS	Waste Analysis and Composition Study
WHO	World Health Organization
WSSC	Water and Sanitation Services Company
WSSC Swat	Water and Sanitation Services Comoany Swat

NOTE

In this report, “$” refers to US dollars

Definition of Terms

"Carbon Monoxide" (also CO): A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

"Carbon Dioxide" (also CO_2): A colorless, odorless, incombustible gas, CO2, formed during respiration, combustion, and organic decomposition and used in food refrigeration, carbonated beverages, inert atmospheres, fire extinguishers, and aerosols. Also called carbonic acid gas.

"Ground Water": The supply of fresh water found beneath the Earth's surface, usually in aquifers, which supply wells and springs. Because ground water is a major source of drinking water, there is growing concern over contamination from leaching agricultural or industrial pollutants or leaking underground storage tanks.

"Laws": means state and local laws and all regulations, rules, orders, decrees, decisions, instructions, requirements, policies and guidance which are issued or made by any Relevant Authority and which are legally binding, as any of them may be amended from time to time.

''Leachate'' Contaminated water that seeps out of landfills. Often contains high amounts of organic matter and toxic chemicals.

''Liner system'' The technical term for the layers of materials (such as clay and geosynthetics) that protect landfills from erosion, and keep trash and leachate from escaping from landfills.

"**Methane"** (also CH_4): A colorless, nonpoisonous, flammable gas created by anaerobic decomposition of organic compounds. A major component of natural gas used in the home.

"Municipal Solid Waste" (MSW) is a waste type that includes predominantly household waste (domestic waste) with sometimes the addition of commercial wastes collected by a municipality within a given area. The term residual waste relates to waste left from household sources containing materials that have not been separated out or sent for reprocessing.

"**Operator"** means the SLF operator employed or contracted by the EA to operate, maintain and manage the facility.

"Particulates" (also PM_{10}): 1. Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions. 2. Very small solids suspended in water; they can vary in size, shape, density and electrical charge and can be gathered together by coagulation and flocculation.

"Personal Protective Equipment" (also PPE): Clothing and equipment worn by pesticide mixers, loaders and applicators and re-entry workers, hazmat emergency responders, which is worn to reduce their exposure to potentially hazardous chemicals and other pollutants.

"Peak Ground Acceleration" (PGA) is a measure of earthquake acceleration on the ground and an important input parameter for earthquake engineering.

"Recyclables" Any materials that will be used or reused, or prepared for use or reuse, as an ingredient in an industrial process to make a product, or as an effective substitute for a commercial product. This includes, but is not limited to, paper, glass, plastic and metal.

"Recycling" means the process by which recovered materials are transformed into new products or feedstock for new products.

"Residual Waste" means all municipal solid wastes that are not processed and/or recycled.

"Risk Assessment": Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants.

"Solid Waste Management" means any activity involving the handling, treatment and disposal of Solid Waste. Also means any supervised handling of waste materials from their source through recovery processes to final disposal.

"Solid Waste Management System" The entire process of storage, collection, transportation, processing, and disposal of solid wastes by any entity engaging in such process as a business, or by any state agency, city, authority, county or any combination thereof.

"Sulfur Dioxide" (also SO_2): A pungent, colorless, gas formed primarily by the combustion of fossil fuels; becomes a pollutant when present in large amounts.

"Transfer Station" means the facility where solid wastes are temporarily stored and consolidated before being transported elsewhere for further treatment or disposal.

"Waste" means any movable articles or material for which their owner wishes to relinquish responsibility by Disposal or which must be removed from their holding place as waste to safeguard the common welfare and to protect the environment.

Content Details

S/No.	Version	Date	Summary of Revisions made
1	1	15-01-2021	First Draft of EIA report
2	2	28-02-2021	Second Draft of EIA report
3	3	06-06-2021	Third Draft of EIA Report

Table of Contents

EXECUTIVE SUMMARY i

1 Introduction 1

1.1 Overview 1

1.2 Project Location 2

1.3 Environmental Category of Project 3

1.4 Objectives of the EIA 3

1.5 EIA Team 4

1.6 Methodology of EIA Study 4

1.6.1 Understanding of the Proposed Operation 4
1.6.2 Review of Legislation and Guidelines 4
1.6.3 Secondary Data Collection 4
1.6.4 Field Data Collection (Baseline Survey) 5
1.6.5 Public Consultations 5
1.6.6 Impacts Identification and Assessment 5
1.6.7 Recommendations for Mitigation Measures 5
1.6.8 Development of Environmental Management Plan (EMP) 5

1.7 Proponent of Project 6

1.8 Structure of the Report 6

1.9 Further Additions & Updating of EIA Study 7

2 Policy and Legal Framework 10

2.1 General 10

2.2 National Policy and Legal Framework 10

2.3 Regulations for Environmental Assessment, Pakistan EPA 10

2.4 Regulatory Clearances, KP EPA 10

2.5 Guidelines for Environmental Assessment, Pakistan EPA 10

2.6 National Environmental Quality Standards (NEQS) 2000 & 2010 11

2.7 Other Environment Related Legislations 11

2.8 Implications of national policies and regulations on proposed project 13

2.9 ADB's Safeguard Policy Statement (SPS), 2009 15

2.10 ADB's Access to Information Policy (AIP) 2018 15

2.11 ADB's Accountability Mechanism Policy 2012 15

2.12 Implications of ADB's safeguard policies on proposed project 15

2.13 IFC Sector Specific Guidelines on Solid Waste Management 18

2.14 Comparison of International and Local Environmental Legislations 19

3 Project Description 23

3.1 Component 1: Waste Collection & Transport to SWMF 23

3.1.1 Existing and proposed waste collection system in Mingora 23
3.1.2 Procurement of SWM Equipment, Machinery and Vehicles 29
3.1.3 Transfer Stations 30

3.1.4 Waste Transport 31

3.2 Component 2: SWMF Development & Operation 31

3.2.1 Objective of SWMF Development 31
3.2.2 Capacity of Mingora SWMF 32
3.2.3 Scope of Works for SWMF development 33
3.2.4 Project Need 36
3.2.5 Rationale for Site Selection 36
3.2.6 Proposed Design Considerations for SWMF 38
3.2.7 Detailed Process Description 40
3.2.8 Construction of Landfill Facilities 45
3.2.9 Landfill Cell Development 45
3.2.10 Landfill Gas Management 47
3.2.11 Leachate Collection and Treatment System 52
3.2.12 Construction Phase Details for SWMF 60
3.2.13 Operation Phase Details for SWMF 64
3.2.14 Closure and Post Closure Plan of SWMF 65

3.3 Instituional Review and Capacity Building (IRCB) Components 66

3.4 Climate Risks from Project 67

3.4.1 Climate Change Trends and Extremes in Mingora 67
3.4.2 Climate Change Considerations for Landfill Site 67

4 Description of Environment 71

4.1 General 71

4.2 Physical Resources 71

4.2.1 Topography 71
4.2.2 Soils 71
4.2.3 Climate 76
4.2.4 Seismology 80
4.2.5 Surface water 81
4.2.6 Groundwater 81
4.2.7 Noise 82
4.2.8 Air Quality 82
4.2.9 Land Use 85

4.3 Ecological Environment 86

4.3.1 Flora 87
4.3.2 Fauna 88
4.3.3 Aquatic Fish 89

4.4 Socio-economic Environment 90

4.4.1 Administrative Setup 90
4.4.2 Demography and Population 91
4.4.3 Religion 91
4.4.4 Cultural and Archaeological sites 91
4.4.5 Ethnicities in Project Area 92
4.4.6 Languages 94
4.4.7 Main Sources of Livelihood/Income 94
4.4.8 Transport 94
4.4.9 Distance to nearest airport from project site 94
4.4.10 Industry 94
4.4.11 Health Care 94

4.4.12 Literacy Rate 95
4.4.13 Education 95
4.4.14 Types of Dwellings 95
4.4.15 Energy Supplies 95
4.4.16 Major Source of Drinking Water 95
4.4.17 Social Amenities in the project area 95
4.4.18 Gender Assessment 95
4.4.19 Existing Scavenging Practices 96

4.5 Sensitive Receptor Mapping 97

4.6 Sensitive Receptor Mapping to assess compliance with IFC EHS Clause 107

5 Analysis of Alternatives 109

5.1 Overview 109

5.2 Alternatives Types 109

5.3 'No Project' Option 109

5.4 Site Selection Alternatives 110

5.5 Landfill Type Alternatives 112

5.5.1 Sanitary Landfill 112
5.5.2 Bioreactor Landfill 112
5.5.3 Secured Landfill 112

5.6 Landfill Construction Alternatives 113

5.6.1 Lining 113
5.6.2 Leachate Collection and Treatment 113
5.6.3 Gas collection and Treatment 114

5.7 Technological Alternatives for Anaerobic Digestion System (AD System) 114

5.8 Technological Alternatives for Material Recovery Facility (MRF) 115

5.9 Waste Disposal Alternatives 115

5.9.1 Thermal/Direct Burn Technologies 115
5.9.2 Physical Processing Technologies 115
5.9.3 Biological Processing Technologies 115
5.9.4 Combined Treatment 116
5.9.5 Qualitative Assessment of Various Technologies 116

5.10 Proposed Solution for Mingora City 125

5.10.1 Scenario Analysis for all possible treatment options 125

5.11 Economic Aspect Analysis 134

6 Potential Environmental Impacts and Mitigation Measures 135

6.1 Methodology for impact screening 135

6.2 Design/Pre-Construction Phase 136

6.2.1 Improper landfill design leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.) 138
6.2.2 Improper selection of landfill site due to non-compliance with IFC Landfill guidelines 139
6.2.3 Lack of integration of EIA/EMP requirements into Construction bid documents 140
6.2.4 Material Haul Routes 140

6.2.5 Contractor's Environmental Safeguards Capacity 140
6.2.6 Identification of Locations for Labor camps and ancillary facilities 141
6.2.7 Cultural Heritage & Religious Sites, Social Infrastructure 141
6.2.8 Land Acquisition and Resettlement Impacts 141
6.2.9 Impacts due to natural hazards 142

6.3 Construction Phase 143

6.3.1 Construction of landfill not in accordance with finalized design 146
6.3.2 Degradation of Ambient Air Quality 146
6.3.3 Community Health and Safety 149
6.3.4 Occupational Health and Safety (OHS) 150
6.3.5 High Noise Levels 157
6.3.6 Hazardous and Non-Hazardous Waste Management 160
6.3.7 Camp & Batching Plant Effluent 162
6.3.8 Soil Erosion and Sedimentation 162
6.3.9 Soil Contamination 163
6.3.10 Employment Conflicts 163
6.3.11 Communicable diseases incl. COVID-19 164
6.3.12 Vegetation and Wildlife Loss 169
6.3.13 Historical/Archaeological Sites 169
6.3.14 Construction of Administeration Building and Other Infrastructure 170
6.3.15 Construction/Widening of Acces Road 172
6.3.16 Sexual Abuse, Exploitation and Harrasement (SEAH) 176

6.4 Impacts Associated with Operation of SWMF 177

6.4.1 Generation of Leachate 178
6.4.2 Possible Contamination of Soil and Groundwater 180
6.4.3 Generation of Landfill Gas 187
6.4.4 Generation of objectionable Odor and impact on air quality 190
6.4.5 Attraction of Vermin and disease vector generation 192
6.4.6 Occupational Health and Safety 195
6.4.7 Waste Collection and Hauling Impacts 196
6.4.8 Wind Blown Litter 197
6.4.9 Impacts on Scavengers/Waste Pickers 199
6.4.10 Improved management of solid waste & health and sanitation 200
6.4.11 Improvements in Public Health 200
6.4.12 Improvements in Aesthetic Aspects 201

6.5 Closure and Post Closure Impacts 201

6.6 Cumulative Impacts 202

6.7 Indirect and Induced Impacts 202

7 Environmental Management Plan & Institutional Requirements 203

7.1 Introduction 203

7.2 Environmental Management Plan (EMP) 203

7.3 Objectives of EMP 204

7.4 Environmental Management/Monitoring and Reporting 204

7.4.1 Inclusion of EMP in Contract documents 204

7.5 Institutional Arrangements 205

7.5.1 Role of PMU, KP LGE&RDD 205
7.5.2 Role of the ADB 205

7.5.3 Role of Construction Supervision Consultant (CSC) 205
7.5.4 Role of KP EPA 206
7.5.5 Role of Project Contractor 206
7.5.6 Role of WSSC Swat 206
7.5.7 Role of Third Party Monitor 207

7.6 Monitoring Parameters 207

7.7 Environmental Training 208

7.7.1 Capacity Building and Training 208

7.8 Environmental Staffing and Reporting Requirements 208

7.9 Environmental Management Costs 264

8 Public Consultation and Information Disclosure 267

8.1 Identification of Stakeholders 267

8.1.1 Primary Stakeholders 267
8.1.2 Secondary Stakeholders 267
8.1.3 Key stakeholders 268

8.2 Information Disclosure and Consultation 268

8.2.1 Scope of Consultations 268
8.2.2 Social Safeguard Focused Group Discussions 274
8.2.3 Findings of the Public Consultations/Focal Group Discussions 275
8.2.4 Response from Social Safeguard Team 275
8.2.5 Basic data of affected people 276
8.2.6 Consultations with Scavengers and Scrap Dealers 276

8.3 Consultation Plan for Construction and Operation Phase 277

9 Grievance Redressal Mechanism 286

9.1 General 286

10 Conclusion and Recommendations 289

11 References 290

Annexures

Annexure A	Rapid Environmental Assessment (REA) Checklist
Annexure B	Questionnaires for Conducting FGDs & Surveys
Annexure C	Details of Public Consultations
Annexure D	Ambient Laboratory Monitoring
Annexure E	Occupational Health and Safety Plan
Annexure F	Emergency Response Plan
Annexure G	Archaeological ‘Chance Find’ procedure
Annexure H	Dust Management Plan
Annexure I	Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor
Annexure J	ToRs of Third Party Monitor
Annexure K	Traffic Management Plan
Annexure L	NEQS Guidelines
Annexure M	WHO Guidance on Laboratory Biosafety
Annexure N	WHO advice on Use of Masks for the COVID-19 Virus
Annexure O	Soild Waste Management Framework
Annexure P	IBAT Screening Report
Annexure Q	Estimation of Leachate Leaking Effect on Ground Water Quality
Annexure R	Letter from KPK Wildlife Department

List of Figures

Figure 1-1: Key Map 7
Figure 1-2: Project Area Map 9
Figure 2-1: EIA Review and Approval Process of Pakistan EPAs........ 14
Figure 3-1: Modes of Waste collections in Mingora 26
Figure 3-2: Proposed SWM Facility for Mingora 34
Figure 3-3: Key Plan of Mingora SWMF 35
Figure 3-4: Schematic Diagram of Weigh Bridge........ 41
Figure 3-5: General process flow diagram for AD System and Composting 42
Figure 3-6: Process flow of Material Sorting Facility 43
Figure 3-7: 3D View of proposed MRF for SWM Facility - Mingora........ 45
Figure 3-8: Bottom Liner of the Landfill Cells........ 46
Figure 3-9: Capping of Landfill 47
Figure 3-10: Design Specification of Gas Vent 50
Figure 3-11: Extension of Gas Vent in Landfill Operations 50
Figure 3-12: Gas Vent System of Mingora Landfill Site 51
Figure 3-13: Leachate Collection Network for Mingora Site........ 53
Figure 3-14: Process Flow Diagram of Leachate Treatment Plant........ 55
Figure 3-15: Process Flow Diagram within DTRO 56
Figure 3-16: Proposed AIO-DTRO Series for leachate treatment........ 56
Figure 3-17: Layout of administration building at Mingora SWMF 58
Figure 4-1: Geology of Project Area 75
Figure 4-2: Temperature trend analysis of Mingora (1911-2017)........ 77
Figure 4-3: Humidity Profile of Mingora City 77
Figure 4-4: Wind Speed Profile of Mingora City........ 78
Figure 4-5: Wind rose for Mingora........ 78
Figure 4-6: Average Rainfall Profile of Mingora City 79
Figure 4-7: Precipitation trend analysis of Saidu Shareef (1960-2011) 79
Figure 4-8: Seismic Zones of Pakistan 80
Figure 4-9: Catchment and Road Access Map of Mingora Landfill 81
Figure 4-10: Sampling Locations for Environmnetal Monitoring........ 83
Figure 4-11: Land Use Map of the Project area........ 85
Figure 4-12: Typical setting and existing landuse of project site........ 86
Figure 4-13: Flora and Fauna of the Project area........ 89
Figure 4-14: Illustrating young children engaged in scavenging as an essential means of their livelihood........ 97
Figure 4-15: Nearest Receptors in Project Area 100

Figure 4-16: Receptors Map for SWMF, Mingora 108
Figure 5-1: Location map of site alternatives 110
Figure 5-2: Scenario-1-No Intermediate treatment 125
Figure 5-3: Scenario-2 126
Figure 5-4: Mass balance and %age waste treatment by different options with scenario-2 126
Figure 5-5: Scenario 3 – Composting, Recycling and landfilling (3 streams) 127
Figure 5-6: Mass balance and %age waste treatment by different options with scenario-3 127
Figure 5-7: Composting, RDF, Recycling and Landfill (4 streams)-scenario 4 128
Figure 5-8: Mass balance and %age waste treatment by different options with scenario-4 129
Figure 5-9: Digestion/Methanation, RDF, Recycling and Landfill (4 Streams) 130
Figure 5-10: Mass balance and %age waste treatment by different options with scenario-5 130
Figure 6-1: Existing alignment for widneining of acces road to Mingora LFS 172
Figure 6-2: Location of Tube-wells and ground water level showing underground direction of flow 181
Figure 6-3: Contamination Concentration at target tubewell locations vs. time in days 185
Figure 6-4: Potential Emissions from LFS 188
Figure 6-5: Corridor of Airborne Impacts from Landfill Operation 194
Figure 8-1: Consultations with Institutional Stakeholders 273
Figure 8-2: Focus Group Discussions (FGDs) for Mingora SWMF 275
Figure 8-3: Consultations with Scavengers/Waste Handlers 285
Figure 9-1: Grievance Redressal Mechanism 288

List of Tables

Table 1.1: Executing Agency Contact Details 6
Table 2.1: Environmental Guidelines and Regulations 11
Table 2.2: ADB Policy Principles 16
Table 2.3: ADB Environmental Assessment Requirements for Category 'A' projects 17
Table 2.4: IFC Work Environment Noise limits 20
Table 2.5: Comparison of International and local Air Quality Standards* 20
Table 2.6: Comparison of International and Local Noise Standards 21
Table 2.7: Comparison of International and Local Water Quality Standards 21
Table 3.1: Modes of Waste Collection 24
Table 3.2: Audit of Exsiting Facility and required corrective actions 27
Table 3.3: Current Waste Carrying Machinery Procurement 29
Table 3.4: Current Non-Waste Carrying Machinery Procurement 29
Table 3.5: Total machinery requirement for Mingora city for project life i.e. 2030 30
Table 3.6: Criteria for Site Selection 36
Table 3.7: Waste Generation Estimation Criteria 39
Table 3.8: Size of Landfill Cells 45
Table 3.9: Design parameters for screen chamber in leachate treatment plant 54
Table 3.10: Design parameters for equalization tank in leachate treatment plant 55
Table 3.11: Design parameters for sand filters in leachate treatment plant 55
Table 3.12: Estimated Contractor's Equipment and Machinery 63
Table 3.13: Source of Raw Material 64
Table 3.14: Operation Phase Activities 64
Table 3.15: List of Equipment and Machinery for operation phase of Landfill Site 65
Table 3.16: Sensitivity Considerations for Landfill Site 68
Table 3.17: Non-climate Stressors and Potential Impact on Landfill Site 69
Table 4.1: Summary of ground conditions across Project Site 72
Table 4.2: Climate Data of Mingora City 76
Table 4.3: Ambient Noise Monitoring Results in Project Area 84
Table 4.4: Comparison of ambient air quality results versus applicable Air Quality standards 84
Table 4.5: Existing Flora in Project Area 87
Table 4.6: Existing Fauna in Project Area 88
Table 4.7: Avifauna of the Project area 88
Table 4.8: Ethnicities in Project Area 92
Table 4.9: Sensitive Receptor Distances from Proposed Landfill Site 98
Table 4.10: Nearest Receptors and Prominent Structures within radius of 2 km from the proposed Landfill Site 101

Table 5.1: Comparison of Site Alternatives 111
Table 5.2: Qualitative Assessment criteria for waste treatment options 116
Table 5.3: Qualitative/Subjective assessment of various technologies for Mingora City 118
Table 5.4: Pros/Cons of Scenario-1 125
Table 5.5: Pros/Cons of Scenario-2 127
Table 5.6: Pros/Cons of Scenario-3 128
Table 5.7: Pros/Cons of Scenario-4 129
Table 5.8: Pros/Cons of Scenario-5 131
Table 5.9: Qualitative Evaluation of Possible Scenarios for Mingora City 132
Table 5.10: Economic aspect analysis of waste treatment methods (UNEP, 2015) 134
Table 6.1: 'Activity Wise'screening of possible Impacts during Design/Pre-Construction phase 137
Table 6.2: Screening of Possible Impacts during Construction Phase 143
Table 6.3: Control measures for Fugitive Dust emissions 147
Table 6.4: Construction Equipment Noise Ranges, dB (A) 158
Table 6.5: Screening of Possible Impacts during Operation Phase 177
Table 6.6: Data of Existing Water Resources around LFS 182
Table 6.7: Input Data for Otaga and Banks Equation 182
Table 6.8: Travel time and Leachate concentration at tubewell locations around LFS 183
Table 6.6: Typical Landfill Gas Components 187
Table 7.1: Environmental Management Plan 210
Table 7.2: 'Pre-Construction' Environmental Monitoring Plan for Baseline Development .. 259
Table 7.3: Construction Phase Monitoring Requirements 260
Table 7.4: 'Operation Phase' Environmental Monitoring Plan 261
Table 7.5: Capacity Development and Training Programme 263
Table 7.6: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring 264
Table 7.7: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring 264
Table 7.8: Annual Cost Estimates for 'Operation Phase' Environmental Monitoring 265
Table 7.9: Estimated Costs for EMP Implementation 265
Table 7.10: Capacity Development and Training Programme for Project Contractor(s) 266
Table 8.1: List of FGDs Consultation and Concerns 269
Table 8.2: Consultations with Government Stakeholders 270
Table 8.3: Consultations with Scavengers and Scrap Dealers 278
Table 8.4: Responses from Scavengers based on Survey Questions 280

EXECUTIVE SUMMARY

Project Overview

1. The Khyber Pakhtunkhwa Cities Improvement Projects (KPCIP) will improve the quality of life of the residents of five KP cities, including Abbottabad, Kohat, Mardan, Mingora, and Peshawar, directly benefitting about 6 million of urban population. KPCIP will help selected cities improve their access to quality urban services through three interlinked outputs: (i) Climate resilient and gender friendly urban infrastructure improve, (ii) Institutional capacities of urban service providers and governments strengthened, and (iii) Increased women's participation in urban governance and access to economic opportunities.

2. KPCIP will support the Government of Pakistan's development priorities, established in (i) the National Water Policy (2018), (ii) the Local Government Act (2019), and (iii) Pakistan Vision 2025. The project is also aligned with ADB's operational priorities of (i) addressing remaining poverty and reducing inequalities; (ii) accelerating progress in gender equality; (iii) tracking climate change, building climate and disaster readiness; (iv) making cities more livable; and (v) strengthening governance and institutional capacity, outlined in ADB's Strategy 2030, and is included in ADB's country operations business plan for Pakistan, 2021–2023.

3. The project readiness financing (approved in March 2019) has financed the preparation and engineering design of the KPCIP. The Department of Local Government, Elections and Rural Development Department (LGE&RDD), the Government of Khyber Pakhtunkhwa, will be the executing agency for the project and the city governments of the five target cities, including the respective Water and Sanitation Services Companies, will be the implementing agencies.

4. This report has been prepared based on detailed engineering designs, due diligence assessments, and studies conducted by the government and project readiness financing consultants. The Government of Pakistan, Asian Development Bank (ADB), and Asia Infrastructure Investment Bank (AIIB) are expected to approve KPCIP in Q3 2021.

5. The Khyber Pakhtunkhaw Cities Improvement Project (KPCIP) is being processed through the Project Readiness Finance (PRF) modality by Asian Development Bank (ADB) under Loan 6016-PAK, being executed by KP Local Government Election and Rural Development Department (LGE&RDD). The Project is focused on investments of subprojects related to water supply, sanitation and drainage, solid waste management, and urban/green spaces. The Project has the following four major components:

   - Improvement of water supply systems in five (5) cities.
   - Improvement of sewerage and drainage systems in five (5) cities, including provision of sewage treatment plants (STPs)
   - Provision of Integrated Solid Waste management (ISWM) system in five (5) cities
   - Development of Urban/Green Spaces in five cities.

6. The proposed Integrated Waste Management System (IWMS) has the following two main components:

- **Component 1**: Improvement of existing waste collection & transport system in Mingora City
- **Component 2:** Solid Waste Management Facility (SWMF) Development & Operation

7. The IWMS within Mingora city is crucial for successful operation of the Solid Waste Management Facility (SWMF) as it provides strategic approach to sustainable management of solid waste covering all sources and all aspects, including generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency. The operational protocols and modalities of the IWMS have been established to improve environmentally sound practices with respect to waste management and attempting to close existing bottlenecks in the system.

8. The Component 1 is an existing activity that is proposed to be further enhanced and improved in turns of its operational efficacy through implementation of the IWMS. On the other hand, the proposed Component 2 is the environmentally sensitive intervention and thus this EIA report focuses on this particular component.

9. The proposed Component 2 consists of the development of a well-engineered and designed solid waste management facility which will ensure the solid waste generated from Mingora city is managed in accordance with international good practices on solid waste management.

10. The proposed SWMF will be developed at Katwaro Maira, Mingora located at a distance of 4.4 km from the city center and 3.0 km away from National Highway at an elevation of approximately 3050 ft. (990m) above mean sea level (AMSL). The SWMF site is accessible from Mingora city via Haji Baba road then Kawtaro Mera Road. The proposed SWMF will be developed on about 8 acres of vacant land comprising of hilly patches. Mingora SWMF site is accessible through metaled road which is passing from congested and populated areas. For successful operation of Mingora SWMF, there is need of widening of existing road form Highway to proposed site.

11. The total acquired area is about 66 Kanals (8.25 Acers). The surrounding area comprises of a rugged mountainous landscape and features some minimal agricultural land use. The site is complex due to the fact that the site is mountainous in nature and it is therefore planned in such a way that waste cells are kept on the backside where lesser excavation or level will be required. There is some sparse residential population located in the vicinity of the project site. A map of the project area is provided as **Figure ES-1.**

Project Need

12. Estimates based on available information reveals that approximately 215 tons/day waste is generated in the city and the waste generation is projected from 2021 to 2031. There is need of development of SWMF at Mingora keeping in view the next 10 years requirements when the waste generation would be around 300 TPD.

13. Total daily solid waste collection and disposal by WSSC Swat is 57 Tons, whereas total daily waste generation in year 2021 would be 223 tons, there is a significant lifting lapse of approx. 161 tons per day due to insufficient number and type of vehicles. Considering the cultural habits of residents of Mingora and weather conditions it is not possible for keeping daily waste generated at household level till evening for collection. During hot weather conditions there are chances that waste will start rotting.

14. Currently, WSSC Swat is dumping about 27 TPD waste at proposed landfill site on daily basis. This dumping is being carried out by Water and Sanitation Services Company Swat (WSSC Swat) until the commencement of operation of the SWMF. This part of the proposed site, where the dumping is being conducted, will be properly remediated through processing of the existing waste lying on site using latest technological methods with machinery to be brought to site that will process the waste and turn it into an organic form with the possibility to combine it with the other organic waste to be disposed off at the cells of the proposed SWMF. Thus, this existing dumping site, which will be fully remediated and restored in accordance with international good practices, will infact not become one of the cells of the SWMF and thus is not considered an existing facility as per ADB SPS, 2009.

15. Site closure plan for existing dumping, including trenching, gas well network and necessary compactions will be developed and implemented once dumping will be stopped.

16. Previously dumping was initiated at Owgdoo (3 km west of the city), many environmental groups and media platforms have highlighted the gross detrimental effects to public health and environment on this dumping. Water and Sanitation Service Company (WSSC), Swat the body responsible for the city's waste management operations, has since halted this dumping and has been proactively pursing a proper landfill site.

17. Like other cities of Pakistan, in Mingora, solid waste management is never taken into an integrated approach, rather lots of efforts and funds are drooled on individual components and to connect the missing links. There is a need to take an initiative to prepare a transparent roadmap for solid waste management services for cities in Pakistan, which is integrated in nature and addresses all the requirements in a logical manner i.e. storage of waste till its final disposal.

18. Throwing of waste into the running water body, such as stream or a canal, is a common practice and almost all water bodies flowing through the city have been turned into dumping sites. WSSC Swat aims to counter these practices and has deployed containers and litter bins on main roads and streets. Sanitary workers, after sweeping the streets, collect waste in wheelbarrows to their designated waste storage points in the area, usually containers.

19. Proposed installation of primary and secondary Muncipal Solid Waste (MSW) collection systems, and the development of an international standard MSW management facility at Mingora has been designed to address SWM issues of the city.

Project Categorization

20. Based on the initial findings, it was ascertained that certain adverse environmental impacts are expected due to development of the proposed SWMF, and thus the subject project is considered environmentally "A" category as per ADB SPS, 2009. Therefore, an EIA has been conducted.

21. As per guidelines project is falling in Schedule II (G) of IEE/EIA regulation, 2000 and requires that an EIA shall be prepared and submitted to KP EPA for review and necessary approval.

Study Methodology

22. Both secondary and primary data on ambient noise levels and air quality, water resources, flora, fauna and information from the detailed design conducted for this and other projects of similar nature were collected, reviewed, and analyzed. Extensive field visits to the project area were undertaken and key receptors and stakeholders within the project area were identified and consulted.

23. Detailed ambient air quality and noise monitoring at different key receptor points in the project area were conducted. Apart from exceedence in PM_{10} at various locations, all other pollutants are within the applicable 'most stringent' standards/guidelines. The ambient noise levels were also assessed to be generally within the applicable standards/guidelines during the day time while exceedances at various locations were observed during the night time. Furthermore, the ground water quality samples were also assessed to be within the applicable NEQS limits.

24. The significance of impacts from the proposed project were then assessed and for those impacts requiring mitigation, suitable measures were proposed to reduce impacts to within acceptable limits as per local and international applicable regulations. A detailed environmental management and monitoring plan was developed to ensure compliance to the proposed measures during the project development.

Public Consultation Process

25. Public consultations were organized through Focus Group Discussions (FGDs) within local community in the month of May, 2020. Total 3 FGDs were conducted on Solid waste management system Katwaro Maira, Mingora. Information on positive and negative impacts associated with constructional and operational stage and proper mitigation of adverse impacts were shared at these consultations. Consultations were also carried out with institutional stakeholders and scavengers/scrapers involved in handling waste in Mingora city and findings are documented in this EIA report.

Analysis of Alternatives

26. If 'no project' option is triggered, it will result in loss of all positive impacts that will pose on Mingora city; such as eradicating open dumping of solid waste, improving civic services in terms of integrated waste management, removing existing bottlenecks in solid waste management system and improving the aesthetic aspects of the city. If the project is not implemented, urban environmental quality will be further degraded. It also limits the urban development of the area in a sustainable manner.

27. On the other hand, if the project is implemented, it will result in improved SWM system services and improved urban environment quality. Furthermore, project implementation will also create job opportunities during construction and operation thereby improving the socioeconomic condition of the local people and help in improving their quality of life. Thus, the 'no project' option is not a viable option.

28. The three different sites considered were as follows:

- **Owgdoo** - Located roughly 3 km west of the city along the Swat River
- **Katwaro Maira** – Located 4.4 Km southeast of the city
- **Islampur Village** - Located 8-10 Km south of the city

29. The Katwaro Maira site was selected since it fulfilled the detailed site selection criteria that was developed and is already owned by WSSC Swat, which minimizes land

acquisition issues. The social acceptability of the project is enhanced by educating the nearby population on the merits of a sanitary landfill and the robustness of the resettlement plan.

30. Different types of Landfills were also considered such as Sanitary landfill, Bioreactor landfill and Secured landfill. Based on the comparison conducted, the project design consultant suggested to construct a sanitary landfill for Mingora as it is relatively low in cost and requires less technical and operational maintenance as compared to other options.

31. Different landfill construction alternatives were also considered such as Lining, Leachate Collection and Treatment and Gas Collection and Treatment with Flaring proposed for landfill gas management.

32. Other types of alternatives that were considered were technological alternatives for Anaerobic Digestion System, technological alternatives for Material Recovery Facility, Waste Disposal Alternatives along with a comparison of possible treatment options as well as an Economic Aspect Analysis of the different types of landfilling technologies.

Key Rationale of Katwaro Maira SWMF site

- Adequate land area (approx. 10 acres) available at Katwaro Maira which can be used for landfilling for next 10 years.
- Site is accessible from Mingora city via Haji Baba road then Kawtaro Mera Road. Transfer distance is about 4.4 km from National Highway. However there is need of road widening for successful operation at the site.
- Site is located outside areas susceptible to natural or human-induced events or forces capable of impairing the integrity of landfill components.
- Site is falling outside of critical habitats of plants, wildlife and sensitive ecosystems.
- Site is located outside of the 10-year groundwater recharge area for existing or pending water supply development.
- Site is located outside of 100 year flood plain. Seasonal stream is available within 100 meters down gradient of the proposed landfill cell development. Further bottom lining of each landfill cell and leachate collection system ensures that no contamination is entering to this seasonal drain. Surface drainage network has been provided in detail design to avoid risk of surface runoff and contamination. Further retaining wall to limit enterance of water into landfill facility is provided along the boundary of landfill site.
- Ground water table is found at depth of 80-200 ft. NSL. Proposed depth of landfill cell is 10 meter (approximately 33 feet), therefore no impact on ground water is anticipated.
- Site is located outside of seismically active area as it falls in Zone 3 on seismic map of Pakistan. No fault lines or significantly fractured geologic structure is present within 500 meters of the perimeter of the proposed landfill cell development that may allow unpredictable movement of gas or leachate.
- No private and public water supply wells present in the proximity of landfill site...

- Nearest Airport is located at Saidu Sharif at aerial distance of 6.5 Km, however due to hilly terrain no impact on aviation activities due to landfill operations is envisaged.

- Sparsely scattered residential settlements are lying at varying distances around the proximity of the proposed landfill site. There are 03 houses in west, 01 house in south and 02 houses in east side of the landfill site which are very close (falling within 250 m distance from landfill cells as per IFC criteria) and considered as sensitive receptors. It will be ensured that during project execution no sensitive receptor will be residing within 250 m distance from landfill cells subject to willingness of owners.

Baseline Conditions

33. **Physical Environment:** Proposed SWMF site is located in a valley surrounded by hilly patches of loamy soil. Gentle slope exists at the site going south to north has a varied elevation within the Swat area, beginning from 600 meters above sea level in the South and rising rapidly up towards the North, to around 6,000 meters above sea level. The surface soil materials are less deposits, residual mantle on sandstones and shale bedrocks, or narrow strips of silty/loam alleviation along major streams. The soil characteristics vary within the area depending upon the parent material and the soil age. The project is located in the catchment area of the Swat River. There are many hill torrents and streams which collect the rain water run–off or seepage water in the form of springs that ultimately drain into the Swat River.

34. Project area is falling in Zone 3 with peak ground acceleration 0.24-0.32 g. There is one surface runoff natural drain adjacent to site which collect rainfall water and drains down to Swat River during rainfall. Retaining wall is proposed in project design to avoid entrance of runoff in SWMF. Ground water table is found at depth of 80-200 ft. NSL and lab analysis shows that water quality is within NEQS. Ambient noise levels being within the most stringent guidelines during the daytime. Air shed seems to be of good quality and ambient air quality is within the acceptable NEQS with PM_{10} being the only pollutant that is exceeding the guidelines at all monitored locations. Current land use of the project area (2 Km radius for landfill site) shows tree cover (56.4%) followed by crop land (23%), Green cover (16%) and settlements (4.4 %).

35. **Biological Environment:** Project is falling outside environmental sensitive areas (Wildlife park, Wildlife sanctuary, Game Reserve or Protected/Reserved Forests) and critical habitats. The present flora of the cultivated areas around Mingora is exotic. The common trees are Phulai, Honey Mesquite, Ber, Jand, Mulberry, Indian rosewood, Tamarisk and blue gum. The most common shrubs Turmeric, Small red poppy and spear grass.

36. Indian Grey Mongoose, Golden Jackal, Wild Goat, Pheasant, Black-necked Spitting Cobra and Mule are the common fauna of the area.

37. The project area was also screened for ecological sensitivities using the Integrated Biodiversity Assessment Tool (IBAT) with its outputs provided as **Annexure P.** The tool was run for three buffer zones (3, 5 and 10 km). The findings of IBAT were correlated with the primary and secondary data collected as part of the detailed scoping activities conducted during preparation of this study. It was observed that IBAT correctly stated that no protected areas and/or key biodiversity areas are present within these three buffer zones. Furthermore, it stated that within a 50 km area of interest, there are possibly 27 species that are listed in the IUCN Red List, consisting of terrestrial, marine and freshwater species.

38. An official letter from the KPK Wildlife Conservator, confirming that 'Neither wildlife sensitive areas nor corridors for endangered species fall in and around the proposed landfill site' was obtained and is provided as **Annexure R** of this report.

39. **Social Environment:** The project area falls in the jurisdiction of Union Council (UC) Dangram Sangota, Tehsil Babuzai, district Swat in Khyber Pakhtunkhwa province. Project area is primarily rural sub-urbs located at 4.4 Km from city center and can be accessed through Katwaro Maira road. The nearest residential settlements are Kawtaro Maira village, Dangram village, Sherarai village, Alahabad colony, Labor colony, Govt KPK Housing society. These areas consist of small residential colonies with poor road access. The average family size in project area is 8.8. No archaeological and cultural site was observed in close proximity of Mingora landfill site. Yusafzai is the major clan of the project area. Major occupations in the project area are farming, animal rearing, serving park army, operating their own transport and manual labor. Basic civic facilities are available in the settlement or in its vicinity. About eight Acres land for project site has been acquired by KP government which belongs to six landowners for which compensation/resettlement process is in progress in consultation with revenue department, GoKPK.

Potential Major Impacts

40. The screening matrices for the pre-construction, construction and operation phases of the SWMF are provided below as **Tables ES.1, ES.2** and **ES.3**.

41. **Pre-construction/design phase**: The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed, as required, are as follows:

- Improper designing of landfill site leading to various impacts
- Improper selection of landfill site due to non-compliance with IFC guidelines

42. **Construction phase**: The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed, as required, are as follows:

- Improper Construction of landfill not in accordance with finalized design
- Community health and safety issues
- Occupational health and safety issues
- Improper handling and/or disposal of hazardous and non-hazardous waste

43. **Operation phase:** The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed, as required are as follows:

- Generation of Leachate
- Possible Contamination of Soil and Groundwater
- Generation of Landfill Gas
- Generation of Objectionable Odor and impact on air quality

- Attraction of Vermin and disease vector generation
- Occupational Health and Safety
- Wase Collection and Hauling Impacts
- Wind-blown litter
- Closure and Post Closure Impacts

Mitigation Measures

44. Mitigations measures associated with pre-construction, design, operation, closure and post closure phases are detailed in the EIA report. Necessary design considerations has been included for leachate collection and treatment, landfill gas management, odor and vector controls. Mitgiations associated with construction phase are detailed in the EIA report to avoid soil and ground/surface water contamination, OHS issues, social conflicts, vegetation loss and communicable diseases.

45. Mitigations for operation phase are provided to ensure that lechate and landfill gas is managed properly, there would be no waste hauling impacts, traffic issues, wind blown litter, vector spread and air quality problems. Daily cover will be applied to avoid odour and litter issues. Buffer zone through necessary plantation will be developed to improve aesthetic appeal of the area. Project will result in improved waste management services, improved public health and improved aesthetic appeal of the area.

Climate Change Exposure of Landfill Site

46. This includes identification of climate change hazards in the context of potential climate scenarios. For example, precipitation changes can degrade covers of landfill. Moreover, a number of anthropogenic stressors, socio-economic and land-use changes near and around the landfill site in the future may complicate and exacerbate the above-mentioned climate change events and increase exposure of the site. Temperature changes can impact the compositing process and also can impact the decomposition process responsible for leachate production. For example, land-development can affect natural protective barriers.

Climate Change Sensitivity of Landfill Site

47. Likelihood of climate change related hazards are included in sensitivity assessment that could negatively affect the functioning of the Mingora landfill site including direct impacts (accessibility, physical damage, water damage) and indirect impacts (accidental fire, explosion or ecosystem damage). These direct and indirect impacts can affect the landfill site in terms of damage to liner or cover materials, washout of contaminated contents, leachate collection and removal, landfill gas management etc.

48. Based on the Climate Risk and Vulnerability Assessment (CRVA), three aspects of Mingora landfill site are assessed for potential climate change impacts (temperature, precipitation, winds, fire hazard) in terms of exposure and sensitivity: 1) underground components, 2) over-ground components and 3) Site infrastructure and operations

Cumulative Impacts

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

Indirect and Induced Impacts

50. Potential impacts arising from each phase of the proposed Mingora SWM facility has been identified and assessed on the basis of field data, secondary data, expert opinion and examining previous similar projects in Pakistan. These include effects on physical, biological and socio-economic environment. Impacts on the environment from air emissions, traffic and community noise have also been assessed and have found to be acceptable and within the carrying capacities of the environmental media.

51. Thus, negative indirect and induced impacts from the proposed landfill works are not expected.

Institutional Arrangements

52. During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with the Project Director (PD), Project Management Unit (PMU), KP Local Government Election and Rural Development Department (LGE&RDD). The PD through assistance from the Supervision Consultant's Environmental staff and the Environment team of PMU, will supervise the implementation of the proposed mitigation measures and monitor the implementation progress in the field. Monthly environmental monitoring data/reports will be incorporated in the project implementation progress reports to be shared with ADB and such monthly reports will be consolidated into bi-annual monitoring reports and submitted to ADB for review and clearance. Upon clearance, all such reports will be uploaded on the PMU and ADB websites.

Conclusion & Recommendations

53. An action plan with clear roles and responsibilities of stakeholders has been provided in the report. The PMU, Contractors and the Construction Supervision Consultant are the major stakeholders responsible for the action plan. The action plan must be implemented prior to commencement of construction work. In order to execute successful operation of SWMF facility, institutional review and capacity building (IRCB) component is included in the project design to enhance services delivery of WSSC Swat.

54. Mitigation measures will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures in the EMP are implemented and to determine whether the environment is protected as intended. This will include observations on and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported.

55. The majority of the environmental impacts are associated with the operation phase of the project since these will be long term, such as generation of objectionable odor and impact on air quality, Attraction of vermin and disease vector generation, Leachate generation, Possible contamination of soil and groundwater, Generation of Landfill Gas etc., to name a few. These shall be mitigated through necessary measures.

56. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation

measures and procedures. Based on the findings of this EIA study, the classification of the Project as Category ‘A’ is confirmed. It is concluded that the proposed project should proceed, with appropriate mitigation measures and monitoring programs identified in the EIA study.

Table ES-1: Screening of possible Impacts during Design/Pre-Construction Phase

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Improper designing of landfill site leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)	Likely	Moderate	Medium	Long Term
2	Improper selection of landfill site due to non-compliance with IFC guidelines for Landfills	Likely	Moderate	Medium	Long Term
3	Lack of integration of EIA/EMP requirements into Construction bid documents	Likely	Moderate	Medium	Short Term
4	Waste Hauling impacts	Likely	Moderate	Medium	Short Term
5	Contractor's Environmental Safeguards capacity	Likely	Moderate	Medium	Short Term
6	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area	Likely	Moderate	Medium	Short Term
7	Cultural Heritage & Religious Sites, Social Infrastructure	Unlikely	Moderate	Low	No residual Impact
8	Land acquisition and resettlement impacts	Likely	Moderate	Medium	Long Term
9	Impacts due to natural hazards	Likely	Moderate	Medium	Long Term

Critical Risk Level	Significant Risk Level
Medium Risk Level	Low Risk Level

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

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Construction of landfill not in accordance with finalized design	Likely	Major	Medium	Long Term
2	Degradation of air quality due to construction works	Likely	Moderate	Medium	Short Term
3	Potential accidents and injuries to communities in project area during construction works	Likely	Moderate	Medium	Short Term
4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Moderate	Medium	Short Term
5	High noise levels from construction activities	Likely	Moderate	Medium	Short Term
6	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium	Short Term
7	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium	Short Term
8	Soil Erosion and Sedimentation	Likely	Moderate	Medium	Short Term
9	Soil Contamination	Likely	Moderate	Medium	Short Term
10	Employment Conflicts	Likely	Moderate	Medium	Short Term
11	Communicable diseases incl. COVID-19	Likely	Moderate	Medium	Short Term
12	Vegetation and Wildlife Loss	Unlikely	Moderate	Low	No residual Impact
13	Historical/Archaeological Sites	Unlikely	Moderate	Low	No residual Impact
14	Construction of Administeration Building and Other Infrastructure	Likely	Moderate	Medium	Short Term
15	Construction/Widening of Access Road	Likely	Moderate	Medium	Short Term
16	Sexual Abuse, Exploitation and Harrassment (SEAH)	Unlikely	Moderate	Low	No residual Impact

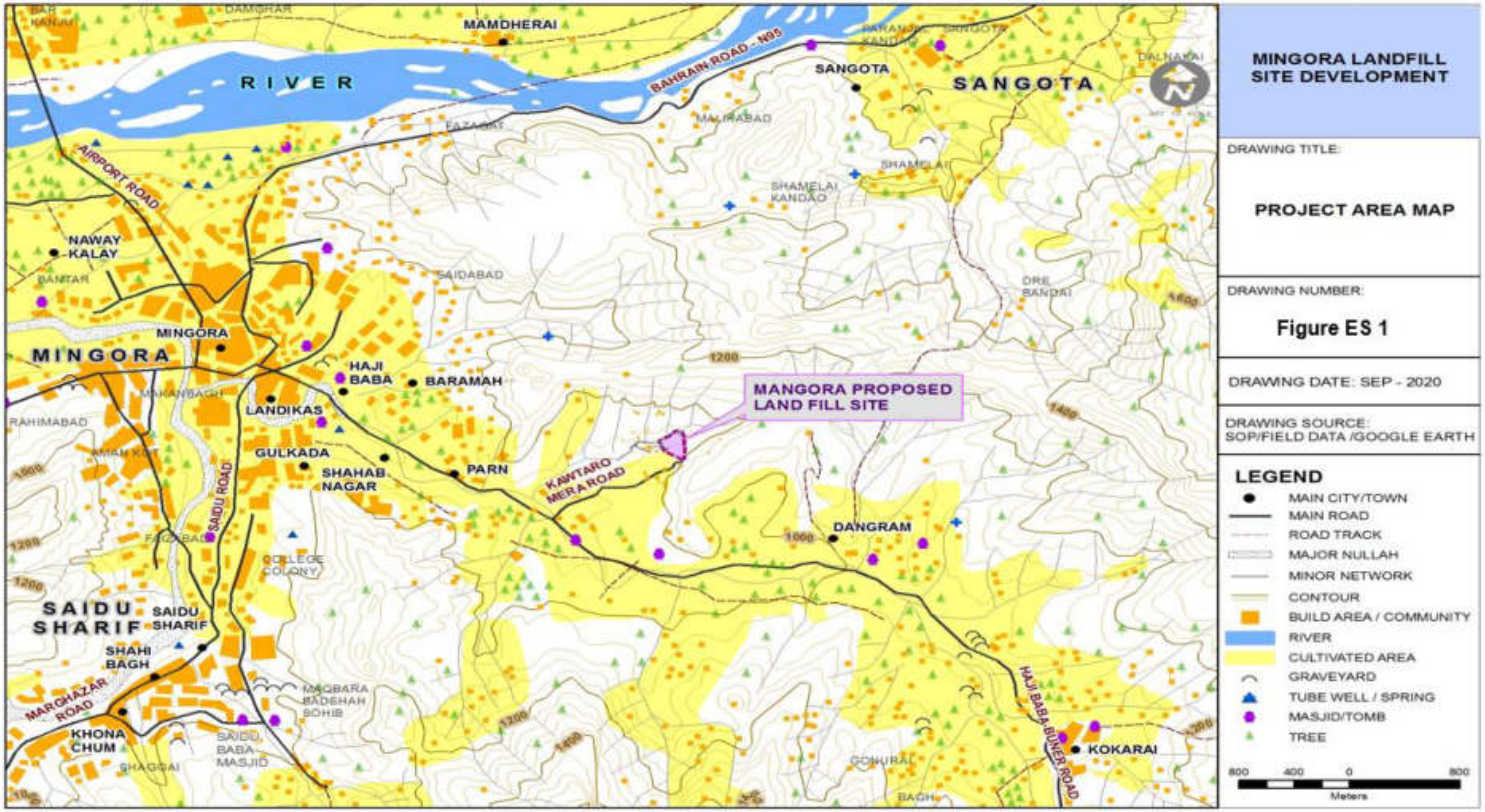
Critical Risk Level	Significant Risk Level
Medium Risk Level	Low Risk Level

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

S/No.	Potential Issues	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Generation of Leachate	Likely	Major	Medium	Long Term
2	Possible Contamination of Soil and Groundwater	Likely	Major	Medium	Long Term
3	Generation of Landfill Gas	Likely	Major	Medium	Long Term
4	Generation of objectionable odor and impact on air quality	Likely	Major	Medium	Long Term
5	Attraction of Vermin and disease vector generation	Likely	Major	Medium	Long Term
6	Occupational Health and Safety	Likely	Major	Medium	Long Term
7	Waste collection and hauling impacts	Likely	Major	Medium	Long Term
8	Wind Blown Litter	Likely	Major	Medium	Long Term
9	Impacts on Scavengers and Waste Pickers	Likely	Major	Medium	Long Term
10	Improved management of solid waste & health and sanitation	Positive impacts expected			Long Term positive residual impact
11	Improvements in Public Health	Positive impacts expected			Long Term positive residual impact
12	Improvements in Aesthetic Impacts	Positive impacts expected			Long Term positive residual impact

Critical Risk Level
Significant Risk Level
Medium Risk Level
Low Risk Level
Positive Impacts

Figure ES 1: Key Map



1 Introduction

1.1 Overview

1. The Khyber Pakhtunkhwa Cities Improvement Projects (KPCIP) will improve the quality of life of the residents of five KP cities, including Abbottabad, Kohat, Mardan, Mingora, and Peshawar, directly benefitting about 6 million of urban population. KPCIP will help selected cities improve their access to quality urban services through three interlinked outputs: (i) Climate resilient and gender friendly urban infrastructure improve, (ii) Institutional capacities of urban service providers and governments strengthened, and (iii) Increased women's participation in urban governance and access to economic opportunities.

2. KPCIP will support the Government of Pakistan's development priorities, established in (i) the National Water Policy (2018), (ii) the Local Government Act (2019), and (iii) Pakistan Vision 2025. The project is also aligned with ADB's operational priorities of (i) addressing remaining poverty and reducing inequalities; (ii) accelerating progress in gender equality; (iii) tracking climate change, building climate and disaster readiness; (iv) making cities more livable; and (v) strengthening governance and institutional capacity, outlined in ADB's Strategy 2030, and is included in ADB's country operations business plan for Pakistan, 2021–2023.

3. The project readiness financing (approved in March 2019) has financed the preparation and engineering design of the KPCIP. The Department of Local Government, Elections and Rural Development Department (LGE&RDD), the Government of Khyber Pakhtunkhwa, will be the executing agency for the project and the city governments of the five target cities, including the respective Water and Sanitation Services Companies, will be the implementing agencies.

4. This report has been prepared based on detailed engineering designs, due diligence assessments, and studies conducted by the government and project readiness financing consultants. The Government of Pakistan, Asian Development Bank (ADB), and Asia Infrastructure Investment Bank (AIIB) are expected to approve KPCIP in Q3 2021.

5. The Khyber Pakhtunkhaw Cities Improvement Project (KPCIP) is be being processed through the Project Readiness Finance (PRF) modality by Asian Development Bank (ADB) under Loan 6016-PAK, being executed by KP LGE&RDD. The Project is focused on investments of subprojects related to water supply, sanitation and drainage, solid waste management, and urban/green spaces. The Project has the following four major components:

- Improvement of water supply systems in five (5) cities.
- Improvement of sewerage and drainage systems in five (5) cities, including provision of sewage treatment plants (STPs)
- Provision of Integrated Solid Waste management (ISWM) system in five (5) cities
- Development of Urban/Green Spaces in five cities.

6. Total daily waste generation of Mingora city is estimated to be 223 tons/day for the year 2021 assuming waste generation rate of 0.42 kg/cap/day for all waste streams i.e. residential, commercial and bulk waste etc. An additional allowance of waste i.e. 25% is accounted for in the above tonnage which is bulk waste. Total waste generation

in Mingora by 2025 is broadly categorized in three types i.e. residential (60%), commercial (15%) and bulk waste (25%) with 10% recyclable including, plastic, metals, papers etc. This translates to roughly 4400 tons/year recyclables, which are currently disposed of in uncontrolled dumps due to absence of formal recycling system resulting in economic loss.

7. Various studies revealed that municipal waste comprises of about 30-40% organic, similarly 30-40% ash and fine particles, 3-7% paper and about 1% of plastic, metal, glass and other small fractions. In the current study, results show overall waste at source level contains 49% green waste, 13% plastic baggies & wrappers 8% non-recyclable paper, 5% recyclable paper, 5% pampers and 5% grass and wood, 4 % textile and rest of the composition container minor fractions of leather and rubber, gals and bottles, plastic recyclables, hairs, bones and sieve.

8. The current practice of open dumping of waste at Katwaro Maira leads to environmental nuisance and public health threats. Further material recovery and recycling often leads to additional littering in streets when rag pickers are rummaging the waste bags and bins. The development of a well-engineered and designed solid waste management facility (SWMF) will ensure that the solid waste generated from Mingora city is managed in accordance with international good practices on solid waste management.

9. This Environmental Impact Assessment (EIA) report focuses solely on the scope of works of the development of the SWMF and assesses any potentially significant impacts and proposes required mitigation measures, which shall be implemented by the Contractor and monitored by the Project Management Unit (PMU), KP Local Government, Elections and Rural Development Department (LGE&RDD) and ADB using the Environmental Management Plan (EMP).

1.2 Project Location

10. The proposed SWMF will be developed at Katwaro Maira, Mingora located at a distance of 4.4 km from the city center and 3.0 km away from National Highway at an elevation of approximately 3050 ft. (990m) above mean sea level (AMSL). The SWMF site is accessible from Mingora city via Haji Baba road then Katwaro Maira Road. The proposed SWMF will be developed on 8.25 acres of vacant land comprising of hilly patches. Mingora Landfill site is accessible through metaled road which is passing from congested and populated areas. For successful operation of Mingora SWMF, there is need of widening of existing road form Highway to proposed site.

11. The total acquired area is about 60.5 Kanals. The surrounding area comprises of a rugged mountainous landscape and features some minimal agricultural land use. There is some sparse residential population located in the vicinity of the project site. Currently, about 27 tons/day waste collected from 09 UCs of Mingora is being dumped on the site. Haphazard open dumping of waste is causing serious environmental and nuisance problems in the project area. Site is accessible through Katwaro Maira road (4.4 Km length) however for successful operation of Mingora SWMF road widening is coverd under the project detail design.

12. Currently, WSSC Swat is dumping about 27 TPD waste at proposed landfill site on daily basis. This dumping is being carried out by Water and Sanitation Services Company Swat (WSSC Swat) until the commencement of operation of the SWMF.

13. This part of the proposed site, where the dumping is being conducted, will be properly remediated through processing of the existing waste lying on site using latest

technological methods with machinery to be brought to site that will process the waste and turn it into an organic form with the possibility to combine it with the other organic waste to be disposed off at the cells of the proposed SWMF. Thus, this existing dumping site, which will be fully remediated and restored in accordance with international good practices, will infact not become one of the cells of the SWMF and thus is not considered an existing facility as per ADB SPS, 2009.

14. Site closure plan for existing dumping including trenching, gas well network and necessary compactions will be developed and implemented once dumpig will be stopped.

15. The key map and the project area map for the proposed SWMF are provided as **Figures 1.1** and **1.2** respectively.

1.3 Environmental Category of Project

16. According to ADB's Safeguard Policy Statement (SPS) 2009, a Rapid Environmental Assessment (REA) Checklist was prepared for the proposed SWMF works (**Annexure A**). The Pakistan Environmental Protection Agency's "Guidelines for the Preparation and Review of Environmental Reports (2000)" were also consulted. As per guidelines, the proposed project is falling in Schedule II (G) and requires an EIA to be prepared and submitted to KP EPA for review and necessary approval.

17. Based on the initial findings, it was ascertained that certain adverse environmental impacts are expected due to development of the proposed SWMF, and thus the subject project is considered environmentally "A" category as per ADB SPS, 2009. Therefore, an EIA has been conducted.

1.4 Objectives of the EIA

18. Following are the objectives of this EIA study:

- Assess the existing environmental conditions of Mingora SWMF area, including the identification of environmental sensitive receptors and develop a baseline of its prevalent environmental and socioeconomic conditions;
- Identify and investigate all impacts of the proposed SWMF pre-construction/design, construction, operation, closure and post closure on the physical, biological and socioeconomic environment of the project area;
- To propose mitigation measures that would help KP LGE&RDD and WSSS Swat in conducting the proposed project activities in an environmentally sustainable manner;
- To uncover the planning and operational phase impacts up to microenvironment levels in which project is proposed to be sited; and
- To develop an Environmental Management Plan (EMP) that would assist KP LGE&RDD and WSSC Swat in the effective implementation of the recommendations of the EIA.

1.5 EIA Team

19. The EIA study team comprised of following experts.

- Environment Specialists by ADB, PMU KP LGE&RDD and EDCM
- Environmental associate
- SWM expert
- IWMS design experts
- Integrated Environmental Laboratory
- Climate change expert
- Social Safeguard Expert
- Social safeguard team of EDCM
- Gender Expert
- ADB and PMU technical team

1.6 Methodology of EIA Study

20. The following methodology was employed for this EIA:

1.6.1 Understanding of the Proposed Operation

21. This involved collecting information from the ADB, PMU KP LGREDD and Engineering Design and Construction Management technical team on the proposed project activities and understanding the activities to identify potential impacts of implementing them.

1.6.2 Review of Legislation and Guidelines

22. National legislation, international agreements, environmental guidelines both of KP EPA, and ADB, and best industry practices have been reviewed to set environmental standards that KP LGREDD as the Implementing Agency will adhere to during implementation of the project.

1.6.3 Secondary Data Collection

23. Available published and unpublished information pertaining to the background environment has been obtained and reviewed. All data sources have been carefully reviewed to collect the following information:

- **Physical environment** – topography, geology, seismology, geomorphology, soils, surface and groundwater resources and climate;
- **Biological environment** – habitat types, flora and fauna (particularly rare or endangered species), critical habitats, vegetation and communities within the area;

- **Physical cultural resources** – sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance; and,

- **Socio-economic environment** – settlements, socio-economic conditions, infrastructure and land use.

1.6.4 Field Data Collection (Baseline Survey)

24. Field visits were undertaken consisting of preliminary scoping through survey and assessment activities to establish the potential impacts and categorization of activities and the Rapid Environmental Assessment (REA) Checklist was completed. The key receptors and stakeholders within the project area were identified.

25. Baseline surveys required to identify and establish physical and biological conditions and ecosystems in the project area has been carried out by EIA team and results has been incorporated in this report. The socio-economic environment in the project areas has been obtained through the socio-economic profiles and social impact assessment carried out by social safeguard team. Climate risk and vulnerability assessment findings have also been presented and discussed.

26. Primary data collection in a two kilometre area of influence, such as ambient noise levels, ambient air quality and ground water quality at the key receptor locations in the project area and particularly in close proximity to the project site was conducted.

27. Review of secondary information on the physical, biological and ecological aspects, physical cultural resources and infrastructure utilities in the Peshawar SWMF area was conducted.

1.6.5 Public Consultations

28. Public consultations (PC) were carried out with all key stakeholders, particularly local communities residing in the project area, local businesses and government and local government bodies in line with ADB's "Safeguard Policy Statement (SPS) – June 2009"/ Environmental Assessment Guidelines. Under ADB requirements, the environmental assessment process must also include meaningful public consultations during the completion of the study. In this EIA study, the public consultation process was carried out including verbal disclosure regarding the project development with stakeholders to brief them about project and to seek their response/recommendation.

1.6.6 Impacts Identification and Assessment

29. Potential impacts arising from each phase of the proposed project have been identified and assessed on the basis of field data, secondary data, expert opinions and examining previous similar projects in Pakistan. These include effects on physical, biological and socio-economic environment.

1.6.7 Recommendations for Mitigation Measures

30. Mitigation measures to minimize, eliminate or compensate the potential environmental impacts has been recommended. The mitigation measures has been recommended on the basis of past experiences, best industry practices, legislative requirements and professional judgement.

1.6.8 Development of Environmental Management Plan (EMP)

31. An Environmental Management Plan (EMP) has been developed for effective implementation of the recommended mitigation measures. The EMP includes controls to minimize the identified impacts and monitoring program to monitor effect of mitigation measures implemented and residual impacts, if any, during implementation. The EMP has identified roles and responsibilities of all concerned parties during the implementation of the project.

1.7 Proponent of Project

32. The LGE&RDD, GoKP is the Executing Agency (EA) for this SWMF development while the project will be implemented through Water and Sanitation Services Company (WSSC), Swat with support from PMU.

33. Contact details of the EA are provided as **Table 1.1** below.

Table 1.1: Executing Agency Contact Details

Executing Agency Details	Information
Name of EA	Project Management Unit, Local Government, Elections and Rural Development Department (LGE&RDD), GoKP
Address	Ground Floor, Afzal Apartments, Jamrud Road, Phase-3 Chowk, Hyatabad Peshawar
Telephone	0092-91-5854555
E-mail	pdkpcip@gmail.com, info@kpcip.gov.pk
Web	Kpcip.gov.pk

1.8 Structure of the Report

34. The EIA report contains eleven chapters as follows:

- Introduction
- Policy and Legal Framework
- Description of the Project
- Description of Environment
- Analysis of Alternatives
- Assessment of Environmental Impacts and Mitigation Measures
- Institutional Requirements Environmental Management Plan
- Public Consultation
- Grievance Redressal Mechanism
- Findings, Recommendations and Conclusions

- References

1.9 Further Additions & Updating of EIA Study

35. This version of the report will be further updated once the detailed design is completed and any other details of the proposed SWMF become available over the coming weeks and months. These revisions shall be incorporated into any subsequent updated versions of this EIA report.

Figure 1-1: Key Map

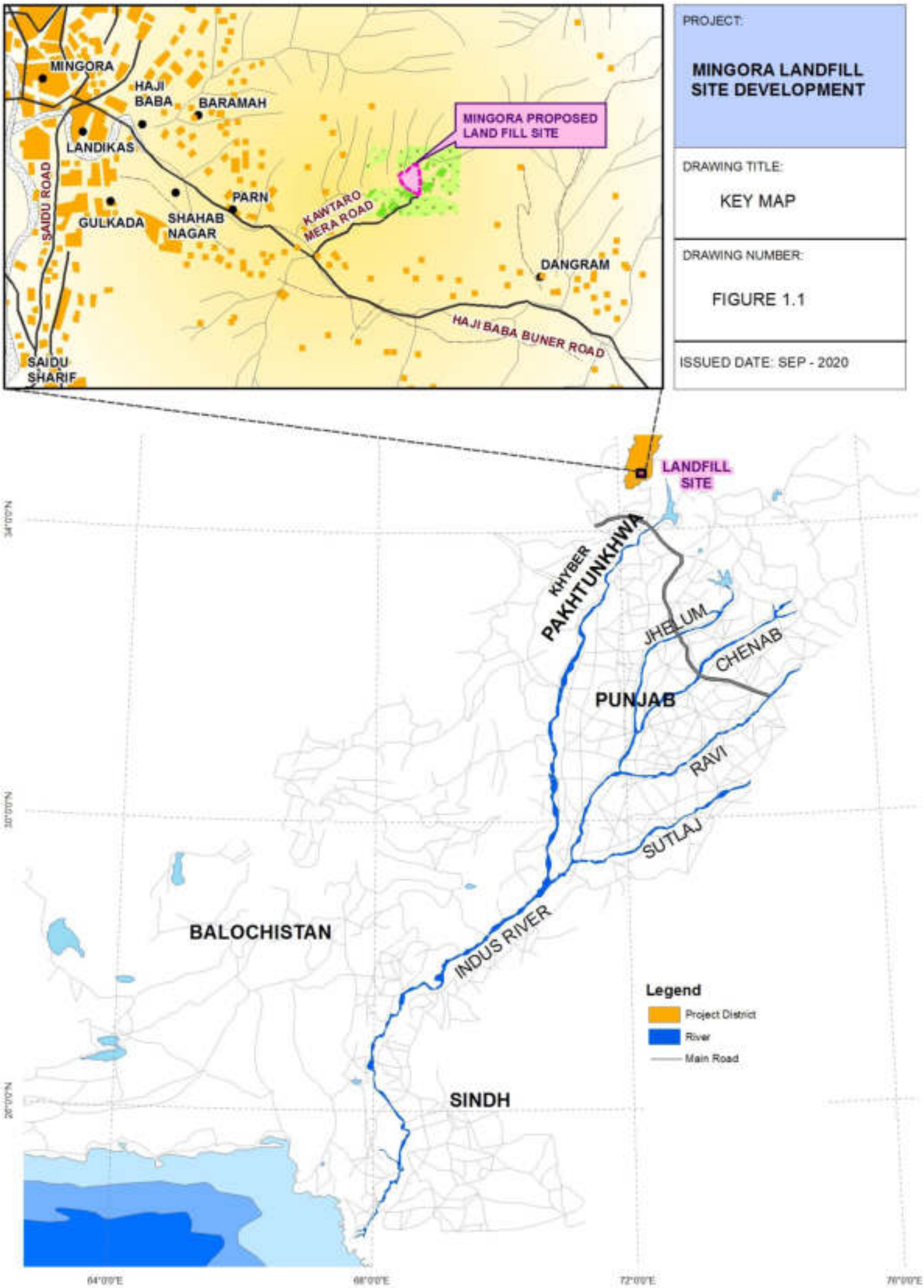
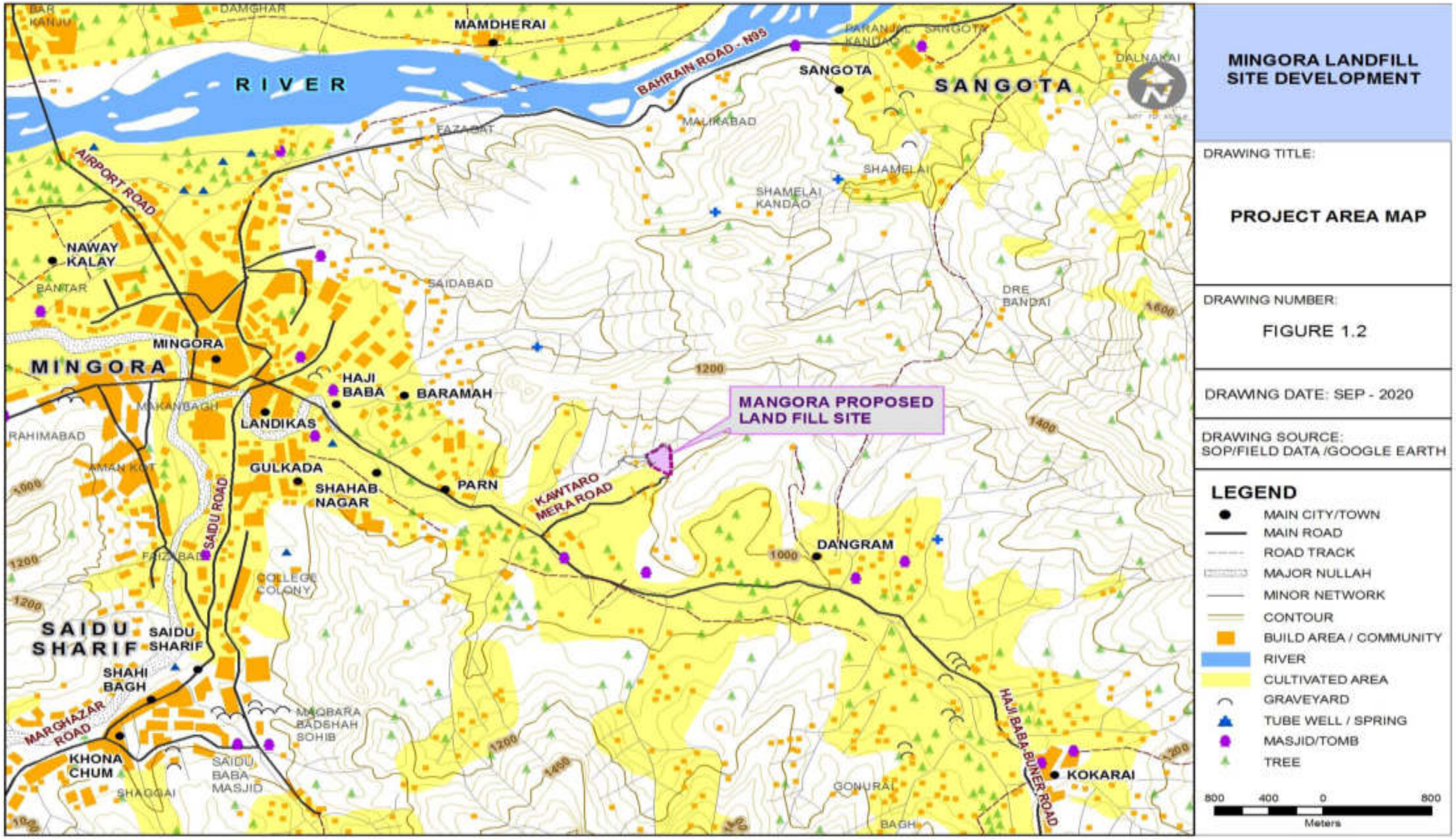

MINGORA
HAJI BABA
BARAMAH
LANDIKAS
SAIDU ROAD
GULKADA
SHAHAB NAGAR
PARN
KAWTARO MERA ROAD
MINGORA PROPOSED LAND FILL SITE
DANGRAM
HAJI BABA BUNER ROAD
SAIDU SHARIF
PROJECT:
MINGORA LANDFILL SITE DEVELOPMENT
DRAWING TITLE:
KEY MAP
DRAWING NUMBER:
FIGURE 1.1
ISSUED DATE: SEP - 2020
LANDFILL SITE
KHYBER PAKHTUNKHWA
JHELUM
CHENAB
PUNJAB
RAVI
SUTLAJ
INDUS RIVER
BALOCHISTAN
SINDH
Legend
Project District
River
Main Road

Figure 1-2: Project Area Map



2 Policy and Legal Framework

2.1 General

36. This section provides an overview of the policy framework and national legislation that applies to the proposed SWMF development at Katwaro Maira, just off Haji Baba-Buner Road a few kilometers southeast of the city. The project will comply with all national legislation relating to the environment in Pakistan and will obtain all the regulatory clearances required from the financing agency, ADB.

2.2 National Policy and Legal Framework

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

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

2.3 Regulations for Environmental Assessment, Pakistan EPA

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

2.4 Regulatory Clearances, KP EPA

40. In accordance with provincial regulatory requirements, an IEE/EIA satisfying the requirements of the KP Environmental Protection Act (2014) is to be submitted to KP environmental protection agency (KP-EPA) for review and approval, and subsequent issuance of NOC before the commencement of construction.

41. As per guidelines project is falling in Schedule II (G) of IEE/EIA regulations, 2000 and requires that an EIA shall be prepared and submitted to KP EPA for review and necessary approval.

2.5 Guidelines for Environmental Assessment, Pakistan EPA

42. The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of

development projects. The guidelines that are relevant to the proposed sub-project are listed below:

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

2.6 National Environmental Quality Standards (NEQS) 2000 & 2010

43. The National Environmental Quality Standards (NEQS), 2000 and 2010, specify the following standards:

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

44. NEQS are attached as **Annexure L**.

2.7 Other Environment Related Legislations

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

Table 2.1: Environmental Guidelines and Regulations

Legislation/Guideline	Description
National Environmental Policy (2005) (NEP)	NEP is the primary policy of Government of Pakistan addressing environmental issues. The broad Goal of NEP is, “to protect, conserve and restore Pakistan’s environment in order to improve the quality of life of the citizens through sustainable development”. The NEP identifies a set of sectoral and cross-sectoral guidelines to achieve its goal of sustainable development. It also suggests various policy instruments to overcome the environmental problems throughout the country.
The Forest Act (1927)	The Act empowers the provincial forest departments to declare any forest area as reserved or protected. It empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and topping of trees, branches in reserved and protected forests. No protected forest is situated in the project area for the development of the SWMF.
Khyber Pakhtunkhwa Wildlife and Biodiversity Act, 2015	It empowers the government to declare certain areas reserved for the protection of wildlife and control activities within in these areas. It also provides protection to endangered species of wildlife. As no activities

Legislation/Guideline	Description
	are planned in these areas, no provision of this law is applicable to the proposed project.
The KP Antiquities Act (2016)	It ensures the protection, preservation, development and maintenance of antiquities in the province of KP. 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 GoKP 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, GoKP, any archaeological discovery made during the course of the project. However, if any archaeological antiquity discovered Archeological Chance Find procedure shall be adopted. Archeological Chance Find procedure has been attached as **Annexure G**.
Pakistan Penal Code (1860)	It authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.
NATIONAL ENVIRONMENTAL AND CONSERVATION STRATEGIES	
National Conservation Strategy	Before the approval of NEP, the National Conservation Strategy (NCS) was considered as the Government’s primary policy document on national environmental issues. At the moment, this strategy just exists as a national conservation program. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas.
Biodiversity Action Plan	The plan recognizes IEE/EIA as an effective tool for identifying and assessing the effects of a proposed operation on biodiversity.
INTERNATIONAL CONVENTIONS	
The Convention on Conservation of Migratory Species of Wild Animals (1981.21)	The Convention requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties are also required to promote or cooperate with other countries in matters of research on migratory species. There are no endangered species of plant life or animal life in the vicinity of the proposed project areas for the landfill works.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	The convention requires Pakistan to impose strict regulation (including penalization, confiscation of the specimen) regarding trade of all species threatened with extinction or that may become so, in order not to endanger their survival further.
International Union for Conservation of Nature	Lists wildlife species experiencing various levels of threats internationally. Some of the species indicated in the IUCN red list are also present in the wetlands of Pakistan.

Legislation/Guideline	Description
and Natural Resources Red List (2000)	

2.8 Implications of national policies and regulations on proposed project

46. The Pak-EPA formulated regulations in 2000 for 'Review of IEE and EIA' which categorise development projects under three schedules-Schedules I, II and III. Projects are classified on the basis of expected degree and magnitude of environmental impacts and the level of environmental assessment required is determined from the schedule under which the project is categorised.

47. The projects listed in Schedule-I include those where the range of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. Schedule-I projects require an IEE to be conducted, rather than a full-fledged EIA, provided that the project is not located in an environmentally sensitive area.

48. The projects listed in Schedule-II are generally major projects and have the potential to affect a large number of people in addition to significant adverse environmental impacts. The impacts of projects included in Schedule-II may be irreversible and could lead to significant changes in land use and the social, physical and biological environments. The proposed SWMF development project has been categorized as Schedule II (G) and requires an EIA.

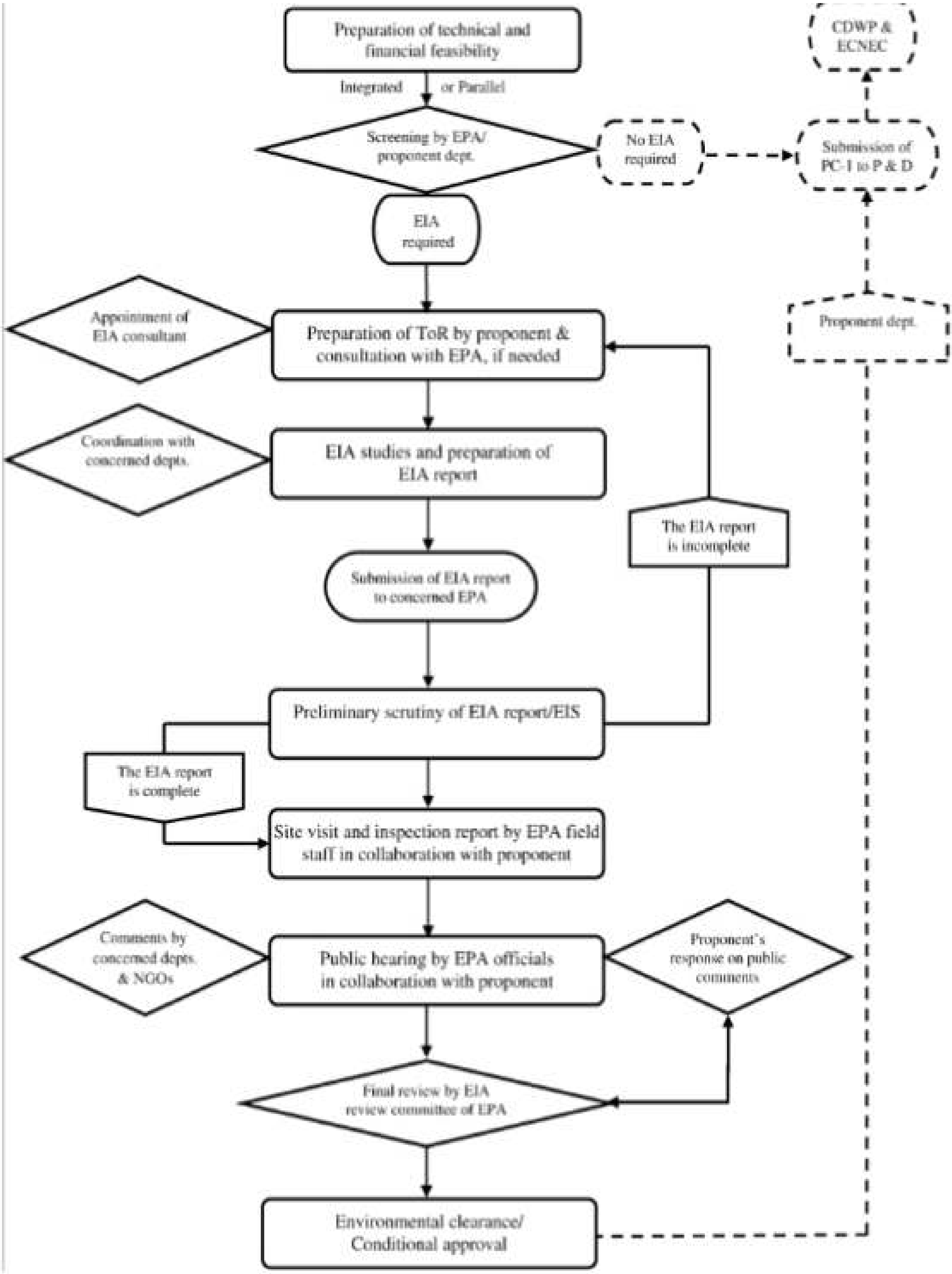
49. The LGE&RDD, GoKP, being the Executing Agency for the Project is responsible for management of project impacts, and have to undertake the commitments and mitigation measures proposed in this environmental report and in the subsequent review and approval conditions.

50. According to the regulations, no construction, preliminary or otherwise, relating to the project shall be undertaken until and unless approval of the EIA report has been issued by the KP EPA.

51. The LGE&RDD will submit the EIA Report on a prescribed application along with the processing fee to KP EPA. After submission of the EIA report, a thirty (30) day period for public comments will be provided. The assessment will be completed within a period of one hundred and twenty (120) days from receipt of the complete documents, and earlier than this wherever practicable. Following the completion of public hearing, if required, and the provision of any further data from the proponent, the decision shall be made and conveyed after thirty days thereafter.

52. The EIA approval process as per environmental legislation applicable in Pakistan is summarized in **Figure 2.1** below.

Figure 2-1: EIA Review and Approval Process of Pakistan EPAs



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

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

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

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

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

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

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

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

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

2.11 ADB's Accountability Mechanism Policy 2012

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

2.12 Implications of ADB's safeguard policies on proposed project

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

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

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

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

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

Table 2.2: ADB Policy Principles

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

No.	Policy principle	Summary
7	Environmental management plan	Implement the EMP and monitor its effectiveness. Document monitoring results and disclose monitoring reports.
8	Biodiversity	Do not implement project activities in areas of critical habitats.
9	Pollution prevention	Apply pollution prevention and control technologies and practices consistent with international good practices. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges. Avoid the use of hazardous materials subject to international bans or phase-out.
10	Occupational health and safety/Community safety.	Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities
11	Physical cultural resources	Conserve physical cultural resources and avoid destroying or damaging them. Provide for the use of “chance find” procedures.

64. The basic environmental assessment requirements for Category ‘A’ projects are provided in **Table 2.3** below.

Table 2.3: ADB Environmental Assessment Requirements for Category ‘A’ projects

Aspect	Environmental Assessment & Management Requirements
Project processing	
Reporting	▪ Prepare full-scale environmental impact assessment (EIA)
Public consultations	▪ Conduct consultations at the early stage of EIA field work and when the draft EIA report is available during project preparation, and before project appraisal by ADB.
Disclosure of environmental assessment report	▪ Disclose draft environmental impact assessment reports at least 120 days before Board consideration.
Project implementation	
Reporting	▪ Submit semiannual reports during project construction, and annual reports during project operation to ADB for disclosure.

2.13 IFC Sector Specific Guidelines on Solid Waste Management[1]

65. The IFC guidelines provide guidance with regards to development and operation of SWM sites. In terms of site selection of the landfill site, these guidelines require the location of the landfill to take into account potential impacts associated with releases of polluting substances, including the following:

- Proximity to residential, recreation, agricultural, natural protected areas, or wildlife habitat and areas prone to scavenging wildlife, as well as other potentially incompatible land uses:
  - Residential development should be typically farther than 250 meters from the perimeter of the proposed landfill cell development to minimize the potential for migration of underground gaseous emissions;
  - Visual impacts should be minimized by evaluating locational alternatives;
  - Siting should be further than 3 km of a turbojet airport and 1.6 km of a piston-type airport or as permitted by the aviation authority fully considering potential threats to air safety due to attraction and presence of birds;
- Proximity and use of groundwater and surface water resources:
  - Private or public drinking, irrigation, or livestock water supply wells located down gradient of the landfill boundaries should be farther than 500 meters from the site perimeter, unless alternative water supply sources are readily and economically available and their development is acceptable to regulatory authorities and local communities;
  - Areas within the landfill boundaries should be located outside of the 10-year groundwater recharge area for existing or pending water supply development;
  - Perennial stream should not be located within 300 meters down gradient of the proposed landfill cell development, unless diversion, culverting or channeling is economically and environmentally feasible to protect the stream from potential contamination;
- Site geology and hydrogeology:
  - Landfills should be located in gently sloped topography, amenable to development using the cell (bund) method), with slopes which minimize the need for earthmoving to obtain the correct leachate drainage slope of about 2%;
  - Groundwater's seasonally high table level (i.e. 10 year high) should be at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development;
  - Suitable soil cover material should be available on-site 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 operation).

[1] https://www.ifc.org/wps/wcm/connect/5b05bf0e-1726-42b1-b7c9-33c7b46ddda8/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&CVID=jqeDbH3

Preferably, the site would have adequate soil to also meet required cover needs (usually a minimum of 15 cm depth of soil)[2].

- Potential threats to landfill site integrity from natural hazards such as floods, landslides, and earthquakes:
  - Landfills should be sited outside of a floodplain subject to 10-year floods and, if within areas subject to a 100- year flood, amenable to an economic design which would eliminate the potential for washout;
  - There should be no significant seismic risk 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 should be adjusted accordingly to prevent failure in the event of seismic activity;
  - No fault lines or significantly fractured geologic structure should be present within 500 meters of the perimeter of the proposed landfill cell development which would allow unpredictable movement of gas or leachate;
  - There should be no underlying limestone, carbonate, fissured or 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 groundwater.

66. All the guidelines mentioned above with regards to site selection for the landfill site have been taken into consideration while finalization of the site for the landfill development.

67. The IFC guidelines also provide guidance on the operational aspects of landfill sites, such as measures to prevent, minimize and control leachate generation, groundwater and leachate monitoring, measures for controlling of landfill gas emissions, controlling of dust and odor emissions from landfill site, measures for controlling dispersal of litter along with closure and post closure activities.

2.14 Comparison of International and Local Environmental Legislations

68. The ADB SPS, 2009 requires application of pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards. The SPS states that when host country regulations differ from these standards, the EA will achieve whichever is more stringent.

69. In order to select the most stringent standards applicable, a mix of local (NEQS) and international (IFC) regulations have been selected. The IFC Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines and Environmental standards are also applicable. It shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the project area.

70. The **Table 2.4** 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

[2] Daily cover needs can be alternatively met by using removable tarps, other relatively inert materials (i.e., compost residuals), or by removing the previously laid daily soil cover at the start of each day for reuse at the end of the same day.

result in an increase of more than 3 dB over existing ambient noise levels at the nearest receptor location off-site.

71. A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 2.5** below. In the case of most pollutants, the Pak NEQS standards for ambient air quality are more stringent in comparison to USEPA and WHO/IFC standards. The applicable and most stringent parameters for each respective pollutant are highlighted in green.

72. Similar to the standards for air quality, the comparison of noise standards provided in **Table 2.6** clearly shows that the Pakistan NEQS standards for noise are more stringent in comparison to the IFC standards. The only exception is the daytime noise level standard for Industrial areas where the IFC standard is more stringent (70 dB (A)) in comparison to NEQS (75 dB (A)) and so for this particular parameter, the IFC standard will be used. Apart from this one exception, the NEQS standards have been used for the proposed landfill development project.

73. Comparision of international and local water quality standards is provided as **Table 2.7.**

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

Table 2.4: IFC Work Environment Noise limits

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

Table 2.5: Comparison of International and local Air Quality Standards*

Pollutants	USEPA		WHO/IFC		Pak. NEQS	
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard
SO_2	3 hrs. 1 hr.	0.5 ppm 75 ppb	24 hr 10 min	20 ug/m³ 500 ug/m³	Annual Mean 24 hrs	80 ug/m³ 120 ug/m³
CO	8 hrs 1 hr	9 ppm (11 mg/m³) 35 ppm (43 mg/m³)	-	-	8 hrs 1 hr	5 mg/m³ 10 mg/m³
NO_2	Annual Mean 1 hr	100 ug/m³ (53 ppb) 100 ppb	1 yr 1 hr	40 ug/m³ 200 ug/m³	Annual Mean 24 hrs	40 ug/m³ 80 ug/m³
O_3	8 hrs	0.07ppm (148 ug/m³)	8 hrs	100 ug/m³	1 hr	130 ug/m³
TSP	-	-	-	-	Annual Mean 24 hrs	360 ug/m³ 500 ug/m³
PM_{10}	24 hrs	150 ug/m³	1 yr 24 hr	20 ug/m³ 50 ug/m³	Annual Mean 24 hrs	120 ug/m³ 150 ug/m³
$PM_{2.5}$	Annual Mean 24 hrs	15 ug/m³ 35 ug/m³	1 yr 24 hr	10 ug/m³ 25 ug/m³	Annual Average 24 hrs	15 ug/m³ 35 ug/m³ 15 ug/m³

					1 hr	

*: The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.
* In instances where the airshed is significantly degraded and the pollutant levels are already exceeding the ambient pollutant concentrations provided in the table above, it shall be ensured that the project activities cause as small an increase in pollution levels as feasible, and amounts to a fraction of the applicable short term and annual average air quality guidelines or standards as established in the project specific environmental assessment.

Table 2.6: Comparison of International and Local Noise Standards

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

*: The standards highlighted in green for each respective Area/Zone are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.
* In instances where baseline noise levels are already exceeding the standards above, it will need to be ensured that the project activities do not cause an increment of more than 3 dB (A) from the baseline noise levels.

Table 2.7: Comparison of International and Local Water Quality Standards

Parameter	Unit	NEQS	WHO/IFC
Bacterial			
E-Coli	numbers/ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
Total Coliform	numbers/ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
Physical			
Color	TCU	≤ 15 TCU	-
Taste	No objectionable/Acceptable	-	-
Odor	No objectionable/Acceptable	-	-
Turbidity	NTU	< 5 NTU	
Total Hardness	mg/l	< 500 mg/l	
TDS	mg/l	< 1000	
pH		6.5-8.5	
Chemical			
Aluminum	mg/l	≤0.005 (P)	0.2
Antimony	mg/l	≤0.005 (P)	<0.005 (P)

Arsenic	mg/l	≤0.005 (P)	0.01
Barium	mg/l	0.7	0.3
Boron	mg/l	0.3	0.3
Cadmium	mg/l	0.01	0.0003
Chloride	mg/l	<250	250
Chromium	mg/l	≤0.05	0.05
Copper	mg/l	2	2
Cyanide	mg/l	≤0.05	0.07
Fluoride	mg/l	<1.5	1.5
Lead	mg/l	≤0.05	0.01
Manganese	mg/l	≤0.5	0.5
Mercury	mg/l	≤0.0001	0.0001
Nickel	mg/l	≤0.02	0.02
Nitrate	mg/l	≤50	50
Nitrite	mg/l	≤3	-
Selenium	mg/l	0.01	0.01
Residual Chlorine	mg/l	0.2-0.5 at consumer end	-
Zinc	mg/l	5	3

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

3 Project Description

75. The proposed Integrated Waste Management System (IWMS) has the following two main components:

- **Component 1**: Improvement of existing waste collection & transport system in Mingora City
- **Component 2:** SWMF Development & Operation

76. The IWMS within Mingora city is crucial for successful operation of the SWMF as it provides strategic approach to sustainable management of solid waste covering all sources and all aspects, including generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency. The operational protocols and modalities of the IWMS have been established to improve environmentally sound practices with respect to waste management and attempting to close existing bottlenecks in the system.

77. The development of the proposed SWMF is designed to support the WSSC Swat and other involved agencies, so as to completely transform the SWM system in Mingora., The project includes institutional strengthening of WSSCS, installation/upgradation of primary and secondary Municipal Solid Waste (MSW) collection systems and the development of an international standard MSW management facility that will accommodate Mingora's MSW for at least 10 years.

78. The Component 1 is an existing activity that is proposed to be further enhanced and improved in terms of its operational efficacy. On the other hand, the proposed Component 2 is the environmentally sensitive proposed intervention and thus this EIA report focuses on this particular Component.

79. The proposed Component 2 consists of the development of a well-engineered and designed solid waste management facility (SWMF) which will ensure the solid waste generated from Mingora city is managed in accordance with international good practices on solid waste management.

80. Waste composition of Mingora at source level contains 49% green waste, 13% plastic bags & wrappers, 8% non-recyclable paper, 5% recyclable paper, 5% pampers and 5% grass and wood, 4 % textile and rest of the composition contain minor fractions of leather and rubber, glass and bottles, plastic recyclables, hairs, bones and sieve. The inorganic collected will be used as Refuse Derived Fuel (RDF), while organic component, plus the animal waste and organic kitchen waste will be used for preparing compost. This would significantly reduce the spatial requirements of the landfill and increase its useful life.

3.1 Component 1: Waste Collection & Transport to SWMF

81. The operational modalities devised for successful implementation of this component are provided below.

3.1.1 Existing and proposed waste collection system in Mingora

82. The existing system of SWM by the Water and Sanitation Services Company Swat (WSSC Swat) is a continuation of the traditional system that was being managed by the Tehsil Municipal Administration (TMAs). Equipment used for waste collection includes the collection bins, containers, trucks, trolleys, compactors and transfer

station containers. The **Table 3.1** below details the waste generation area and mode of waste collection and proposed improved practice for IWMS for Mingora city.

Table 3.1: Modes of Waste Collection

Waste Generation Area	Mode of Collection	Existing Practice	Proposed Improvements in existing practices
Residential Units	Door to door collection using compactors, mini dumper, motorcycle rickshaws or handcart depending on accessibility.	Information about timing of waste collection is provided to residents. WSSC Swat complaint number and area supervisors' contact details are publically available.	Awareness among general public to encourage door to door collection of solid waste is proposed.
Commercial areas	Placing of communal bins or containers for large commercial area Door to door collection for business in residential area	Optimized timing of waste collection vis-a-vis commercial activities	Underground bins are proposed where containers cannot be placed due to congestion and less space. Waste segregation at source particularly in commercial areas and institutional buildings is proposed. Periodic awareness campaigns by WSSC Swat with respect to waste segregation in commercial areas and institutional buildings are proposed. It is proposed that WSSC Swat shall support/facilitate commercial markets committees and institutes in developing color coded waste collection system to promote segregation at the source.

Waste Generation Area	Mode of Collection	Existing Practice	Proposed Improvements in existing practices
Construction Demolition Waste	Construction waste is collected through use of special vehicles usually dump trucks along with loader	WSSC Swat is collecting waste free of charge.	Protocols for builders to pay for debris removals are proposed.
Animal Waste	No organized mode of collection is available.	WSSC Swat is collecting waste through use of special vehicle.	Organized waste collection system of animal waste is proposed as this waste can be used for composting.
Institutional Waste	Communal storage outside premises	WSSC Swat is collecting waste from communal containers.	Placing of appropriate containers within premises of institutes by WSSC Swat is proposed. Such container will be emptied by WSSC at regular interval.
Hospital Waste	Communal storage within premises	Non-hazardous municipal waste is being collected by WSSC Swat. Infectious waste is being mixed with municipal waste by healthcare facilities.	Treatment of infectious waste within hospital premises is proposed to avoid its reach at landfill site.

Figure 3-1: Modes of Waste collections in Mingora

	
Waste collection fleet	Tractor and Dumper
	
Tipping vehicle owned by WSSC Swat	Medium tipper

83. The **Table 3.2** below provides the audit findings that was conducted to assess the existing activities being conducted from an environmental and social safeguards perspective and the required corrective measures that will be implemented.

Table 3.2: Audit of Exsiting Facility and required corrective actions

S/No.	Component	Existing Practice	Required Corrective Action
1	**Storage of waste at source**	▪ Lack of public awareness, motivation, and education ▪ Lack of civic sense and bad habits of people to litter ▪ Lack of cooperation from households, trade, and commerce ▪ Lack of litter bins in the city ▪ Long distance between community bin ▪ Resistance to change the public attitude	▪ Door to Door collection will reduce littering in the streets ▪ Strong behavior change communication programs will improve citizen's behavior. ▪ Removal of roadside communal bins would have a major impact on the street environs.
2	**Segregation of recyclables**	▪ Lack of wide publicity through electronic and print media ▪ Lack of public awareness and motivation, resulting in poor response from citizens ▪ Lack of citizens' understanding how to use separate bins for storage of recyclables ▪ Lack of sufficient knowledge of benefits of segregation ▪ Lack of cooperation and negative attitude of people ▪ Lack of finances to create awareness ▪ Difficulty of educating scavengers ▪ Absence of by-laws	▪ Segregation and materials recovery facilities will be developed at the transfer stations & /or at the LFS; ▪ Refuse Derived Fuel (RDF), facility shall be made part of the MRF; ▪ Organic component of waste shall be converted to organic compost; ▪ In the medium term (3rd year onwards), efforts will be made to encourage segregation at source, with a 2-bin system.
3	**Collection**	▪ Citizens throw waste on streets instead of communal bins. ▪ Workers need to collect all scattered waste manually. ▪ Multiple transactions of waste till disposal site ▪ Lack of awareness and motivation ▪ Unavailability of adequate primary collection vehicles like mini tippers, handcarts etc. ▪ Insufficient response from citizens	▪ Improved citizens behavior throw communication programs would encourage better management of waste; ▪ Collection vehicles pool will be suited to door to door collection; ▪ All collection staff will have PEP, in order to safeguard their health and safety; ▪ Citizens will hold the key to accountability, to ensure that the daily door to door collection is performed.
4	**Daily sweeping of streets**	▪ 100% manual sweeping system makes difficult for the sanitary workers to cover WSSP jurisdiction each day. ▪ Manual attendance management system is inefficient and leads to inefficiencies.	▪ With full Door to Door collection, the need for daily sweeping of all streets would be minimized to max twice a week; ▪ Focus will be on outcome-based indicators and not running after the workers attendance.

		▪ Unavailability of workers on Sundays and public holidays	▪ No need to sweep on Sundays.
5	**Communal Storage**	▪ Shortage of containers ▪ Lack of financial resources leading to broken and ill maintained bins; ▪ Lack of planning for waste storage depots or temporary storage locations; ▪ Inaccessible areas and narrow lanes that do not allow sufficient space for container	▪ All unnecessary communal storage points in residential areas shall be removed. ▪ No containers, no throwing by households into the streets; ▪ Only commercial areas and institutions will have communal bins; ▪ User charges will be levied to induce financial sustainability.
6	**Transportation & Transfer Stations**	▪ Many open vehicles for transport ▪ Old vehicles that are difficult to replace ▪ No route planning ▪ No scheduling for lifting of containers ▪ Lack of or no transfer stations	▪ Waste will be carried out in fully covered vehicles, in order to avoid any littering and pollution. ▪ Number of vehicles will be minimized, with transfer stations and larger hauling containers. ▪ Environment friendly transfer facilities with dust & odor control.
7	**Waste Treatment**	▪ Hardly any waste treatment in the formal sector ¯ Lack of technical know-how for a scaled-up treatment facility ▪ Lack of institutional capacity ¯ No success story in the country	▪ Materials Recovery Facility (MRF) will be an integral component of the treatment and disposal system. ▪ Options for Private sector participation will be explored in operations of the MRF centers. ▪ Specialized skilled workers will be operating the transfer stations, and MRF.
8	**Disposal of Waste**	▪ Lack of financial resources for a scientifically designed land fill site; ▪ Lack of technical personnel for LFS management; ▪ Lack of technical know-how for scientific disposal of waste ▪ Unavailability of appropriate land ¯ Lack of institutional capacity	▪ Landfill shall be properly designed and operated. ▪ Segregation, MRF and Composting facilities will enhance the useful life of Landfill. ▪ LFs shall have proper facilities like reception areas, weigh bridge, CCTV, RFID, access road, daily soil cover, security, lighting for 24 /7 usage and professionally trained workers to operate and supervise.

3.1.2 Procurement of SWM Equipment, Machinery and Vehicles

84. The project design consultant, Engineering Design Construction Management (EDCM), has analyzed the future waste generation of the city and identified SWM equipment, machinery and vehicle requirements for current year and for project life span. The procurement plan has been established based on the review of existing waste collection fleet of WSSC Swat and taking into consideration the current total available volumetric capacity of WSSC Swat. The existing usable vol. cap of WSSC Swat is 68 m^3, while the proposed volume capacity of the system is 520 m^3/day. Procurement shall be conducted using the difference of volumetric capacity i.e. 452 m^3 / day. PMU/WSSC Swat will adopt energy conservation strategies through procurement of energy efficient equipment and vehicles. WSSC Swat will consider optimization of such equipment/machinery during operation phase to adopt energy conservation.

85. Proposed procurement of SWM fleet for solid waste carrying machinery, non-waste carrying machinery and future machinery requirements for year 2030 are shown in **Tables 3.3, 3.4** and **3.5** below.

Table 3.3: Current Waste Carrying Machinery Procurement

Machinery	Vol. Cap m^3	Total Required	Additional 10%
Minitippers 1m^3	13	13	15
Minitippers 2m^3	49	25	28
Compactors 7m^3	49	07	08
Compactors 13m^3	229	18	20
Dumpers 10m^3	112	11	13
Total	**452**	**74**	**84**

Table 3.4: Current Non-Waste Carrying Machinery Procurement

S/N	Machinery	Qty	Working (Km's)/Machinery	Total daily Working (Km's)
1	Mechanical Sweeper – Vacuum	02	35	70
2	Mechanical Sweeper – Tractor	02	20	40
3	Mechanical Washer	02	15	30
4	Drainovator	02	10	20
5	Green Shredders	02	As Required	
6	Tractor Loaders	05	As required	
Total		**15**		

Table 3.5: Total machinery requirement for Mingora city for project life i.e. 2030

Source	Machinery	Year			
		2,025		2,030	
		No's	Vol. Cap m^3	No's	Vol. Cap m^3
Residential Waste Collection	Mini Tippers $1m^3$	15	15	18	16
	Mini Tippers $2m^3$	23	46	28	48
	Compactor $07m^3$	08	48	10	63
	Hand Carts	247	-	295	
Commercial Waste Collection	Compactor $13m^3$	05	63	06	65
	Mini Tippers $2m^3$	05	10	08	10
	Hand Carts	154	-	185	-
Bulk Waste	Dumpers 10 m^3	13	129	15	140
Secondary Residential Waste	Compactor 25 m^3	15	201	18	208
Lifting Machinery	Tractor Loader	04	-	05	-
Total (Excl. Handcarts)		**88**	**520**	**108**	**622**

3.1.3 Transfer Stations

86. Currently, most waste collected by collection vehicles is taken to the dumping site at Katwaro Maira directly. Smaller vehicles dump their waste at open collection points and this waste is lifted in bigger dump trucks etc. In current project design there is no Main transfer station proposed for Mingora city as projected waste generation rate is quite low i.e. 300 tpd by 2030.

87. In order to improve the overall waste management system and urban environment, waste transfer stations have been proposed. The other prime objective of this intervention is to restrict commuting of smaller vehicles to the landfill site, thus reducing negative environmental impact. Depending upon the site, location and collection vehicles, three types of transfer stations are proposed. Initially keeping in view the current waste generation of Mingora city only mini and mobile transfer stations are considered.

- **Mini Transfer Station** – Arm Roll vehicles containers of 15-20 m^3 size, placed along a ramp in enclosures

- **Mobile Transfer Station** – for vehicle to vehicle transfer – where space is constrained, large vehicles, like compactor trucks, could be used for emptying small collection vehicles.

88. **Main Transfer Station** – for transport convergence into trailers. These transfer stations could be coupled with a segregation or Material Recovery Facilities (MRFs), reducing load on the actual landfill site.Transfer stations will serve for transfer of waste

from samll capacity vehicle to large capacity vehicles to haul waste at SWMF site. Waste segregation will be carried out at Material Recovery Facility, located wihtin the landfill site. Waste management plan for transfer stations will be prepared prior to start of operations by the WSSC Swat. Main transfer stations in Mingora shall be constructed if required in future. Waste management plan will ensure that no waste is littered and mishandeld during operations at transfer stations. Waste management plan will be prepared by WSSC Swat and will be submitted to PMU for review and approval before start of operations at transfer stations. It will be ensured that no public or neighbors grievances arise due to operations at waste transfer stations and if any received it will be timely and appropriately addressed by concerned authorities. SOPs will be established and implemented at waste transfer stations to avoid impacts of odour, land degradation, water pollution and public nuisance.

3.1.4 Waste Transport

89. For transportation, compactors, arm-roll trucks, skip lifters, tractor trolleys, and dump trucks are used. Tractors, trolleys, Arm-Roll trucks and front-end loaders assist the secondary collection. Waste from streets is collected by sanitary workers and is brought to collection points using hand carts or wheelbarrows. From the collection points, waste is transported to final disposal sites, using compactor trucks. WSSC Swat have currently deployed its full resources to collect and dispose the waste generated on daily basis. This system on the whole is less efficient since it requires more time and more manpower to function. The innovation of rickshaws and mini-dumpers promises to improve reach and efficiency, particularly when incorporated in the IWMS.

90. Currently, the WSSC Swat has a collection fleet with overall capacity of 57 tons/day. The fleet includes 2 tractor trollies, 3 dumpers, 4 multiloader and 02 hino compactor. Total daily solid waste collection and disposal by WSSC Swat is 57 Tons, whereas total daily waste generation for the year 2021 is 223 tons, there is a significant lifting lapse of approx. 161 tons per day due to insufficient number and type of vehicles. Tractor trollies are not purpose-built vehicles for waste collection and transportation within the city limits, so they would generally be avoided. Maximum transportation would be routed through transfer stations, except when collection vehicles are large enough to go directly to the SWMF or are close to the SWMF or reach outer periphery after collection route completion.

3.2 Component 2: SWMF Development & Operation

3.2.1 Objective of SWMF Development

91. The proposed SWMF is an urban development project with the objective of providing waste collection and disposal services for the residents of Mingora city. The project aims to benefit the current population of approximately 0.43 million that are estimated to increase to about 0.51 million by 2030. The project is designed with the objective to cater to adverse environmental impacts of the present open dumping site at Katwaro Maira, which include:

- Haphazard waste spread in nearby agriculture lands
- Odor problems due to emission of CH_4, SO_2 and H_2S
- Risk of vector spread
- Risk of fire and explosion of dump site gas

- Uncontrolled leachate infiltration causing land degradation
- Surface water and groundwater pollution
- Aesthetic Impacts
- of the open dumpsite
- Economic loss due to disposal of recyclable materials
- Increased scavenging activity in the Mingora

3.2.2 Capacity of Mingora SWMF

92. The most suitable technological option for handling about 200 tons per day (tpd) waste generated in Mingora city is a combination of mechanical and biological treatment options. Around 92% of the organics, recyclables and combustibles will be disposed off through other means and this volume of waste will not reach landfill site, hence saving landfill handling capacity for a longer time, recovering the economic potential of the waste and improving environment through reducing the methane emissions from the landfill. This percentage varies in different cities keeping in view the life style and economic status of the residents.Furthermore, the estimates provided here are only benchmark figures used by the SWM experts during designing of the ISWM at the feasibility level and do not contradict the mass balance prepared by the design consultant, provided as **Figure 5.9** of this EIA study. Project design report has proposed a set of mechanical & biological treatment (MBT) option after detailed techno-economic assessment:

- A centralized waste management facility will be handling around 200 TPD of the municipal waste considering 170 TPD waste and future requirements will be developed at Mingora city.
- Around 30-40 tpd of waste generated in fruits and vegetables markets, hotels & restaurants and parks will be delivered directly to the aerobic digestion /composting facility.
- Sorting line with capacity of 20 tph (12 hours operation), consisting of bags opener, trommel screens, magnets, ballistic separator and bailing units
- After sorting and segregation, 80-85 tpd green waste will be subjected to Anaerobic Digestion and subsequent composting using aerated piles.
- Approximately 75 tpd of RDF will be produced which may be sold to the cement industries or brick kilns.
- Around 5 tpd recyclables will be sorted which may be sold to the recycling industry.
- Around 5-7 tpd of inert waste will be landfilled.
- Landfill area would comprise of number of waste cells separated by access road for each cell, liner system at the bottom and provision of daily cover during the active phase of operation of each cell. Every cell will include gas and leachate collection piping network which will be transported on site for treatment and disposal. Other than the technical components of landfill, the site will house administration building, weighbridge for recording incoming waste data, wheel

washing and parking yard.

93. The process flow of the proposed SWMF for Mingora is provided in **Figure 3-2** while the key plan for the proposed facility is provided as **Figure 3-3** below.

3.2.3 Scope of Works for SWMF development

94. In order to understand the impact of all the project phases to the receiving environment, it is necessary to provide details of the activities to be performed, its magnitude and duration.

95. The general step wise sequence of activities to be conducted for the SWMF development are described below. It shall be ensured that staging of activities takes place to manage any potential impacts, including traffic management issues.

Pre-Construction phase activities

96. The following activities have already been completed by PMU KPCIP and Engineering Design Construction Management (EDCM) consultant:

- PMU and EDCM consultant mobilization
- Situation analysis and condition assessment
- Geotechnical and topographic survey
- Detailed Engineering Design
- Social safeguard assessment
- Preparation of tender document, cost estimates and BOQs

Figure 3-2: Proposed SWM Facility for Mingora

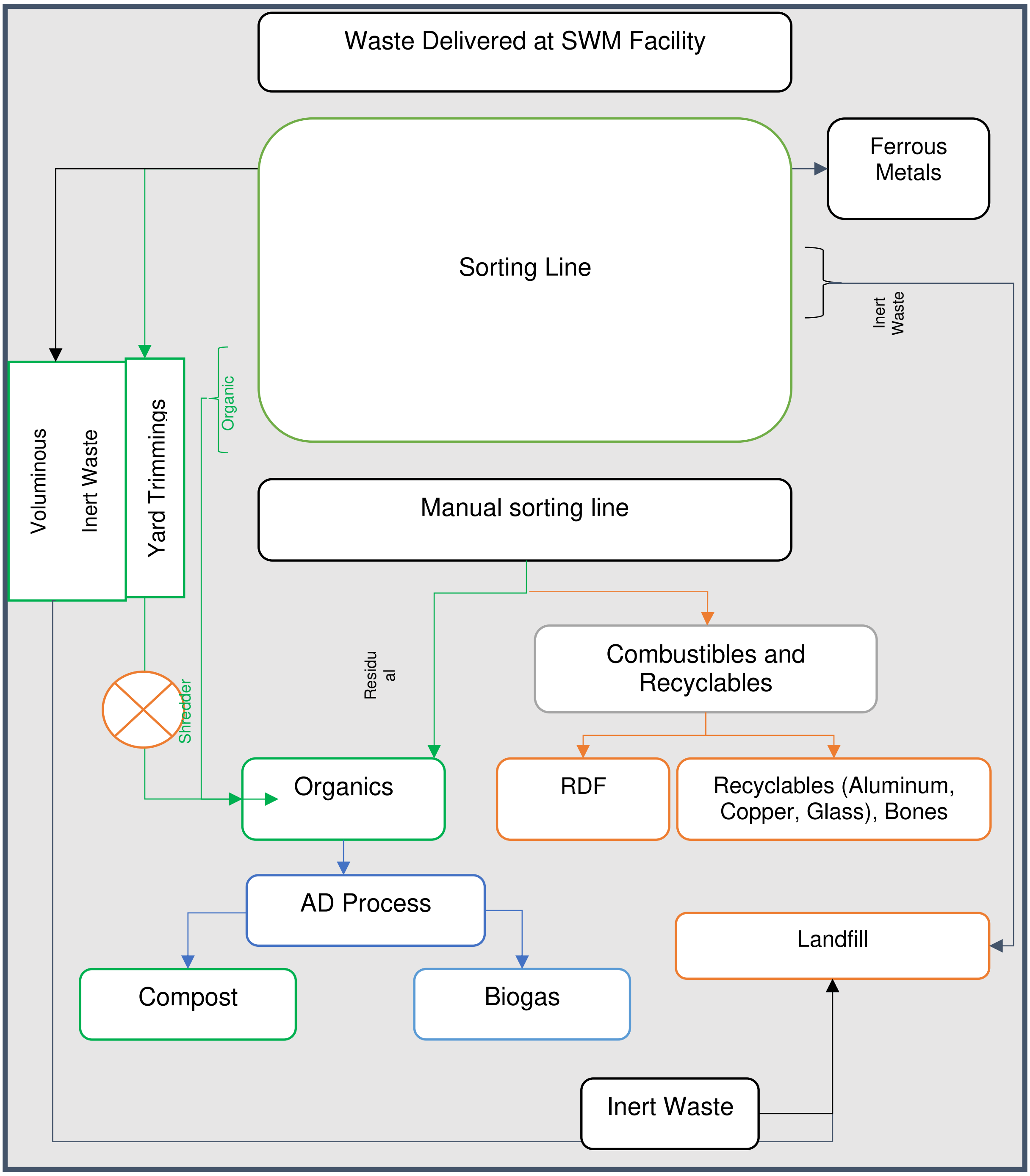
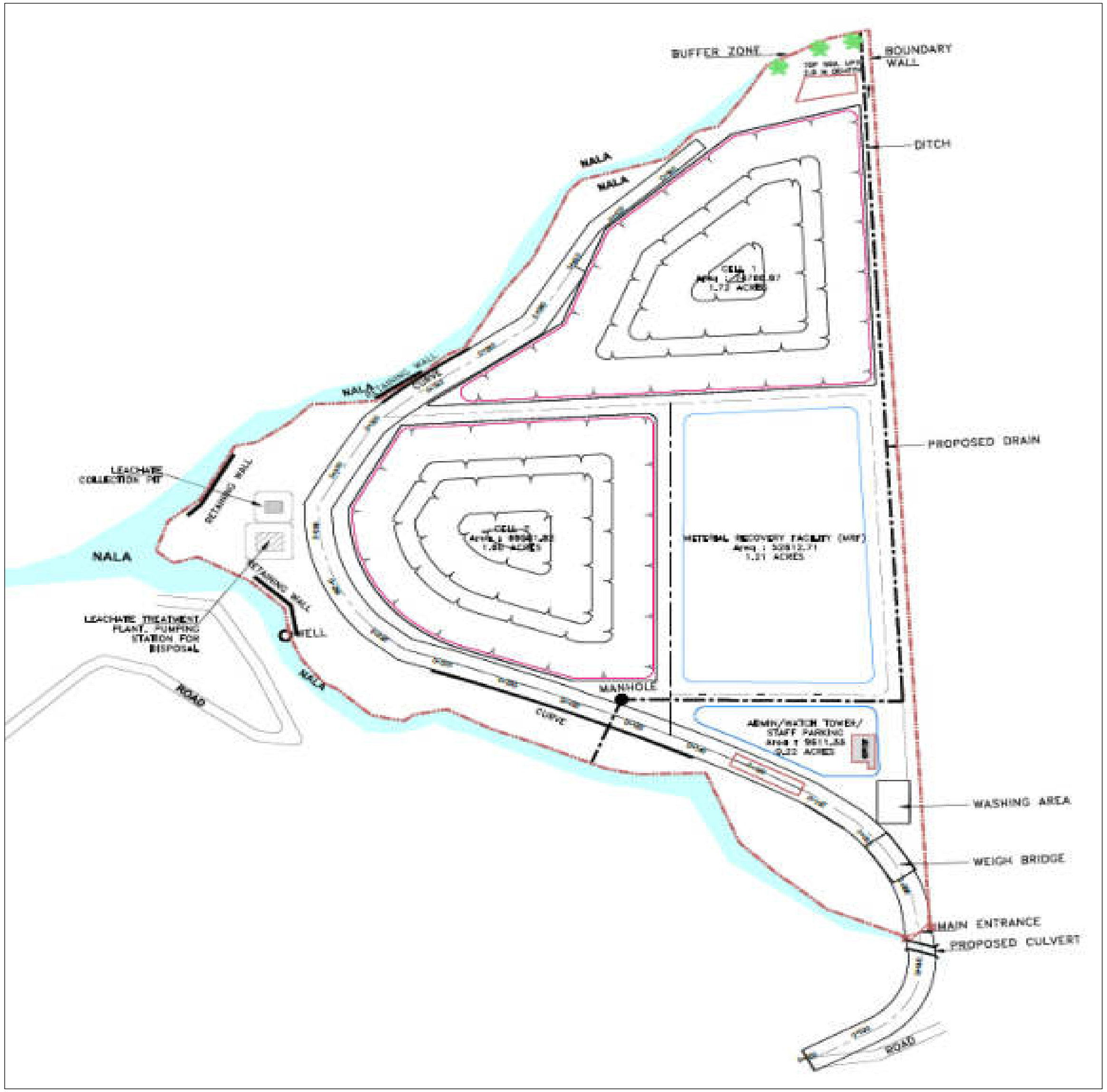


Figure 3-3: Key Plan of Mingora SWMF



3.2.4 Project Need

97. Estimates based on available information reveals that approximately 215 tons/day waste is generated in the city and the waste generation is projected from 2021 to 2031. There is need of development of SWMF at Mingora keeping in view the next 10 years requirements when the waste generation would be around 300 TPD.

98. Total daily solid waste collection and disposal by WSSC Swat is 57 Tons, whereas total daily waste generation in year 2021 is 223 tons, there is a significant lifting lapse of approx. 161 tons per day due to insufficient number and type of vehicles. Considering the cultural habits of residents of Mingora and weather conditions it is not possible for keeping daily waste generated at household level till evening for collection. During hot weather conditions there are chances that waste will start rotting.

99. Currently, WSSC Swat is already dumping in the proposed landfill site daily at about 27 TPD rate. Previously dumping was initiated at Owgdoo, many environmental groups and media platforms have highlighted the gross detrimental effects to public health and environment. Water and Sanitation Service Company Swat (WSSCS), the body responsible for the city’s waste management operations, has since halted this dumping and has been proactively pursing a proper landfill site.

100. ‘Like other cities of Pakistan, in Mingora, solid waste management is never taken into an integrated approach, rather lots of efforts and funds are drooled on individual components and to connect the missing links. There is a need to take an initiative to prepare a transparent roadmap for the outsourcing of solid waste management services for cities in Pakistan, which is integrated in nature and addresses all the requirements in a logical manner i.e. storage of waste till its final disposal.

101. Proposed installation of primary and secondary MSW collection systems, and the development of an international standard MSW management facility at Mingora has been designed to address SWM issues of Mingora city.

3.2.5 Rationale for Site Selection

102. The proposed SWMF has been selected on the basis that it must comply with basic KP government regulations, IFC EHS guidelines for waste management facilities and the ADB SPS 2009. Proposed selection of this SWMF must take into account impacts from leachate, litter, dust, vector and odor on surrounding environment. The various factors that have been kept in focus while selecting the proposed SWMF site are provided in **Table 3.6** below.

Table 3.6: Criteria for Site Selection

Factors considered for site selection	Rational for Site Selection
Landfill area and capacity to meet requirement of landfill site	There is adequate land area (approx. 10 acres) available at Katwaro Maira which can be used for landfilling for next 10 years.
Accessibility of landfill site	Site is accessible from Mingora city via Haji Baba road then Kawtaro Mera Road. Transfer distance is about 4.4 km from National Highway. However there is need of road widening for successful operation at the site.

Factors considered for site selection	Rational for Site Selection
Site Stability	Site is located outside areas susceptible to natural or human-induced events or forces capable of impairing the integrity of landfill components. Examples of unstable areas are those with poor foundation conditions, areas susceptible to mass movements (landslides, rock falls, etc.) and areas with karst terrains (sinkholes). Geotechnical report has been carried out for the site and design is based on the findings of this report.
Land Use	Currently about 27 tons waste collected from 09 UCs of Mingora is being dumped daily by WSSC Swat.
Critical Habitat/Sensitive ecosystem	Site is falling outside of critical habitats of plants, wildlife and sensitive ecosystems.
Restricted Zone, Wildlife/Forest Protected areas	Site is falling outside of restricted zone/wildlife/forest protected areas.
Site should be located outside of the 10-year groundwater recharge area for existing or pending water supply development	Site is located outside of the 10-year groundwater recharge area for existing or pending water supply development.
Perennial stream	Seasonal stream is available within 100 meters down gradient of the proposed landfill cell development. Further bottom lining of each landfill cell and leachate collection system ensures that no contamination is entering to this seasonal drain. Surface drainage network has been provided in detail design to avoid risk of surface runoff and contamination.
Topography	Landfill site is located in hilly patch of loamy soil. Gentle slope exists at the site going south to north.
Ground Water Table	Ground water table is found at depth of 80 ft. NSL. Proposed depth of landfill cell is 3 meter (approximately 10 feet), therefore no impact on ground water is anticipated.
Flood plain & other climate risks	Site is located outside of 100 year flood plain. As site is located in depression therefore there are chances of flash flooding however there is natural seasonal drain passing adjacent to the landfill site which carries rainwater downstream in hilly terrain. Surface drainage network has been provided in detail design of landfill site to avoid risk of surface runoff and contamination. Further retaining wall to limit enterance of water into landfill facility is provided along the boundary of landfill site.

Factors considered for site selection	**Rational for Site Selection**
	Please refer to Section 3.3 below for a detailed assessment of the climate risks facing the project.
Seismic Risk/Fault lines	Site is located seismically active area as it falls in Zone 3 on seismic map of Pakistan. No fault lines or significantly fractured geologic structure is present within 500 meters of the perimeter of the proposed landfill cell development that may allow unpredictable movement of gas or leachate.
Private/ Public water supply wells	No private and public water supply wells present in the proximity of landfill site. Gentle slope exists at the site going south to north. During site survey it was observed that private boring wells operate in some residential units located down gradient north of site boundary, more than 500 meters from site perimeter. Similarly, no other irrigation or livestock water supply wells located down gradient of the landfill boundaries around a perimeter of 500 meters.
Airports	Nearest Airport is located at Saidu Sharif at aerial distance of 6.5 Km, however due to hilly terrain no impact on aviation activities due to landfill operations is envisaged.
Sensitive Receptors	Sparsely scattered residential settlements are lying at varying distances around the proximity of the proposed landfill site. There are 03 houses in west, 01 house in south and 02 houses in east side of the landfill site which are very close (falling within 250 m distance from landfill cells as per IFC criteria) and considered as sensitive receptors. It will be ensured that during project execution no sensitive receptor will be residing within 250 m distance from landfill cells.

3.2.6 Proposed Design Considerations for SWMF

103. The design selection has a major influence on the construction, operation and restoration of the facility. The design concept depends on the ground conditions, the geology and hydrogeology of the site, the potential environmental impacts and the location of the waste disposal site. In order to incorporate advancement in technology and changes, a periodic review of the design should be carried out, as the lifespan of a disposal site from commencement to completion is long compared to other construction projects. Aspects that have been considered in the design are briefly discussed below.

Nature and Quantity of the Waste

104. Nature of waste that will be landfilled at Mingora would be only MSW. It is regarded as waste generated by households and waste of similar nature generated by commercial and industrial premises, institutions such as schools, hospitals and other facilities

inhabited by people, construction and demolition of buildings, and from public spaces such as streets, markets, slaughter houses, public toilets, bus stops, parks and gardens.

105. As per the estimates, Mingora city will generate about 223 tons of waste per day in 2021. For the purpose of calculation of useful life of landfill, if 25% extra waste generated from all other sources is factored-in, total waste reaching the landfill is considered to be 257 tpd in 2025 and about 308 tpd by 2030. Main criteria used for estimation waste generation rate is given in **Table 3-7** below**.**

Table 3.7: Waste Generation Estimation Criteria

Criteria	Description
SWM Planning Horizon (2020-2030)	10 Years
Population	Projections based on 1998 Census
Population growth rate (%)	2.13%
Per Capita Waste Generation	0.42 Kg/ca/d
Per capita waste generation annual increment (%)	1.5%
Additional allowance (%)	25%
Loose waste density (kg/m^3)	305

106. For waste projection in the future, an annual growth rate of 1.5 % is applied to current waste generation of 0.42 kg/ca/d. Similarly, population projection is also made at the population growth rate as suggested by Pakistan Bureau of Statistics at 2.13% annually. Mingora will have total waste generation rate of 223 tons per day in 2021. For purposes of design for waste treatment, the calculation has been made at 257 tpd, considering the growth till 2025. Keeping in view the infrastructure investment required for landfill, 10 years useful life of landfill is considered for design. However, it is also assumed that from year 3 of the project, around 75-92 tpd would be diverted to the MRF being developed, as part of this project. This would reduce the waste reaching the LFS and hence ensure the optimum land utilization.

Protection of Soil and Water

107. Bottom and cap lining system for each landfill cell has been designed for the protection of soil, groundwater and surface runoff. The liner system may consist of a natural or artificially established mineral layer combined with a geo-synthetic liner that must meet prescribed permeability and thickness requirements.

Leachate Control and Management

108. An efficient leachate collection system has been provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum. The leachate system will consist of a leachate collection layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) with pipe network to convey the leachate to treatment facility.

Gas Control

109. The accumulation and migration of gases from landfill facility must be controlled. Landfill gas will be collected through installation of perforated pipes within the cells. This gas transferred to gas recovery unit where it receives subsequent treatment and utilization, or disposal in a safe manner through flaring or venting.

Odor/Litter/Vector Control

110. Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. Working surface of waste will be covered with a soil layer called "daily cover" at the end of each working day. Amount of soil to be used in daily cover will be about 10% of the waste volume. Suitable quality of excavated material can be used as daily cover material.

Stability

111. Consideration has been given to the stability of the sub-grade, the base liner system, the waste mass and the capping system. The sub-grade and the base liner will be sufficiently stable to prevent excessive settlement or slippage.

Visual Appearance and Landscape

112. Consideration has been given to the visual appearance of the landfill site during operation and at termination of landfill site and its impact on the surrounding landforms. Necessary plantation will be carried out which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation within and at boundary of facility to improve landscape of the area.

Operational and Restoration Requirements

113. Landfill will be operationalized in a phased manner. Site infrastructure has been included for the provision of; administration building, lookout tower, weighbridge, waste inspection area, wheel wash area, site services and security fencing to meet operational and restoration requirement.

Monitoring Requirements

114. One groundwater monitoring well was maintained out of the drills made for geotechnical investigation. However, more wells may be constructed, if required, once the landfill starts operation.

3.2.7 Detailed Process Description

115. Following are the major operations that will be performed at the SWMF in Mingora:

- Reception of the incoming waste stream;
- Placement and volume reduction of the waste through mobile compactors such as bulldozers;
- Installation of material recovery facility, Aerobic Digestion (AD) system and compositing; and
- Installation of the landfill and environment control facilities

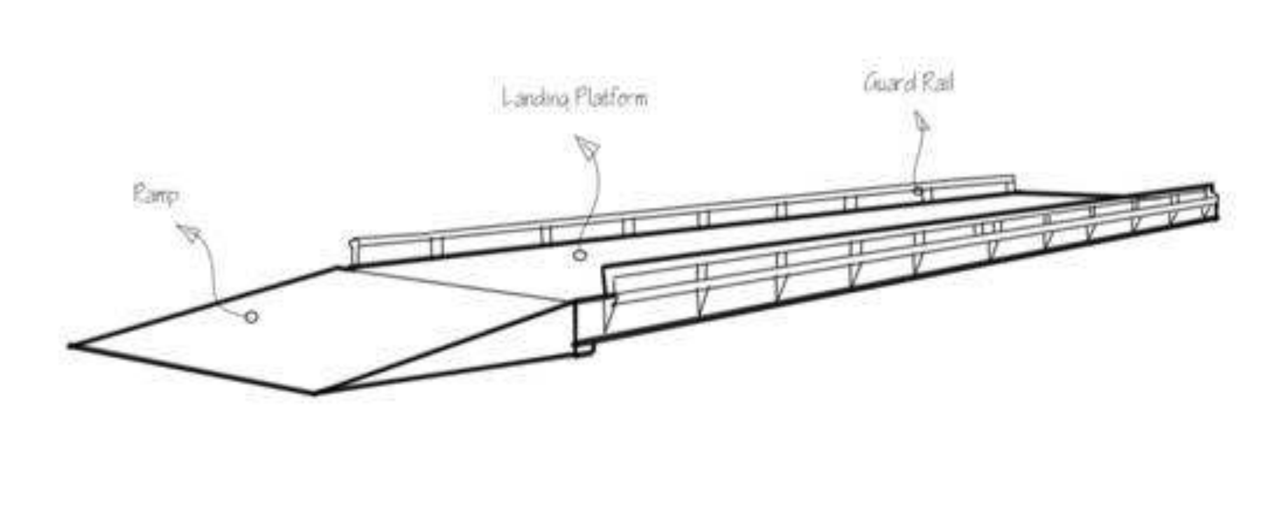
116. In a SWMF, waste is spread in thin layers, compacted to the smallest practical volume and covered with the soil or other suitable material at the end of each day. When the disposal site reaches its ultimate capacity, a final layer of cover material is applied.

117. The detailed process description for disposal of MSW at the proposed site is presented in the following sections.

Weigh Bridge and Unloading Bay

118. Prior to the unloading, the trucks will pass over a weight bridge to determine the exact amount of collected garbage from the city every day. In order to minimize the solid waste collection vehicle's circulation inside the landfill boundary and to reduce emissions and odours, an unloading bay has been incorporated in the design. To reduce the possibility of littering, incoming collection vehicles will empty the waste on the tipping floor outside the building to reduce the circulation at the site. Weighbridge of 100 tons capacity will be installed at the entrance gate for Mingora landfill site. A pit type weigh bridge of size 20X5 m having modular cubical bolting assembly will be installed on steel platform which will be fixed on RCC raft. Schematic diagram of weighbridge is shown in **Figure 3-4** below.

Figure 3-4: Schematic Diagram of Weigh Bridge

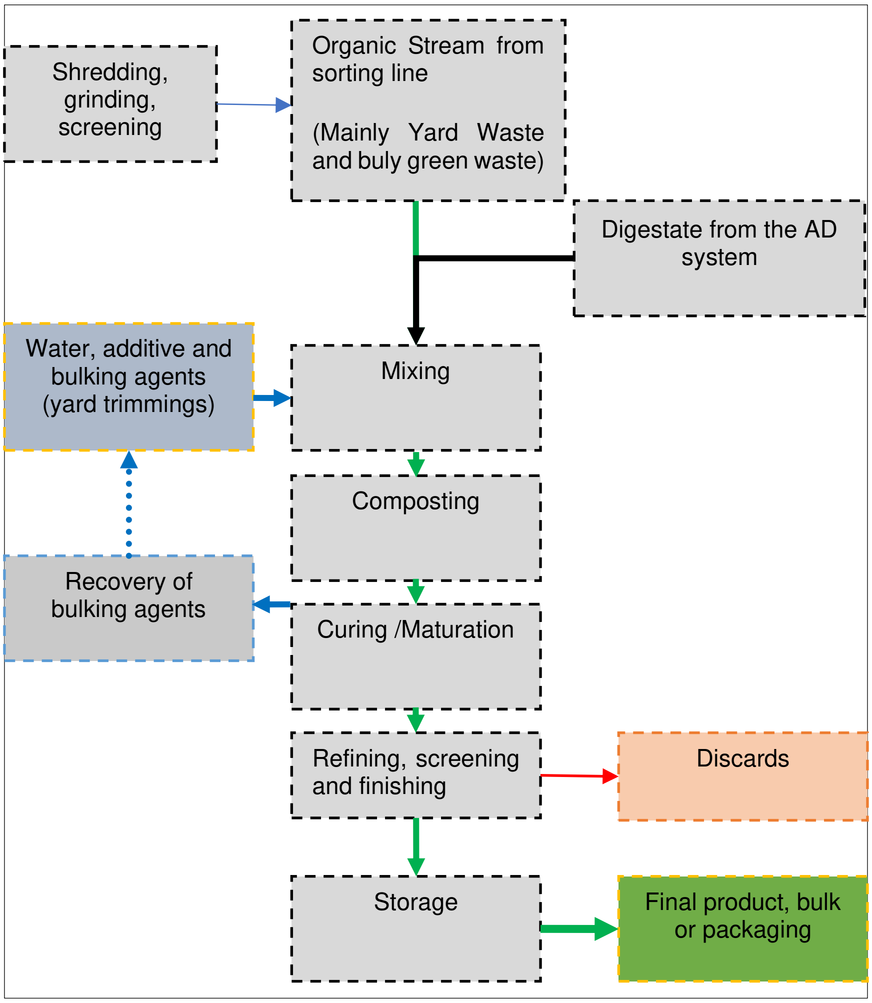


Composting and Biodigesters

119. During the detail design phase, feasibility of choice of organic waste treatment has been discussed in detail, nonetheless, area for biological treatment of organic waste (0.32 acres) has been set aside on the landfill site. All the waste collected from the city will first reach MRF for sorting and segregation. From there, organic waste and residual waste will be transported to bio digester and compositing area for final treatment and disposal. Compost pad of Plain Cement Concrete (PCC) will be constructed for windrow composting. After segregation and sorting, the yard waste will be sent to AD system where it will be dried and then sent to composting process.

120. About 85-120 tpd organic waste from Mingora city would be subject to compositing and AD system that will be installed at the facility. The general process flow diagram for the AD system and composting facility is provided as **Figure 3-5** below.

Figure 3-5: General process flow diagram for AD System and Composting



121. Typical preparation steps include: (a) sorting of salvageable material (b) removal of non-putrescible (c) grinding (d) addition of wastewater sludge if necessary. Following conditions are essential for effective composting. For optimum results, the size of the waste should lie between 2 and 8 cm. Size reduction is accomplished through shredding. Sufficient number of microorganisms must be present to perform digestion and so sewage sludge is added for this purpose. The following conditions will be achieved for compositing of MSW:

- C/N ratio should be 30 to 50;
- C/P ratio should be 100 or less;
- Moisture content should be 50 to 60%. Addition of water is done to raise moisture contents, if required;
- pH should vary between 5.5 to 8.5 throughout the process;
- Air should be thoroughly dispersed throughout the organic waste. This is done by frequently turning and mixing the wastes;
- Temperature should be maintained between 50 to 60° C for active composting period.

122. For Aerobic digestion system (AD system), the following options are proposed.

- Wet or dry AD;
- Single or two stage ADS;
- Thermophilic or mesophilic AD;
- Continuous, plug flow or batch AD.

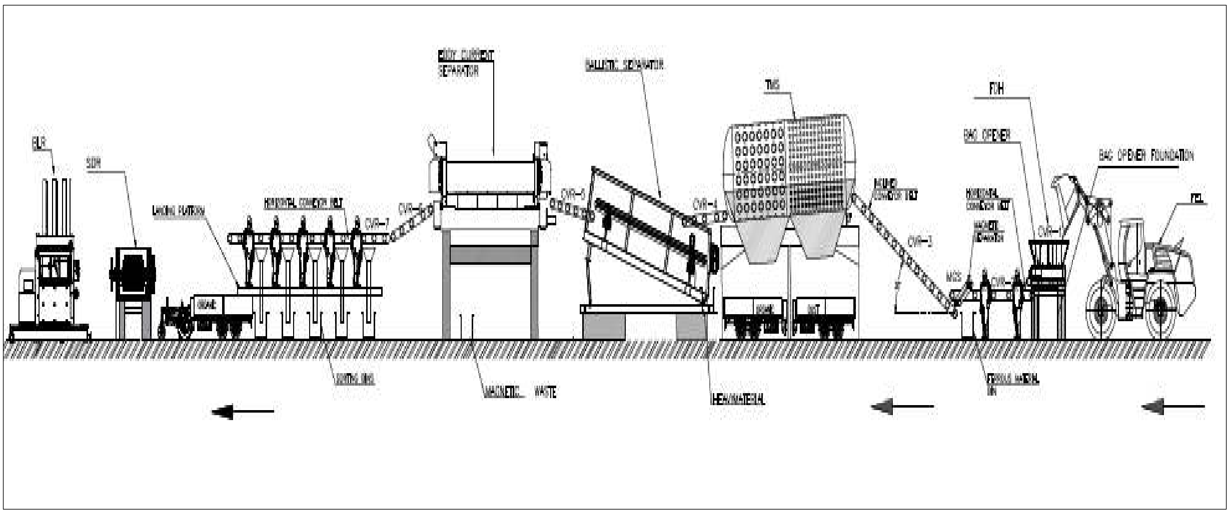
123. The design decisions would need to be combined with pre-treatment decisions to create an overall AD design which would best meet the needs of the project, depending upon the waste characterization. Project design report suggests that AD system should not be prescribed at this stage and KP government may invite AD vendors/EPC contractors to provide customized approaches to AD and pre-treatment options.

124. WSSC Swat/GoKP may set out performance specifications that AD vendors/EPC Contractor will need to meet and vendors/EPC Contractor will pick the combination of technologies and approaches which they feel will work best for the feedstock to be treated. For example, a dry AD vendor could put a wet pre-processing system on the front end of their system. Understanding risks and benefits is important background, but this information should not be used in making a procurement decision (either by dictating requirements in an RFP and/or in the evaluation of proposals). Specifying the AD system design at this stage may limit the competition and thereby cost escalation of the proposed system.

Material Recovery Facility (MRF)

125. The MRF area is located adjacent to landfill facility. The sorting area will be constructed with steel structures for roof with a ceiling height reaching approximately two stories high. Dedicated machinery will be provided for sorting and segregation area such as a front-end loader and fork lifter. Process flow description is provided in **Figure 3-6** below.

Figure 3-6: Process flow of Material Sorting Facility



126. The operations involved in MRF are as follows:

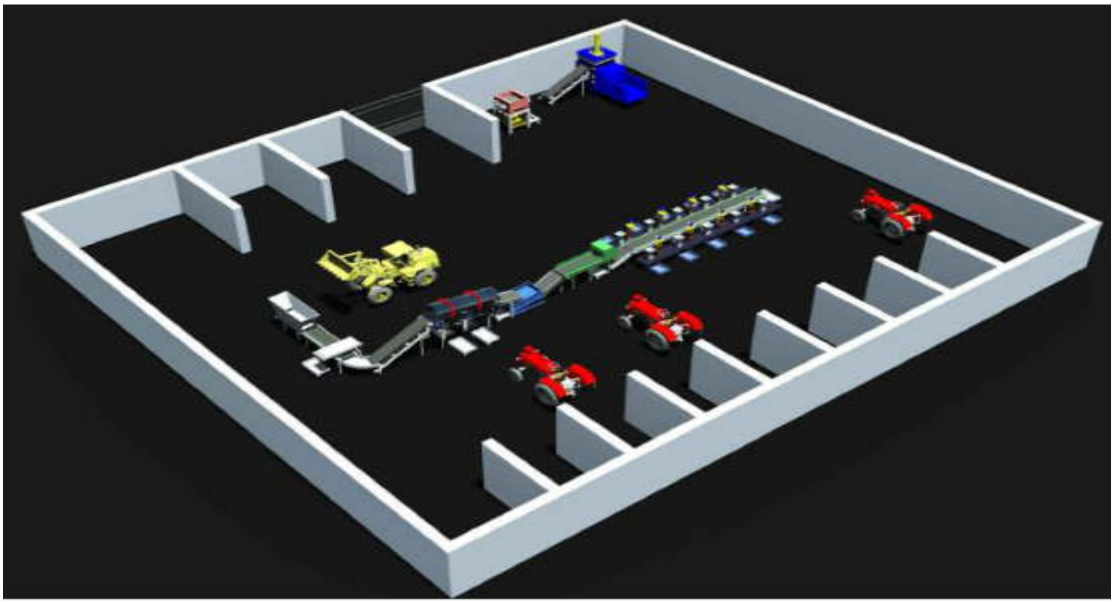
- Waste will be off-loaded on a tipping floor at the MRF. The floor is divided into three chambers to ease the operations on first-in, first-out basis. The overall area can cater for two days' offloads, keeping a safety cushion for routine maintenance shutdowns.

- From tipping floor, front end loader will carry waste in batches and load into hopper.

- A bag opener is installed at the beginning of the segregation process. It will be used to open the closed bags. It will also work as a metering input device to control the throughput.
- After passing the bag opener, the waste will pass through a small horizontal conveyor belt, where larger components of the waste will be removed manually before entering other sorting equipment. The removal of large items from sorting line will not only safeguard the facility against unnecessary loading of bulk waste, but it will also save the mechanical equipment from avoidable wear and tear.
- At the end of pre-sorting conveyor belt, a magnet will be installed to recover ferrous metals.
- A Trommel screen with two distinct opening sizes of <90 mm and <6 mm is incorporated afterwards. Material below 90 mm is mostly organic, which will be dropped into trolleys placed right underneath the trommel. Once filled, the trolleys will be transported by tractors for further processing. As for the material < 6 mm which is primarily inert or fines, it will also be collected in a trolley and taken to landfill cells. This reject from MRF can be used as cover soil in waste cells.
- Waste stream after the trommel screen will pass from a Ballistic Separator and separated into two main streams: a) 3D or rolling fraction where all PET, HDPE, PP and other heavy fractions tend to jump towards the lower end of the system and b) 2D or flat fraction where all film and flat material tends to move upwards. During this process, material is continuously shaken and consequently the dust and 'fines' are screened by the perforated surface of the blades.
- Another chamber separates non-ferrous metals with the help of Eddy-Current technique of aluminum sorting.
- Afterwards, the material is fed onto a manual sorting conveyor belt located inside the picking station where plastics, glass, paper, cloth and other materials are picked before non-ferrous metals. Waste sorting manually will be collected in containers placed beneath the chutes, which will be emptied in their designated areas within the sorting facility. These materials can then be consolidated with the help of baler for ease of transportation.
- Recyclables and RDF materials are fed onto a baler automatically to be packed in the shape of blocks. These are then stored for transportation to market.
- Industrial size shredder is proposed for reducing the size of larger waste components.
- The whole facility will have ventilation installed for creating a comfortable environment for the waste picking team. The installed ventilation will also reduce the spread of COVID-19.

127. A 3D view of a typical MRF is provided as **Figure 3-7** below.

Figure 3-7: 3D View of proposed MRF for SWM Facility - Mingora



3.2.8 Construction of Landfill Facilities

128. Following activities are involved in construction of sanitary landfill:

- Landfill Cell Development
- Landfill Gas Management
- Leachate collection and treatment system
- Associated Infrastructure and Buildings

3.2.9 Landfill Cell Development

Landfill Cell Size

129. The waste cells construction will comprise of excavation, leveling and compaction of existing natural ground. Considering the difficulty of finding suitable and cost-effective site in the vicinity of the city, the landfill is designed to utilize the available area to its maximum potential. Therefore, cells are designed to be excavated to a depth of 03 meters below the natural ground level while the waste cell will be raised to 15 m before closing them with top cover.

130. Layers of composite barrier will be constructed to prevent any percolation of leachate into groundwater. Excavation slopes will be maintained at 1:3. Two landfill cells are proposed for the landfill site and the location of the landfill cells is provided in Project Key Plan. The size of the proposed landfill cells are provided in **Table 3-8** below.

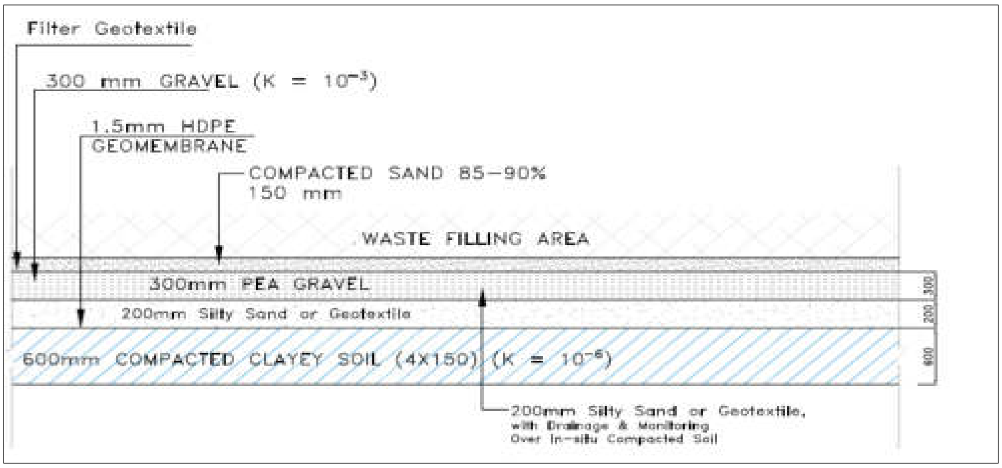
Table 3.8: Size of Landfill Cells

Landfill Cell ID	Size (Acres)
Landfill Cell-1	1.72
Landfill Cell-2	1.60

Bottom Lining of Landfill Cells

131. The liner system at the base of waste cells is aimed to protect the surrounding environment. It includes soil, groundwater and surface water protection through containment of leachate, controlling ingress of groundwater, and assisting in the control of the migration of landfill gas. The liner system must achieve consistent performance and has to be compatible with the expected leachate for the useful life of the facility. Bottom lining of the landfill cells will be carried out through provision of lining at subsoil comprising of plastic and clay material. Specifications of bottom liner designed for the proposed landfill are provided in **Figure 3-8** below.

Figure 3-8: Bottom Liner of the Landfill Cells



132. As illustrated in the **Figure 3.8** above, the specification of bottom lining of the proposed landfill site are as follows:

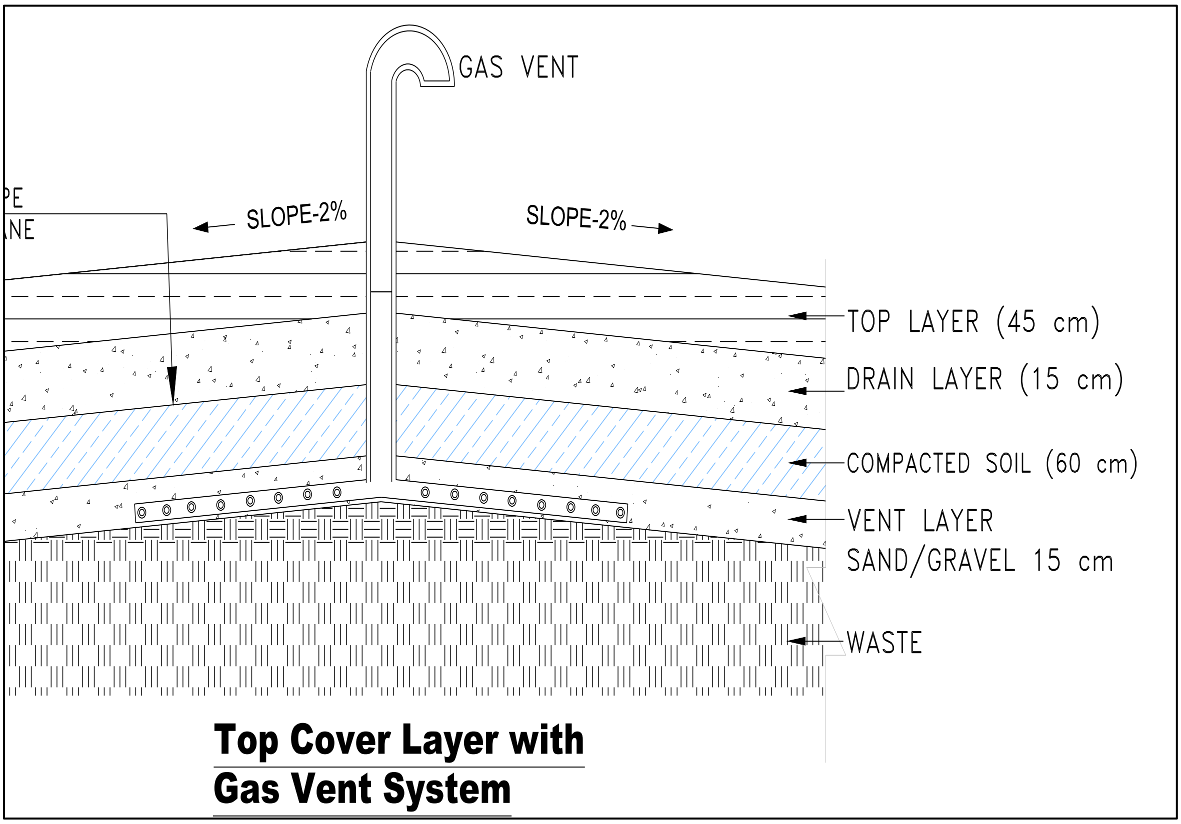
- A total of 600 mm clay liner of permeability of $1x10^{-6}$ cm/sec will be compacted at the bottom in series of 150mm layers each compacted to 95% of compaction, followed by 150 mm base layer for drainage and monitoring. This layer will be topped by 1.5 mm HDPE geomembrane.
- As soon as HDPE is placed, 200 mm silty sand or geotextile will be covered on top of HDPE for the protection of the HDPE on the side slopes. The main purpose of this sand layer on top of HDPE geomembrane serves as leakage detection layer.
- Above this 300 mm PEA gravel layer will be placed followed by 150 mm compacted (85-90%) sand layer.

Final Capping Layer of Landfill Cell

133. Final capping of landfill cells will be carried out in order to limit and control the amount of precipitation that enter the waste and to limit wind and water erosion and burrowing animals' activity. Main objectives of the capping system are: minimizing infiltration into landfill, maximize surface drainage and run-off and gas control migration.

134. The **Figure 3-9** below illustrates the typical final cover layer designed for landfill cells.

Figure 3-9: Capping of Landfill



135. The top cover system will consist of the following arrangements:

- Thick top soil layer of 45 cm capable of supporting vegetation in order to protect the landfill surface from wind and water erosion.
- Drain Layer of 15 cm at bottom to maximize runoff of precipitation while minimizing infiltration and preventing ponding of water on the landfill.
- Compacted soil layer or barrier of 60 cm of low permeability to limit and control the amount of precipitation that enters the waste.
- Vent layer of 15 cm thickness comprised of sand and gravel

Daily Cover

136. Daily cover is placed on working surface of waste in order to reduce the risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. It is a soil layer and is placed on each working day. Generally, the amount of soil to be used in daily cover will be about 10% of the waste volume. Suitable amount of daily cover is usually stocked at the landfill sites during landfill cell excavation. However, any suitable excavated material from construction works can be used as daily cover.

3.2.10 Landfill Gas Management

137. Landfill gas is produced through decomposition of organic fraction present in the MSW deposited to the landfill site by microbial activity. Landfill gas is composed of roughly

50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO_2) and a small amount of non-methane organic compounds. Methane is a potent greenhouse gas 28 to 36 times more effective than CO_2 at trapping heat in the atmosphere over a 100-year period, as per the latest Intergovernmental Panel on Climate Change (IPCC) assessment report (AR5)[3.] Methane possesses the combustible and explosive properties and also a Green House Gas responsible for global warming. In order to limit landfill gas entrance into environment and to avoid fire and explosive hazards land fill gas collection system has been designed.

138. The average depth of the waste body in waste cells is recommended at 18 meters. Therefore, vertical gas collection systems will be implemented within the landfill cells. The gabion of the gas collection wells will be 1 m square filled with gravel, and these will be constructed with iron mesh. There will be a perforated HDPE pipe 150 mm in diameter and with pressure class of PN16 in the center of the gas collection wells. The gap between the iron mesh and the perforated pipe will be filled with 16/32 mm pebble stone. The proposed gas vent system designed for Mingora landfill site has been shown in **Figure 3.10**.

139. At start of Landfill operation venting is proposed as small quantity of gas will be produced. The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate, considering that only a small quantity of gas is produced. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For KPCIP landfill operations after few years when significant quantity of gas is produced, open flame flare technology, consisting of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology.

140. With gas generation starting in 2023, a modeling Software Land GEM is used to forecast the volumes of gas and accordingly, gas collection and venting system within landfill cells is designed as shown as **Figures 3-11 and 3-12**.

141. Project design consultant EDCM has estimated the amount of emissions through US EPA Landfill Gas Emission Model (Land GEM). It is an automated tool for estimating emission rates for total landfill gas, methane, carbon dioxide, nonmethane organic compounds (NMOCs), and individual air pollutants from MSW landfills. Land GEM results for pollutant emissions resulting from the flaring operations at the site are presented in impact assessment section. Land GEM results shows that emissions of Sulphur dioxide (SO2) and Methane (CH4) are both minimal with only 0.9 kg/day (0.01 g/s) of SO_2 and 22.2 kg/day (0.26 g/s) of CH_4 being emitted. Also result shows very limited yearly volumes of emissions of NMOC and Hazardous Air Pollutants (HAPs) from landfill site. Keeping in view these limited volumes and after cotrolled flaring no deteroratation to air quality is expected from the facility. Further the project area consists of a rural and open setting with no built area located in close proximity to the site, thus any minimal pollutant emissions will be rapidly diluted upon release and thus will not result in any significant impact on the airshed of the project area. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.

[3] https://www.epa.gov/lmop/basic-information-about-landfill-gas

Figure 3-10: Design Specification of Gas Vent

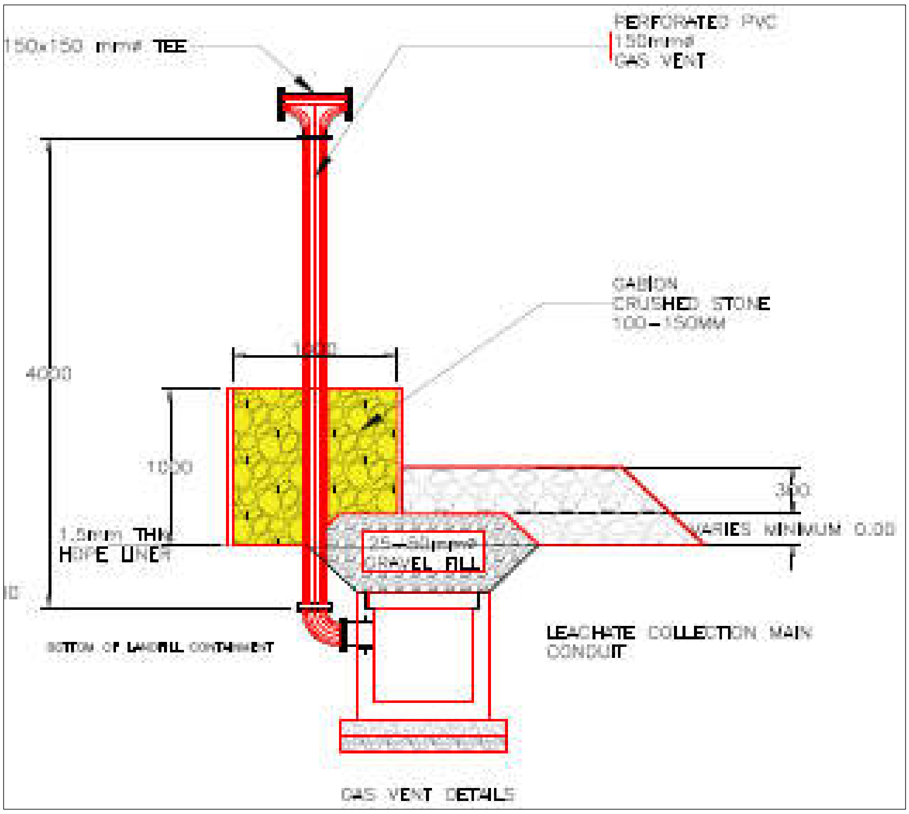


Figure 3-11: Extension of Gas Vent in Landfill Operations

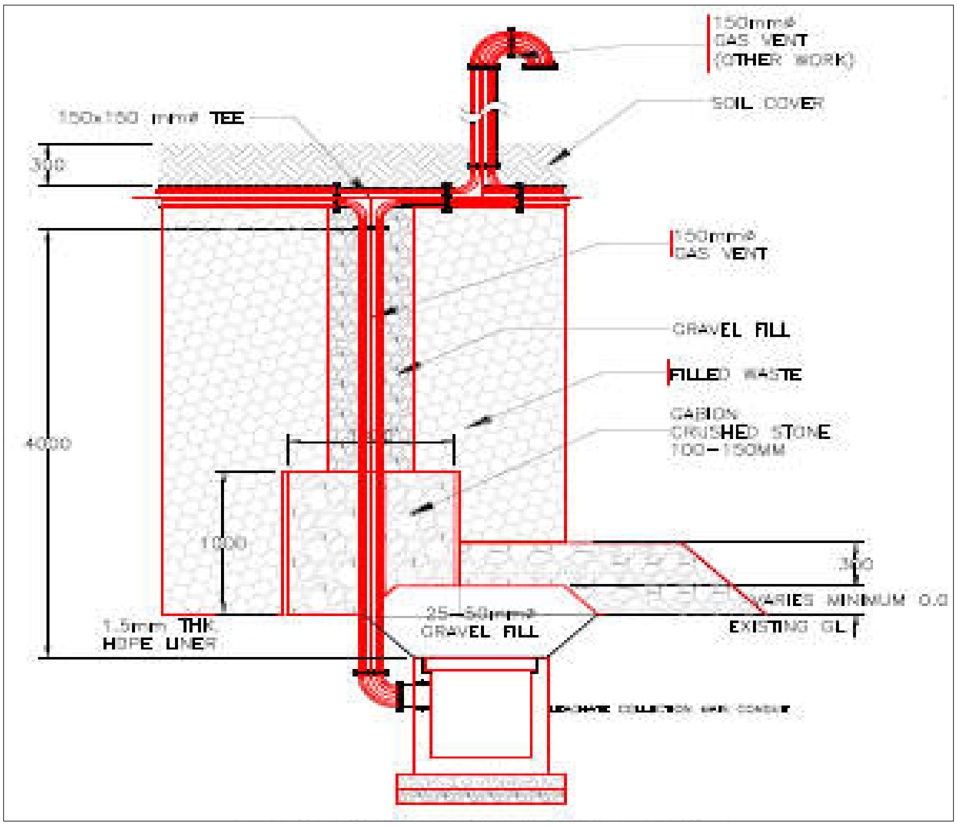
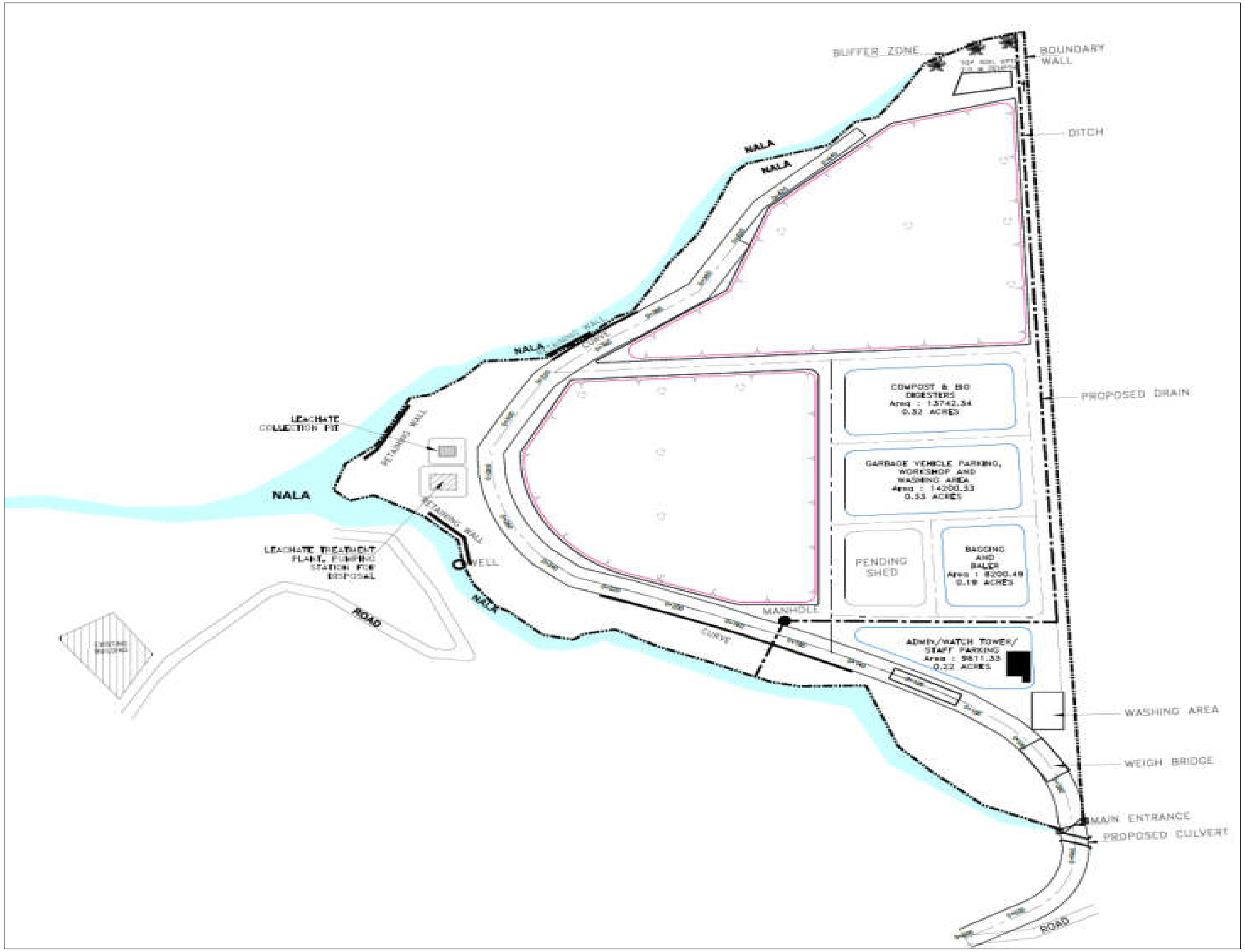


Figure 3-12: Gas Vent System of Mingora Landfill Site



3.2.11 Leachate Collection and Treatment System

142. Leachate produced in a landfill is a liquid which percolates through the waste carrying suspended and soluble materials that originate from or are products of the degradation of the waste. This liquid needs to be managed on site to avoid any seepages into the ground, any spill-over into ditches and drains, influence on gas collection system or effect on the stability of waste fill. For Mingora landfill site, leachate collection and treatment system has been designed which is explained below.

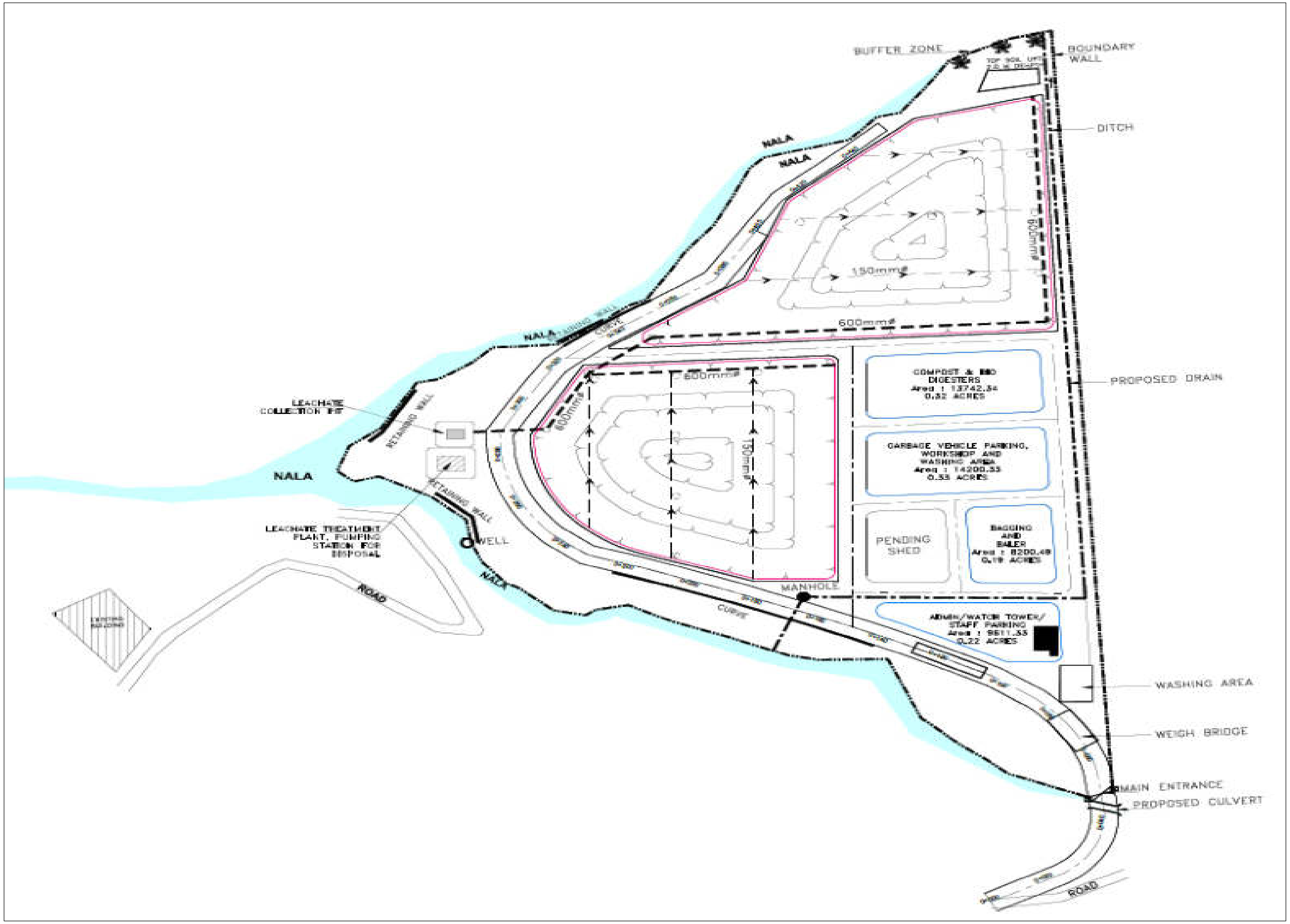
Leachate Collection System

143. Leachate is a waste product produced as a result of decomposition of organic fraction of waste by microorganisms in the landfill site. The mass balance in the leachate generally depends on the biological decomposition in the garbage body, amount of precipitation, temperature changes, and treatment of the leachate and/or transfer rate of the leachate to the treatment facility. This balance will be controlled and arranged according to the conditions during the operation phase. The leachate is collected via main and auxiliary leachate pipes. The longitudinal elevation of the leachate collection pipes laid inside the pebble stone drainage bed at 1% minimum.

144. Auxiliary leachate collection pipelines are planned in each waste cell to be placed at 30 m distance apart. In addition to that, main leachate collection pipes will be placed longitudinally across 2 waste cells. The main leachate collection pipes shall be HDPE pipes 600 mm in diameter and in PN16 pressure class. The auxiliary leachate collection pipes shall be perforated uPVC pipes 300 mm in diameter and in PN16 pressure class. The main leachate collection pipes conjoin on a common line and connect to the leachate collection pond.

145. A leachate collection system comprising of a drainage layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) will be considered. Synthetic drainage material may be used on sidewalls of the landfill cells, where the construction and operation of granular material may be difficult. Perforated leachate collection pipes and filter layer will complete the piping network for the waste cell. Leachate collection and treatment system proposed for the landfill site is illustrated in **Figure 3.13** below.

Figure 3-13: Leachate Collection Network for Mingora Site



Leachate Storage

146. Leachate production is calculated based on previous climate data and leachate generation model. The leachate collection pond is planned to be positioned at southwest site of landfill cell. A leachate holding tank of 500 m^3 (sufficient to store 5 days leachate production) will collect the leachate before it enters the treatment plant. Inside the plant, a second over-sized holding tank of 125 m^3 will be provided for condensed liquid (membrane refuse) which will be re-injected into the landfill. The sludge from leachate treatment system will be dewatered to 60% water content by air drying followed by disposal in the landfill.

Leachate Treatment

147. A leachate treatment facility with a design capacity of 50 m^3 per day is proposed. Leachate treatment has been designed on activated sludge treatment with advance level treatments (Disc Tube Reverse Osmosis-DTRO) for heavy metals and other pollutants potentially present in leachate.

148. Prior to the DTRO treatment, leachate will be subjected to preliminary treatment using the following unit operations:

- Screening to separate large floating materials in and/or on leachate.
- Sedimentation/equalization to balance out the process parameters, such as flow rate, organic loading, and strength of leachate streams, pH, and temperature over a 24-hour period
- Sand filtration for removal of the organic components, turbidity and suspended solids (SS)

149. The process flow diagram of leachate pre-treatment designed for the proposed landfill site is provided as **Figure 3-14.** Design parameters of screen chamber, equalization tank and sand filters are provided in **Tables 3.9, 3.10** and **3.11** below**.**

Table 3.9: Design parameters for screen chamber in leachate treatment plant

Screen Chamber (Fine Screens)	Value	Unit
Peak Design Flow	**0.07234**	**Cum/s**
Assume Clear spacing between bars, **o**	6.00	mm
Velocity ahead of screen **(Va)**	0.60	m/sec
Width of each screen channel, W	**0.2411**	m
Assume Angle of inclination	30.00	Degree
Assumed Detention Period in the Screen channel	6.00	sec
Assume Length of the screen chamber	**3.60**	m

Figure 3-14: Process Flow Diagram of Leachate Treatment Plant

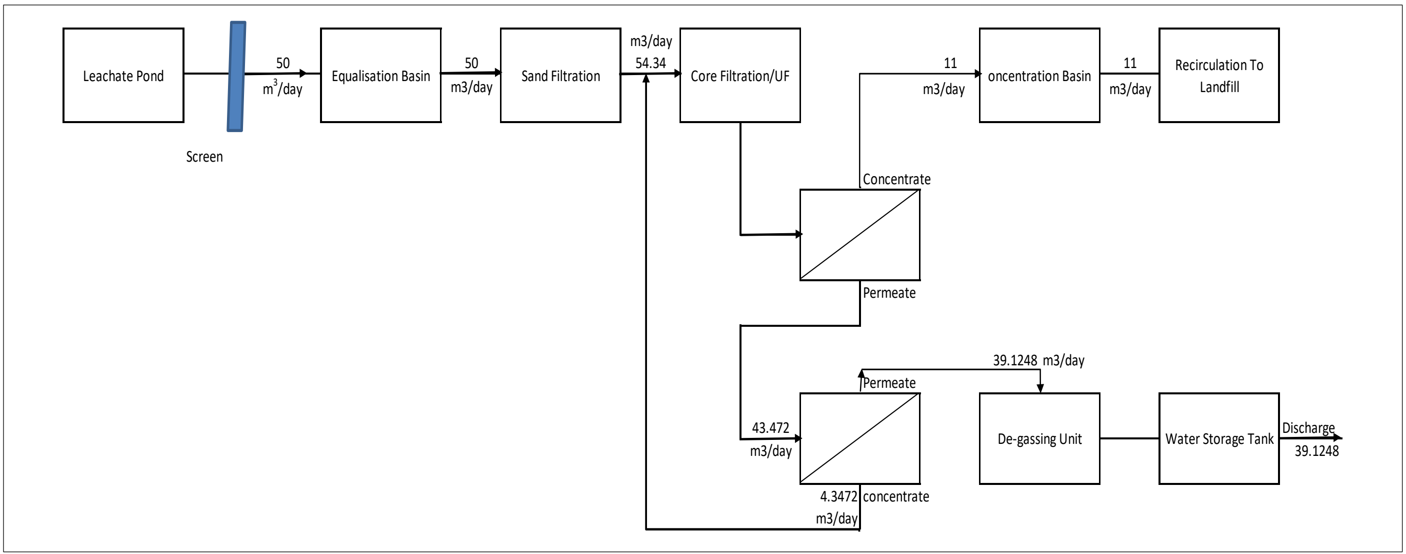


Table 3.10: Design parameters for equalization tank in leachate treatment plant

Equalization Tank	Value	Unit
Peak Design Flow	6250.00	Cum/day
Assumed Detention period	*2*	hours
Volume of the Tank	*520.8*	Cum
Assumed Depth of Liquid column	*5*	m
Area required for the equalization tank	*104.2*	Sq.m
No. of Tanks Proposed	*1*	
Breadth of the tank	*8.5*	m
Length of the tank	*12.75*	m

Table 3.11: Design parameters for sand filters in leachate treatment plant

Sand Filter	Value	Unit
Average Flow	50.00	Cum/day
Filter Operating hours	20.00	hrs
Operating flow	2.50	Cum/hr
Filter Loading rate	11.00	Cum/hr/Sq.m
Area of the Filter required	0.23	Sq.m
Diameter of the Filter Required	0.60	m

Containerized Leachate Treatment solution AIO-DTRO Series

150. The Disk Tube Reverse Osmosis (DTRO) plant will be used for leachate treatment. These are commercially available as package unit which may be procured from the vendor directly and installed. DTRO is a kind of RO (Reverse Osmosis). It has the advantages compared with other processes, such as unaffected by biodegradability and C/N ratio, stable effluent quality, flexible system operation and fast start-up and better handling of the heavy metals which is the major concerns. It has been widely used for landfill leachate treatment as constructionWSS costs for leachate treatment have been gradually reduced by these systems over past 10 years.

151. The process flow diagram within DTRO and typical AIO-DTRO series proposed for Mingora facility are shown in e4**Figures 3-15** and **3-16** below**.**

Figure 3-15: Process Flow Diagram within DTRO

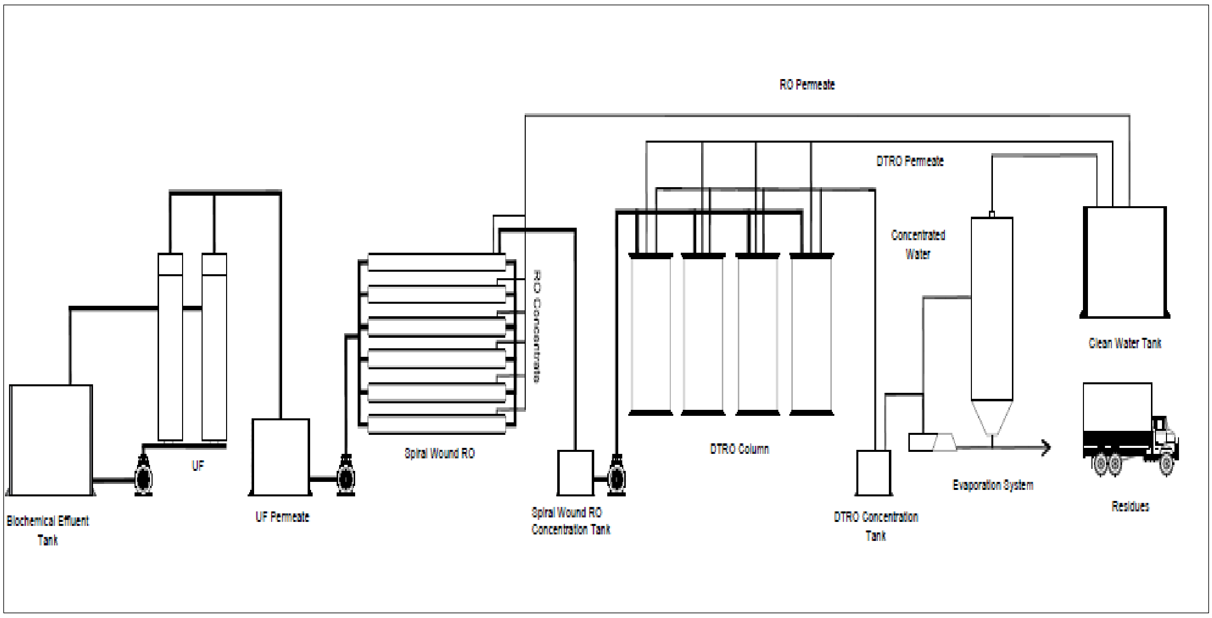


Figure 3-16: Proposed AIO-DTRO Series for leachate treatment

Concentration Basin

152. An over-sized holding tank of 125 m^3 will be provided for condensed liquid (membrane refuse) which will be re-injected into the landfill.

Degassing Unit

153. A degassing tower is provided to act as the stripper which eliminates surplus CO_2 by stripping with air in order to raise the pH of the permeate, which was sent to the top of the stripper and was rinsed downwards through the column counter currently with up flowing air sent by blowers. The stripper will remove 95% of inorganic carbon, and 68% of TOC.

154. Treated water will be stored for application like landscaping and sprinkling or it can be discharged to municipal drains after compliance with NEQS.

Infrastructure / Buildings

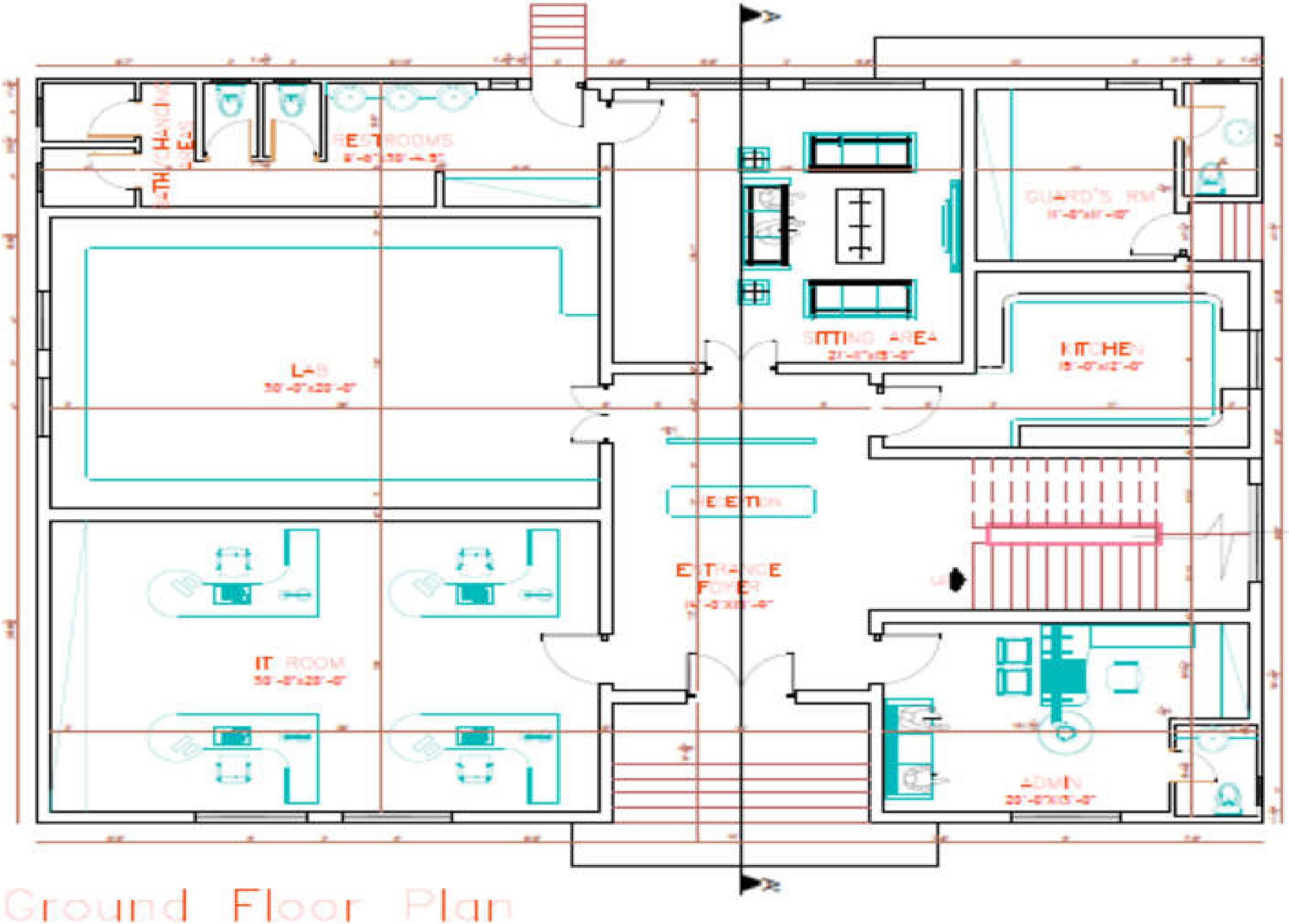
155. The proposed landfill will have proper facilities such as administration building, waste reception areas, weigh bridge, CCTV, RFID, access roads, daily soil cover, security, lighting for 24 /7 usage and professionally trained workers to operate and supervise.

156. The following building infrastructure is proposed:

Administration building and Lookout Tower

157. A 3-story high administration building has been designed within the landfill premises. It is planned such that it will accommodate landfill operations team, has a laboratory for quality control and MIS monitoring room for data acquisition and transfer to head office. The building also contains a conference room for meetings at landfill, an inventory room for storing supplies for repair and maintenance of landfill machinery and vehicles. There are showers, prayer area, rest rooms and a kitchen in the building. A car park outside the building is also designed for personnel's' vehicles. The area of the administrative building is surrounded by landscaping and greenery. The building has a look-out tower on the fourth level for viewing operations at the facility. A Lookout tower of height 49'-6'' will be constructed for visual surveillance of the landfill facility. The layout of admin building, including lookout tower, is presented in **Figure 3-17** below**.**

Figure 3-17: Layout of administration building at Mingora SWMF



Construction of roads

158. The approach road of about 4.4 km in length from National Highway to the landfill is available however it should be widened as part of external development component of landfill construction. Roads inside the premises will cover all periphery. Road width will be 10 m wide with two lanes each 4 m for two-way traffic of waste carrying vehicles. Access roads within cells will be kept 8 meters wide while the longitudinal slope has been designed at 1:10. Vehicle parking shed for waste carrying vehicles has been designed along with a workshop for routine repair and maintenance work.

Surface Drainage Network

159. The runoff at landfill will be managed through the provision of surface water diversion channels and collection systems. Drainage for surface runoff along periphery is proposed through a network of RCC drainage channels.

Storage area for Soil Cover

160. Soil or similar inert material shall be used for the lifetime of the landfill site, to cover the waste on a regular basis. Extra thickness of "final cover" material shall also be required once the site has reached completion. The simple spreading of daily cover is a highly effective way to reduce the attraction of waste to birds, suppress odor, prevent fly infestations, discourage rats and other animals and to reduce exposure to atmospheric conditions and to reduce wind-blown litter.

161. Ideally, cover material will be taken from within the site, increasing the available space for waste disposal and reducing the need to bring material from elsewhere. The material excavated from the site is estimated to be adequate for use as temporary and final cover material. Final confirmation will be made on remolded permeability of the representative samples taken from the borrow source, if adopted. At this time, we expect that the soil removed during excavation will be used. The soil will be compacted to at least 95 percent of the modified proctor density within a moisture content range of 0 to 3 percent wet of optimum.

Wheel Washing and Vehicle Parking

162. A vehicle parking shed for landfill vehicles and occasional parking of waste carrying vehicles has been designed along with a workshop for routine repair and maintenance work. There will be pumps and nozzles that spray pressurized water to clean the wheels. The wheel washing unit will comprise of a sedimentation tank. The dirt on the wheels of vehicles will settle and the water in the pool will be transferred to wastewater sedimentation tank while the stale water can be used for washing the vehicles.

Workshops

163. There will be two different sections for greasing and oil/filter change for the vehicles, and a waste oil storage tank for storing the waste oil while there will be separate units for welding and electrical repairs.

Tree Plantation/Buffer Zone

164. Inside the boundary wall, tree plantation will be conducted to create an environmental barrier between the external and internal environment. Indigenous tree plantation will be carried out which will serve as the buffer zone. Green patches provided for landfill site is shown in Project Key Plan. For the landfill to present a clean and aesthetically

pleasing view, buffer zone with tree plantation and landscaped berms will be done at appropriate places. Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity can be started in collaboration with Swat District Development Authority (SDDA) or WSSC Swat can outsource the activity separately.

Boundary Wall

165. The boundary around the landfill will be a wall constructed of brickwork of 9'' thickness all around the premises.

3.2.12 Construction Phase Details for SWMF

Construction Schedule

166. The project construction phase is expected to last for a total of 2 years with the activity expected to commence in the second quarter of 2021 and completed by mid of 2023.

Construction phase activities

167. The activities to be conducted during construction phase of the project are provided below:

- **Development of Construction and Labor Camps**

168. One of the first activities to be completed by the Contractor shall be the establishment of the construction and labour camp. The Contractor will also establish construction yards and sites (including storage and batching plant), offices and a workshop.

169. The construction of the proposed landfill will be divided into construction work packages and these packages will be awarded to the selected project Contractors.

170. The construction activity has to span over approximately twenty-four months. There shall be a number of contracts for a variety of works. The selected Contractors shall have the option to select suitable site(s) located near the project sites to establish his labor camps. If private land is selected, the contractor shall enter into contract with the private owner. During construction phase, an estimated 150-200 persons consisting of both semi-skilled and skilled human resource will be required.

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

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

173. The proposed site for the Contractor's camp shall include the following facilities:

- **Labor camp site**

- Accommodation
- Kitchen
- Dining area
- Sanitation facilities
- Septic tank
- Liquid and solid waste disposal facilities
- Generator(s), for operation when the power supply from the grid station was not available

Construction camp site

- Uncovered material storage
- Covered material storage
- Parking for vehicles and plant
- Batching plant
- Generator(s)
- Site offices

Workshop site

- Workshop
- Storage area
- Generator(s)

Site preparation

174. There may be a need to carry out cutting and filling of the land in order to attain the designed ground elevation. During the process, areas above the design elevation shall be cut and spoils shall be used to fill areas below the designed elevation. The area is to be clean of any obstructions in areas where the general design elevation is already attained. Cut and fill activities will be carried out using mostly heavy mechanical equipment. Manual labor will be negligible.

175. The ground will be compacted until the desired ground bearing capacity is attained. This is to ensure that all structures, particularly the foundations to be erected are stable and will not be subject to subsidence, settlements and other earth pressures.

Development of Access Roads & Internal Roads, drainage facilities and other horizontal earth works

176. Haul roads from the reception area to the entrance to each phase shall be designed to a standard adequate to allow trafficking of heavy vehicles. Haul roads may need to accommodate the passage of heavy construction vehicles e.g. steel wheel compactors

and tracked bulldozers. Service roads to other facilities on site e.g. leachate treatment plant, gas extraction system, should be to an adequate standard to allow access by service vehicles.[4]

177. Particular attention should be given to the access point to each cell. It is important that the access routes chosen do not put the liner at risk. Typical access ramps will be up to 6m in width and have slopes up to 10%.

- **Construction of building infrastructure**

178. Site building infrastructure must be designed, constructed and maintained to a high standard and should include the following facilities:

- Administration building consisting of an administration office, first aid area and general reception area;
- Sanitary facilities: showers and toilets;
- Staff facilities: lockers and mess room;
- Waste reception area;
- Monitoring equipment store;
- Equipment maintenance and fuel storage; and
- Parking area
- Properly installed ventilation to reduce the spread of COVID-19

179. Purpose built buildings will be constructed with on-site laboratory facilities provided as necessary. The administration building would include a working telephone, a facsimile machine and would be suitable for the storage of records.

- **Construction of the weighbridge system and Unloading Bay and its components**

180. The weighbridge should be located adjacent to the waste reception area and sufficiently far enough away from the public road to avoid queuing onto the road. Weighbridge is planned to be positioned at entrance of the facility. Weighing facilities should be adequate to accommodate the weighing of both incoming and outgoing traffic if necessary.

- **Construction of Material Recovery Facility (MRF) & Allied Machinery**
- **Landfill Site Construction**

181. The development of the landfill area will consist of the following activities:

- Excavation for landfill cell and bottom lining along with leachate collection and treatment pond & gas collection pipes;

[4] https://www.epa.ie/pubs/advice/waste/waste/EPA_landfill_site_design_guide.pdf

- Construction of the access ramps, leachate collection and treatment pond;
- Run off and run on collection network;
- Final capping and arrangements for gas venting and flaring;

Construction Machinery Requirement

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

183. The **Table 3.1**2 below outlines the approximate number of major machinery and vehicles that are envisaged to be required for the project construction works.

Table 3.12: Estimated Contractor's Equipment and Machinery

Sr. No.	Machinery / Equipment	Quantity required*
1	Excavators	2
2	Dumpers	2
3	Batching Plants	1
4	Loaders	2
5	Power Generators	4
6	Rollers	2
7	Tractor Trolley	6
8	Transit Mixer	1
9	Compactor / Roller	2
10	Crane	1
11	Crush Plant	1
12	Concrete Pump	1
13	Vibro Hammer	1
14	Welding Generators	2
15	Watering Tanks (moveable)	3
16	Haulage Trucks	20
17	Cars/Pickups	8

* Number of machinery is indicative and can be changed subject to working schedule.

Construction Materials Requirement

184. During the construction phase, construction materials in considerable volumes will be required. Typical material required for landfill cell development include base mineral liner, cap barrier layer, leachate drainage blanket; other drainage layers e.g. capping layer and groundwater/surface water, gas collection and venting system, road material and daily cover. The common source of the material require for civil work are described in **Table 3.13** below.

Table 3.13: Source of Raw Material

Sr.	Raw Material	Source
1	Earth Material	Available locally, borrowed from the lands acquired for the project.
2	Aggregate	Available at many sources within the vicinity of the site.
3	Rip-rap material	Available locally from nullah bed deposits and rock excavations.
4	Sand	Sand is available in near vicinity and river bed.
5	Water	Ground water is available at depth of 80-200 feet and it will be used for construction purpose.
6	Cement	Ordinary Portland Cement is suitable, which is available at various factories in Pakistan mainly from Peshawar or Mardan.
7	Reinforcement steel	Steel re-rolling mills in Peshawar meeting the standards from the billet produced either by Pakistan steel or imported. These will serve the purpose of steel availability.
8	Energy	Electricity supplies are available at the site through Mingora grid station, located at a distance of 6.5 km.

3.2.13 Operation Phase Details for SWMF

Scope of Activities

185. The activities to be conducted during the operational phase of proposed project are provided in **Table 3.14** below.

Table 3.14: Operation Phase Activities

Landfill Development	Operation activities involved
Waste hauling to LFS	The compactor truck will transfer waste from Mingora city to the landfill site.
Weigh Bridge and Unloading Bay	▪ Weighing operation ▪ Maintenance of mechanical and electrical equipment
Landfill site operations	▪ Waste inventory management ▪ Daily cover ▪ Material Recovery facility ▪ AD and Compositing facility ▪ Leachate management (i.e., collection, treatment and disposal) ▪ Landfill gas management (i.e., monitoring, collection, flaring) ▪ Environmental monitoring
General Operations	▪ Admin block operations ▪ Maintenance of equipment and machinery ▪ Vehicle servicing

Landfill Development	Operation activities involved
	▪ Disposal of solid waste and waste water generated during operations ▪ Workers Health and Safety ▪ Site Security

Operation Equipment and Machinery

186. The equipment required during the operation phase of the landfill site can be divided into three functional categories: waste movement and compaction, earth cover transport and compaction, and support functions. The **Table 3.15** below provides the equipment expected to be required for operation phase of the landfill site.

Table 3.15: List of Equipment and Machinery for operation phase of Landfill Site

Sr. No.	Machinery / Equipment	Equipment use in landfill operations	Quantity required*
1	Bucket Loader	It is used to fill earth cover material into vehicles at landfill site.	1
2	Chain Dozer	It is used for leveling of waste or excavated soil at the landfill site.	1
3	Trash Compactor	It is used for compaction, propulsion and spreading of waste in a landfill.	1
4	Hydraulic Excavator	It is used for Excavation purposes.	1

* Number of machinery is indicative and can be changed subject to working schedule.

Manpower Requirement

187. It is expected that existing organizational capacity of WSSC Swat may not be able to successfully run the future model, therefore, ISWM system along with human resource requirement will be proposed. The institutional design of the WSSC Swat and its linkage with line reporting departments would be reviewed. The agreement will be reviewed and KPIs would need to be aligned with the design of the solid waste management system.

188. An institutional review and capacity building firm has been engaged under the project to successfully operationalize the project and improve the capacity of WSSC Swat in terms of efficient SWM service delivery.

189. Estimated manpower requirements during construction phase of the project would be about 150 persons while during operation phase would be 50 persons.

3.2.14 Closure and Post Closure Plan of SWMF

190. Both the Closure and Post Closure plans will come into effect towards the end of the SWMF's useful life, usually 40 to 50 years from commencement of operation of the SWMF. In this time, there could be marked changes made to them depending on how environmental and socioeconomic conditions in and around the site and Mingora city have evolved.

191. The closure plan will include:

- Landfill cover and landscaping of the completed site;
- Long term plans for the control of runoff, erosion, gas and leachate collection & treatment.

192. Post closure plan will include:

- Routine inspection of completed landfill;
- Maintenance of surface water diversion facilities, landfill surface grades, the condition of liners;
- Maintenance of landfill gas and leachate collection equipment;
- Long term environmental monitoring plan so that no contaminants are released from the landfill site.

193. These plans have yet to be developed but will be customized to the proposed SWMF facility and will be prepared within first few years after commencement of the SWMF operation.

3.3 Instituional Review and Capacity Building (IRCB) Components

194. In order to execute successful operation of SWMF facility at Mingora, institutional review and capacity building (IRCB) component is included in the project design to enhance services delivery of WSSC Swat. PMU KPCIP has awarded IRCB contract to consortium of four firms in November, 2020. It is an integral part of the larger multi-year KPCIP. IRCB contract will facilitate improvements to the business model to ensure operational efficiency and sustainability. IRCB firm will conduct an applicable training needs assessment and training plans.

195. IRCB contract will facilitate performance benchmarking of KPCIP based on an understanding of current operations and developing an output-based monitoring system for impact of the planned subproject investments. IRCB will evaluate business model by considering following options.

- Service delivery by the WSSC Swat (or other government or quasi-government entity)
- Service delivery by outsourcing to a private sector provider
- Service delivery via a hybrid of the above two options
- Service delivery by other, innovative means, such as community initiative, that may not have been initially identified

196. PMU KPCIP will design capacity building interventions using participatory approach through IRCB contract. PMU KPCIP will define monitoring of IRCB contract in project administration manual and will closely monitor the effectiveness of IRCB contract within WSSC Swat.

3.4 Climate Risks from Project

3.4.1 Climate Change Trends and Extremes in Mingora[5]

197. Water stress, glacial retreat and permafrost conditions at higher altitude are considered as the key potential climate change impacts for Mingora city which can negatively affect urban infrastructure including Mingora SWMF. Climate Change is expected to adversely affect the Swat region by increasing the frequency and severity of natural disasters including avalanches, storms, droughts, riverine floods and cloudburst flashfloods (CBFF).

198. The average annual temperature in Mingora is 19.3°C | 66.7°F. With an average of 29.2°C | 84.6 °F, June is the warmest month. January has the lowest average temperature of the year. It is 7.5°C | 45.5°F. The average temperatures vary 21.7°C. The mean temperature reveals an increase of 0.9°C, maximum temperature 0.4°C and mean minimum temperature 0.5°Celsius (Kalam station, district Swat).

199. The precipitation regimes in project area are mainly controlled by monsoon rains from July to September; they have become more intense in recent years. Significant increasing trends in precipitation over time have been detected during the monsoon season.

200. During winter monsoon March receives 125 mm rainfall while during summer August receives maximum rainfall of 134 mm. Average total annual rainfall in the Mingora is about 897 mm.

201. Long term annual climatic patterns using standardized seasonal and precipitation time series data over a 51-year period (1961-2011) shows a decreasing trend during winters in the first decade, however the values seem to be increasing through 2010. The LOWESS curve for summer precipitation seems to be gradually increasing through the years. For the annual precipitation series, significant positive trends were detected at Saidu Sharif station (7.48mm/yr) from 1961 to 2011.

202. Monthly precipitation trends at Saidu Shareef station using the Mann-Kendall and Spearman's rho test showed a statistically significant increased precipitation trend from January to June and from October to December but a significant decline in July and August. Different studies have found a statistically significant increasing trend in winter precipitation for the northwest area of Pakistan however significant variations have been seen in summer precipitations during the 1961-2011 period.

203. These climate change patterns and socio-economic changes including rapid urbanization can cause urban flooding events. Intense precipitation as well as infrastructure developments that have reduced urban surface interception, flash floods are increasing, which are likely to continue to become more severe in the future. Urban flooding is largely due to intense precipitation and changes in land use (especially increased concrete surfaces due to residential and commercial area growth) and due to inadequate sewerage and drainage systems while the main nullahs, rivers, streams are flooded due to intense rainfall.

3.4.2 Climate Change Considerations for Landfill Site

[5] Climate data and findingd are adopted from Climate Risk and Vulnerability Assessment (CRVA) report for Mingora City.

204. Climate change can impact different aspects of the landfill site due to projected increased temperatures and intense floods from heavy rainfalls at the location of the landfill site. These climatic changes in the nearby areas can also have serious consequences at the landfill site due to flash flooding.

205. In addition to the impacts of changing climate, landfill sites can also be a source of greenhouse gas emissions which need to be considered for climate change mitigation options. These gases can also create a fire hazard due to a change the decomposition rates caused by increased temperatures.

206. Based on the Climate Risk and Vulnerability Assessment (CRVA) theoretical framework, it is important to assess the climate change exposure and sensitivity of the landfill site and suggest possible adaptation measures with respect to the identified elements. The suggested adaptation measures need to be monitored and re-evaluated as a continuous process during the operations for any required changes to ensure that the suggested measures are sustained over the life span of the landfill site. Three aspects of landfill site are assessed for potential climate change impacts (temperature, precipitation, winds, fire hazard) in terms of exposure and sensitivity: 1) underground components, 2) over-ground components and 3) Site infrastructure and operations, provided as **Table 3.16** below.

207. ***Climate Change Exposure of Landfill Site:*** This includes identification of climate change hazards in the context of potential climate scenarios. For example, precipitation changes can degrade covers of landfill. Moreover, a number of anthropogenic stressors, socio-economic and land-use changes near and around the landfill site in the future may complicate and exacerbate the above-mentioned climate change events and increase exposure of the site. Temperature changes can impact the compositing process and also can impact the decomposition process responsible for leachate production. For example, land-development can affect natural protective barriers. Some of these non-climatic stressors are provided in **Table 3.17** below.

208. ***Climate Change Sensitivity of Landfill Site:*** Likelihood of climate change related hazards are included in sensitivity assessment that could negatively affect the functioning of the landfill site including direct impacts (accessibility, physical damage, water damage) and indirect impacts (accidental fire, explosion or ecosystem damage). These direct and indirect impacts can affect the landfill site in terms of damage to liner or cover materials, washout of contaminated contents, leachate collection and removal, landfill gas management etc.

Table 3.16: Sensitivity Considerations for Landfill Site

Systems Components		Vulnerabilities		
		Physical Damage	Water Related Damage	Reduced Access
Landfill Components	Pipe systems for leachate treatment and disposal of landfill gas collection and transfer	X	X	X
	Transfer pumps for leachate and landfill gas	X	X	

Systems Components		Vulnerabilities		
		Physical Damage	Water Related Damage	Reduced Access
	Treatment pond for leachate	X		X
	Pre-treatment of landfill gas (coolers, condensers, blowers)	X	X	
	Landfill gas flares	X	X	X
	Storage containers for chemicals	X	X	X
	Disposal system for treatment residuals	X	X	X
	Discharge system for treated leachate	X	X	
	Auxiliary and monitoring equipment	X	X	
	Synthetic materials (e.g. geomembrane in liners or cover system, geotextile for leachate filtration)	X	X	
	Bottom layer of unlined waste		X	
	Vegetative layer for an evapotranspiration cover	X	X	
	Groundwater or landfill gas monitoring wells	X		X
	Composting facility & AD system	X	X	
	Material Recovery Facility	X	X	
Infrastructure and Landfill Site Operations	Surface water drainage systems	X	X	X
	Mobile Transfer Stations		X	X
	Fencing, boundary walls for access control and litter prevention	X		
	Unpaved road to landfill site			X
	Buildings, sheds etc.	X	X	X
	Natural gas and electricity connections/lines	X	X	X
	Fuel storage and transfer	X	X	X
	Water supply	X	X	X
	Machinery and vehicles	X	X	X

Table 3.17: Non-climate Stressors and Potential Impact on Landfill Site

Non-climatic Events	Potential Impacts on Landfill Site
Land-use changes (e.g. new housing schemes, commercial buildings, small businesses and other built environment etc.)	• Road leading to the site might be encroached or get congested in the future • Wastewater generation and its disposal from the new commercial and domestic activities
Agriculture practices (changes in cropping patterns and water usage)	• Seepage near the landfill site
Modification /construction of irrigation networks	• Seepage near the landfill site, flooding due to increased water usage

Construction of new roads	• Obstruction natural water ways might cause flooding
Groundwater contamination	• Groundwater aquifers contamination due to leachate

209. The above-mentioned sensitivity and exposure analysis is based on available information in the concept designs, detailed design, other reports and information on general components of a landfill site.

4 Description of Environment

4.1 General

210. Mingora is surrounded by Chitral, Upper Dir and Lower Dir in the West, Gilgit-Baltistan in North Kohistan, Buner and Shangla in the East and South East. It is located at an altitude of 950 meters and about 2 kilometers away from Saidu Sharif, the present administrative capital of Swat. The city of Mingora serves as a gateway to the popular tourist destinations like Kalam valley, Kumrat valley, Maydan, Bahrain, Marghazar, Miandam, Malam Jabba and Saidu Sharif.

211. The proposed SWMF site is located at Katwaro Maira in the outskirts of Mingora city at a distance of approximately 4.4 km from the city center.

212. The description of various features of the project area environment including the physical, ecological, cultural and socio-economic environmental aspects are presented in the following sub-sections.

4.2 Physical Resources

4.2.1 Topography

213. Topography of Mingora is compised of mountains ranges (offshoots of Hindukush) and associated valleys with plains. This range runs in the general direction of North and South and has a varied elevation within the Swat area, beginning from 600 meters above sea level in the South and rising rapidly up towards the North, to around 6,000 meters above sea level. Proposed SWMF site is located in hilly terrain.

4.2.2 Soils

214. The Mingora is covered with un-consolidated deposits of silt, sands and gravels. The surface soil materials are less deposits, residual mantle on sandstones and shale bedrocks, or narrow strips of silty/loam alleviation along major streams. The soil characteristics vary within the area depending upon the parent material and the soil age. Inseptisols, Entisols and Ardisols are the dominant soil types.

215. The proposed landfill site comprises of unconsolidated surficial deposits of silt, sand and gravels.Based on detailed geotechnical investigations, it has been assessed that the ground comprises of Firm to Stiff to Very Stiff Lean Clay/Silty Clay up to a depth of 4.0 m underlain by Medium Dense Clayey Sand with Gravels/Silty Sand up to a depth of 10.0 m underlain by Firm to Very Stiff Silt/Sandy Lean Clay with Gravels up to maximum investigated depth of 25.0 m below EGL.

216. The average Net allowable bearing capacity of the Isolated Foundation at a depth of 1.0 m (Width ranging from 1.0 m to 3.0 m) below EGL is 1.00 tsf, while average Net allowable bearing capacity of the Strip Foundation at a depth of 1.0 m (Width ranging from 1.0 m to 3.0 m) below EGL is 0.89 tsf.

217. In addition, a summary of the ground soil conditions based on two boreholes conducted across the proposed project site are provided as **Table 4.1** below.

Table 4.1: Summary of ground conditions across Project Site

Borehole No.	Top Depth (m)	Bottom Depth (m)	Description
BH-01			
BH-01	0	4	Brown, Firm to Very Stiff, Low Plastic, Low Dry Strength, Dry, Lean Clay with Sand.
BH-01	4	9	Grey, Medium Dense, Coarse Grained, Dilatency Low, Dry, Clayey Sand with Gravel. Gravel, are subrounded and elongated. Gravel are of igneous and metamorphic rock origion.
BH-01	9	15	Brown, Firm to Very Stiff, Low Plastic, Low Dry Strength, Dry, Sandy Lean Clay. Little Fine Gravel. Gravel are subrounded and elongated. Gravel are of igneous and metamorphic rock origin.
BH-01	15	25	Grey, Medium Dense, Coarse Grained, Dilatency Low, Dry, Silty, Clayey Sand with Gravel. Gravel are subrounded and elongated. Gravel are of igneous and metamorphic rock origin. Coarse Gravel and Boulder detachment of (12.00-13.00) cm encountered from (20.00-25.00) m.
BH-02			
BH-02	0	1	Brown, Stiff, Low Pastic, Low Dry Strength, Dry, Silty Clay.
BH-02	1	10	Grey, Medium Dense, Coarse Grained, Dilatency Low, Dry, Silty Sand.
BH-02	10	17	Brown, Very Stiff, Non Plastic, Low Dry Strength, Silt. Trace Fine Gravel. Gravel are rounded and elongated. Maximum Gravel size is 4cm. Gravel are of Metamorphic rock origin.
BH-02	17	25	Grey, Medium Dense, Coarse Grained, Dilatency Low, Wet, Silty Sand with Gravel. Gravel are rounded and elongated. Max. Gravel size is 4 cm. Gravel are of Sedimentary rock origin, boulder detachment 10-13cm of Metamorphic nature, loose sediments.

218. Baseline quality of soil at existing dumping area and surrounding proximity of landfill site will be carried out prior to closure of the existing dumping site and commencement of landfill operation to assess any possible contamination.

219. In addition, the recommendations of the geotechnical investigation of the project site are as follows:

Formation of Temporary and Final Cover

- Soil or similar inert material should be used for the lifetime of the landfill site, to cover the waste on a regular basis. Extra thickness of "final cover" material shall also be required once the site has reached completion.

- The simple spreading of daily cover is a very effective way to reduce the attraction of waste to birds, suppress odor, prevent fly infestations, discourage rats and other animals, to reduce exposure to atmosphere conditions and to reduce wind blow litter.

- Ideally, cover material should be taken from within the site, increasing the available space for waste disposal and reducing the need to bring material from elsewhere.

- The material excavated from the site should be adequate for use a temporary and final cover material. Final confirmation should be made on remolded permeability of the representative samples taken from the borrow source if adopted. At this time, it is expected that the soil removed during excavation will be used.

- The soil should be compacted to at least 95 percent of the modified proctor density within a moisture content range of 0 to 3 percent wet of optimum.

Excavation at Site

- The excavation required for the construction of foundation up to a shallow depth of about 1.0 m, can be made without provision of any supporting system. The provision of dewatering must be kept in the scope of work of construction due to possibility of rainy season, during construction.

- The excavation for the land fill area can be easily done with simple mechanical means. Since the adjacent areas are open therefore, no major stability issues are anticipated to results in to property loss, however, it is recommended to excavate at a slope angle established by hit and trial method at site for an excavation of about 10 m, which is foreseen in the light of current ground conditions.

- As a broad guideline it is suggested to adopt a slope angle of 2H: 1V, however, based on hit and trial method adopted at site, the angle can be further steepened.

Liquefaction Potential

- Liquefaction is a loss of the shear strength of a soil that occurs when the ground experiences strong ground shaking. The phenomenon may result in large total and/or differential settlement beneath structures founded on the liquefying soils. In order for the potential effects of liquefaction to be manifested at the ground surface, the soils generally have to be granular, loose to moderately dense, saturated relatively near the ground surface, and must be subjected to a sufficient magnitude and duration of shaking.

- According to the grading for the proposed Landfill Site, surficial soils will be removed so that the proposed filling will be directly underlain by medium dense to dense Sandy silty gravels. Due to the lack of a week sandy soil, and the competency of the ground, the potential for significant, large-scale liquefaction effects and associated dynamic settlement to cause damage to the composite liner system and other site facilities is relatively low.

220. In addition, the following additional recommendations have been made:

- Proper paving should be provided along the periphery of the Structure.

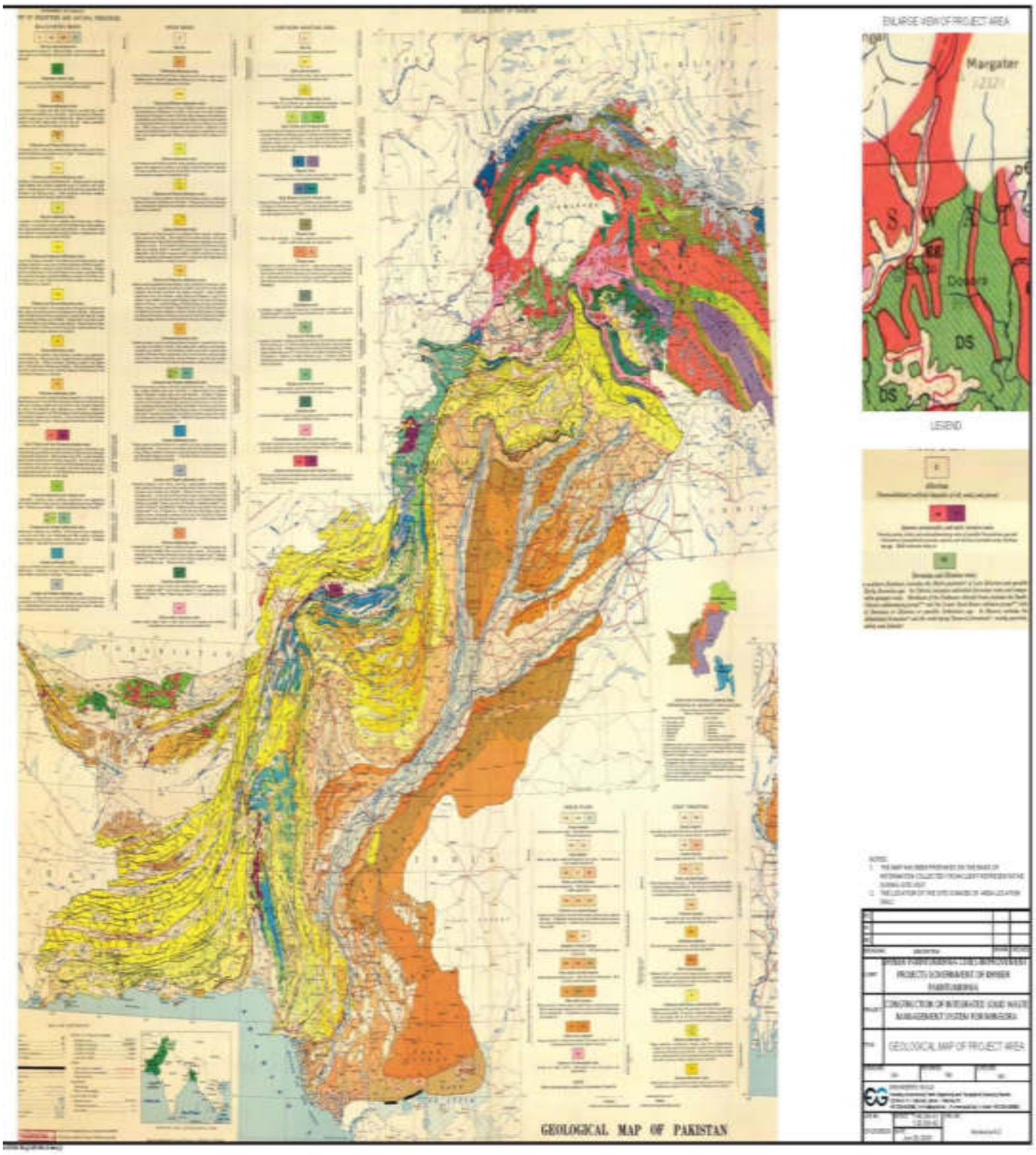
- All the backfilling of the foundation above concrete pad should be done with cohesive material to avoid seepage of water in the foundation base. Alternatively, the top 30 cm of any backfilling should be carried out with non-swelling cohesive soil.

- Adequate water proofing/damp proofing shall be provided for the structure. To avoid problem regarding moisture, it is recommended to adopt water-reducing admixtures in concrete.

- If any soft and loose material encountered, at foundation excavation level, during construction, then it should be further excavated and replaced with suitable granular material in proper compaction.

- Cement coatings should also be provided to avoid moisture movement through the concrete.

Figure 4-1: Geology of Project Area



4.2.3 Climate

221. The Mingora lies on 950 m above sea level. In Mingora, the climate is warm and temperate. Mingora has a significant amount of rainfall during the year. This is true even for the driest month. Climate is characterized by hot-summer Mediterranean. According to Köppen and Geiger, this climate is classified as Cfa. Climate profile of Mingora is provided in **Table 4.2.**

Table 4.2: Climate Data of Mingora City

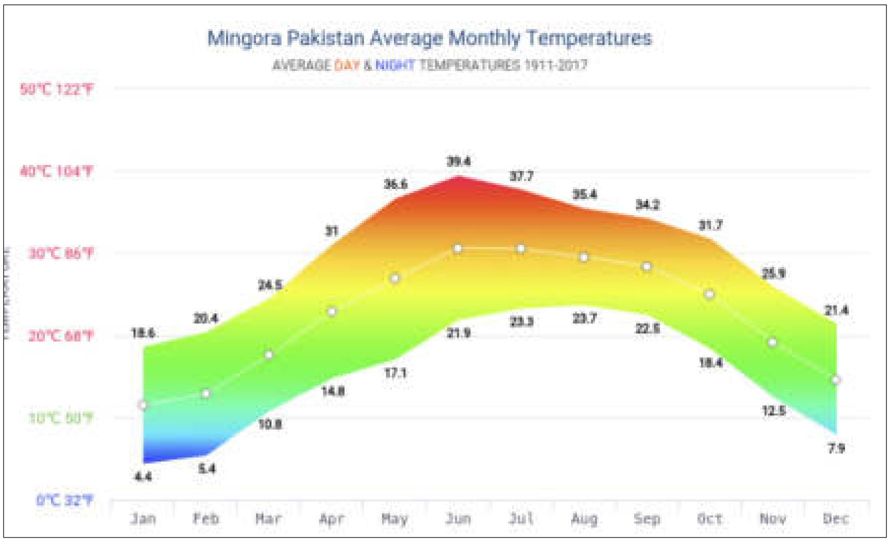
Climate data for Mingora [hide]													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	13.0 (55.4)	15.8 (60.4)	20.2 (68.4)	25.6 (78.1)	31.7 (89.1)	36.8 (98.2)	35.4 (95.7)	33.7 (92.7)	32.3 (90.1)	28.0 (82.4)	21.8 (71.2)	15.3 (59.5)	25.8 (78.4)
Daily mean °C (°F)	7.6 (45.7)	10.3 (50.5)	14.2 (57.6)	19.2 (66.6)	24.5 (76.1)	29.2 (84.6)	29.0 (84.2)	27.8 (82.0)	25.6 (78.1)	20.5 (68.9)	14.6 (58.3)	9.4 (48.9)	19.3 (66.8)
Average low °C (°F)	2.1 (35.8)	4.8 (40.6)	8.2 (46.8)	12.7 (54.9)	17.3 (63.1)	21.6 (70.9)	22.6 (72.7)	21.9 (71.4)	18.9 (66.0)	12.9 (55.2)	7.4 (45.3)	3.5 (38.3)	12.8 (55.1)
Average rainfall mm (inches)	81 (3.2)	98 (3.9)	125 (4.9)	90 (3.5)	46 (1.8)	31 (1.2)	130 (5.1)	134 (5.3)	64 (2.5)	28 (1.1)	22 (0.9)	48 (1.9)	897 (35.3)

Temperature

222. The average annual temperature in Mingora is 19.3°C | 66.7°F. With an average of 29.2°C | 84.6 °F, June is the warmest month. January has the lowest average temperature of the year. It is 7.5°C | 45.5°F. The average temperatures vary 21.7°C. The mean temperature reveals an increase of 0.9°C, maximum temperature 0.4°C and mean minimum temperature 0.5°Celsius (Kalam station, district Swat).

223. The warm season lasts from the May to August with an average daily maximum temperature of above 36°C. The cold season lasts from the October to April with an average daily minimum temperature below 20°C. The temperature trend analysis of Mingora (1911-2017) is shown as **Figure 4.2** below.

Figure 4-2: Temperature trend analysis of Mingora (1911-2017)

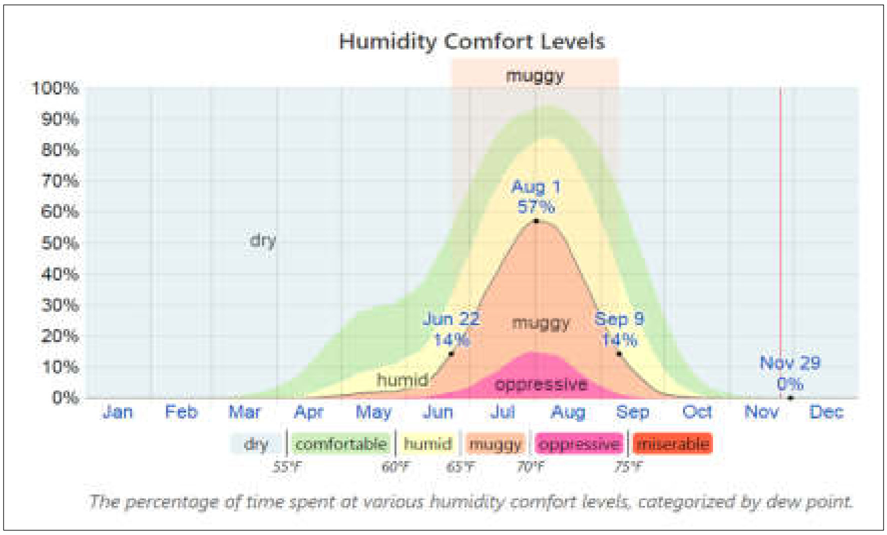


Relative Humidity

224. Mingora experiences extreme seasonal variation in the perceived humidity. The muggier period of the year lasts for 2.6 months, from June 22 to September 9, during which time the comfort level is muggy, oppressive, or miserable at least 14% of the time. The muggiest day of the year is August 1, with muggy conditions 57% of the time as can be seen in **Figure 4.3** below.

225. The air is driest around Jan-Mid March and in Nov-Dec at which time the relative humidity drops to 0%.

Figure 4-3: Humidity Profile of Mingora City[6]

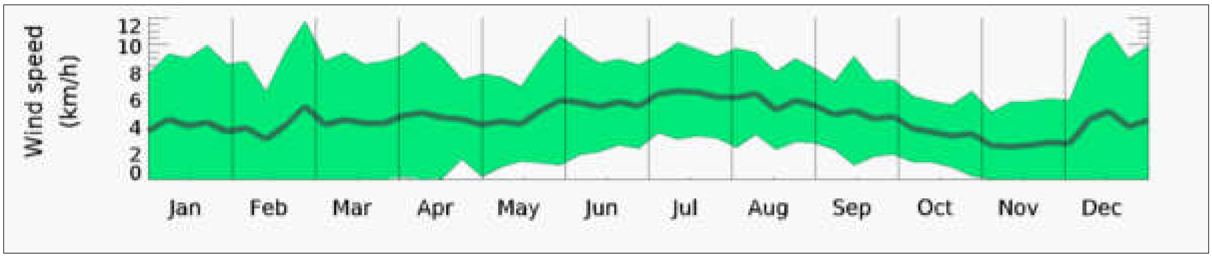


[6] https://weatherspark.com/y/107422/Average-Weather-in-Mingora-Pakistan-Year-Round#Sections-Humidity.

Wind Speed

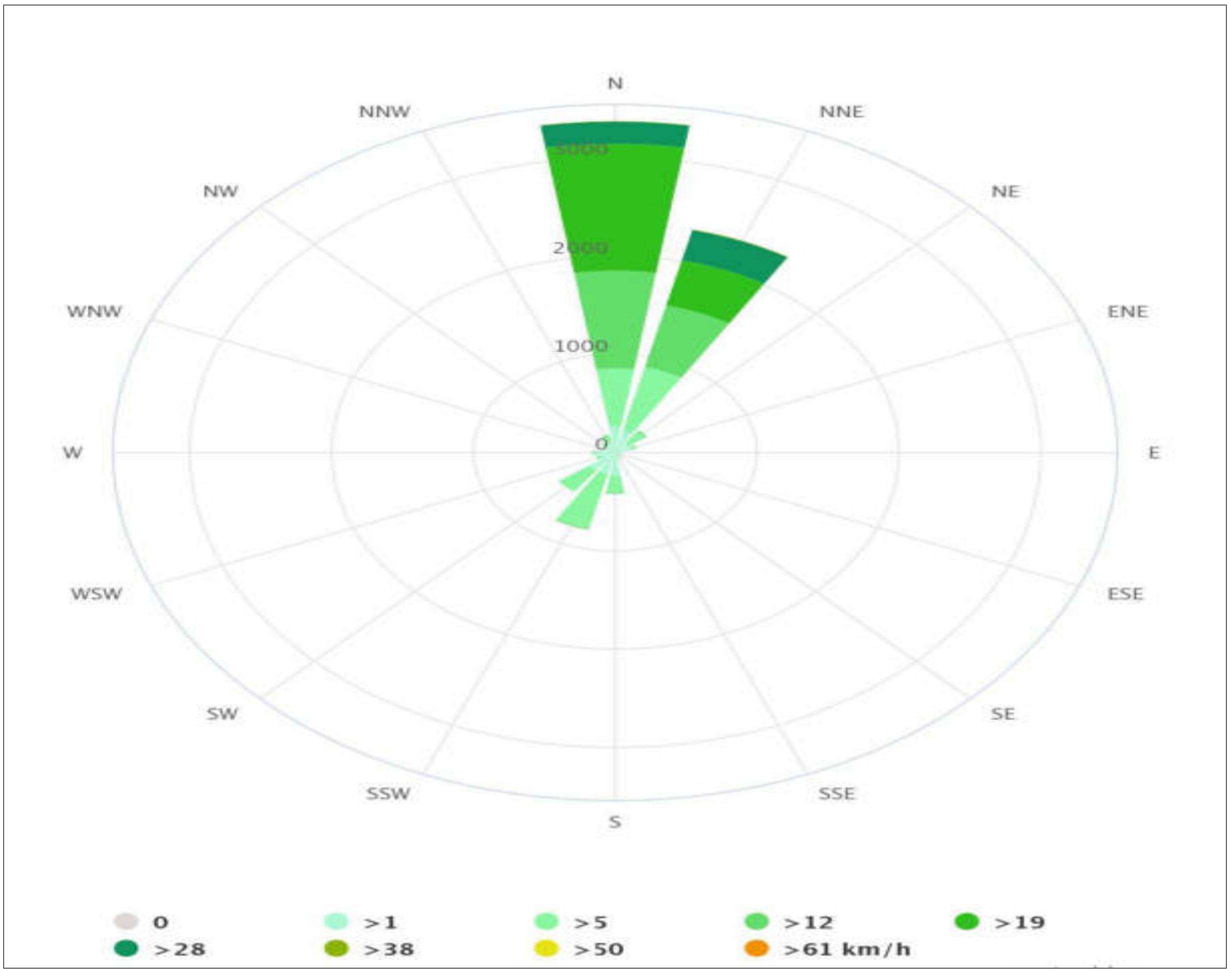
226. Over the course of the year, the typical wind speed vary between 0 km/h and 8 km/h (moderate to high breeze), rarely exceeding 12m/s (strong breeze) as can be seen in **Figure 4.4** below. The Wind speed for Mingora is provided as **Figure 4.5** below.

Figure 4-4: Wind Speed Profile of Mingora City



227. Dominant direction of wind in Mingora is north side and north to north east side. The Windrow profile for Mingora is provided as **Figure 4.5** below.

Figure 4-5: Wind rose for Mingora[7]

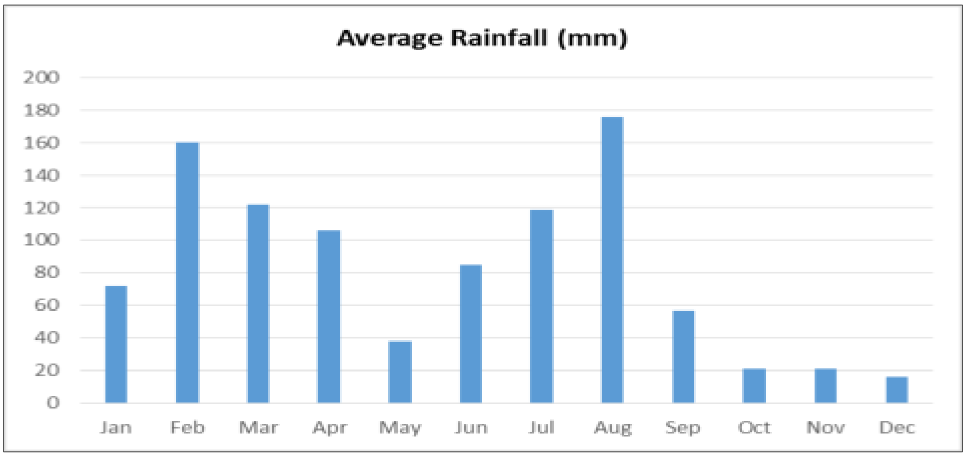


[7] https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/mingora_pakistan_1170395, The meteoblue climate diagrams are based on 30 years of hourly weather model simulations and available for every place on Earth at 30 Km spatial resolution.

Precipitation

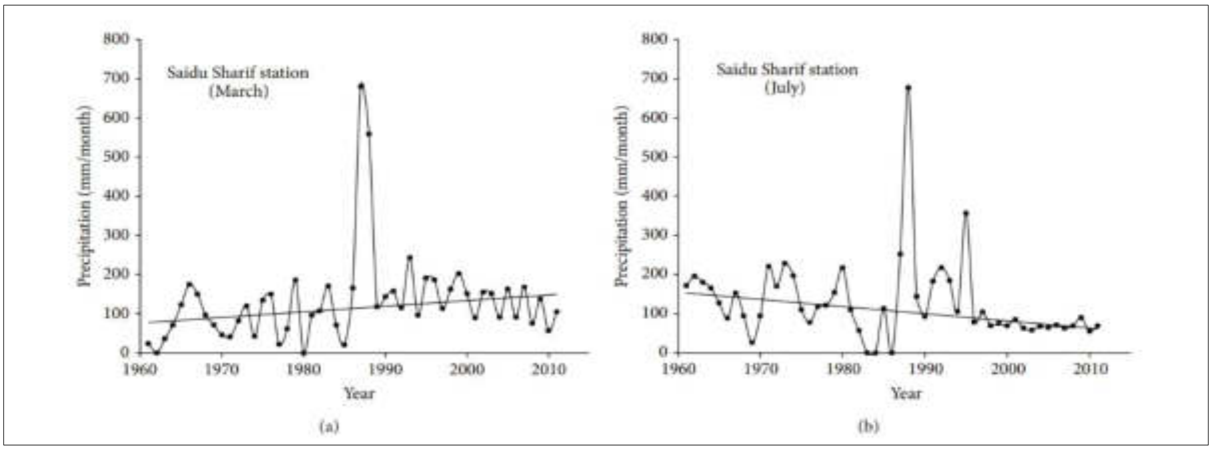
228. The city's average annual rainfall in Mingora is 933 mm while monthly average rainfall stands at 82 mm. About 176 mm rainfall observed in month of August while minimum rainfall of 16 mm observed in month of December. Average annual rainfall of Mingora city is shown in **Figure 4-6**.

Figure 4-6: Average Rainfall Profile of Mingora City



229. Long term annual climatic patterns using standardized seasonal and precipitation time series data over a 51-year period (1961-2011) shows a decreasing trend during winters in the first decade, however the values seem to be increasing through 2010. The LOWESS curve[8] [9]for summer precipitation seems to be gradually increasing through the years. For the annual precipitation series, significant positive trends were detected at Saidu station (7.48mm/yr) from 1961 to 2011 provided in **Figure 4-7**.

Figure 4-7: Precipitation trend analysis of Saidu Shareef (1960-2011)



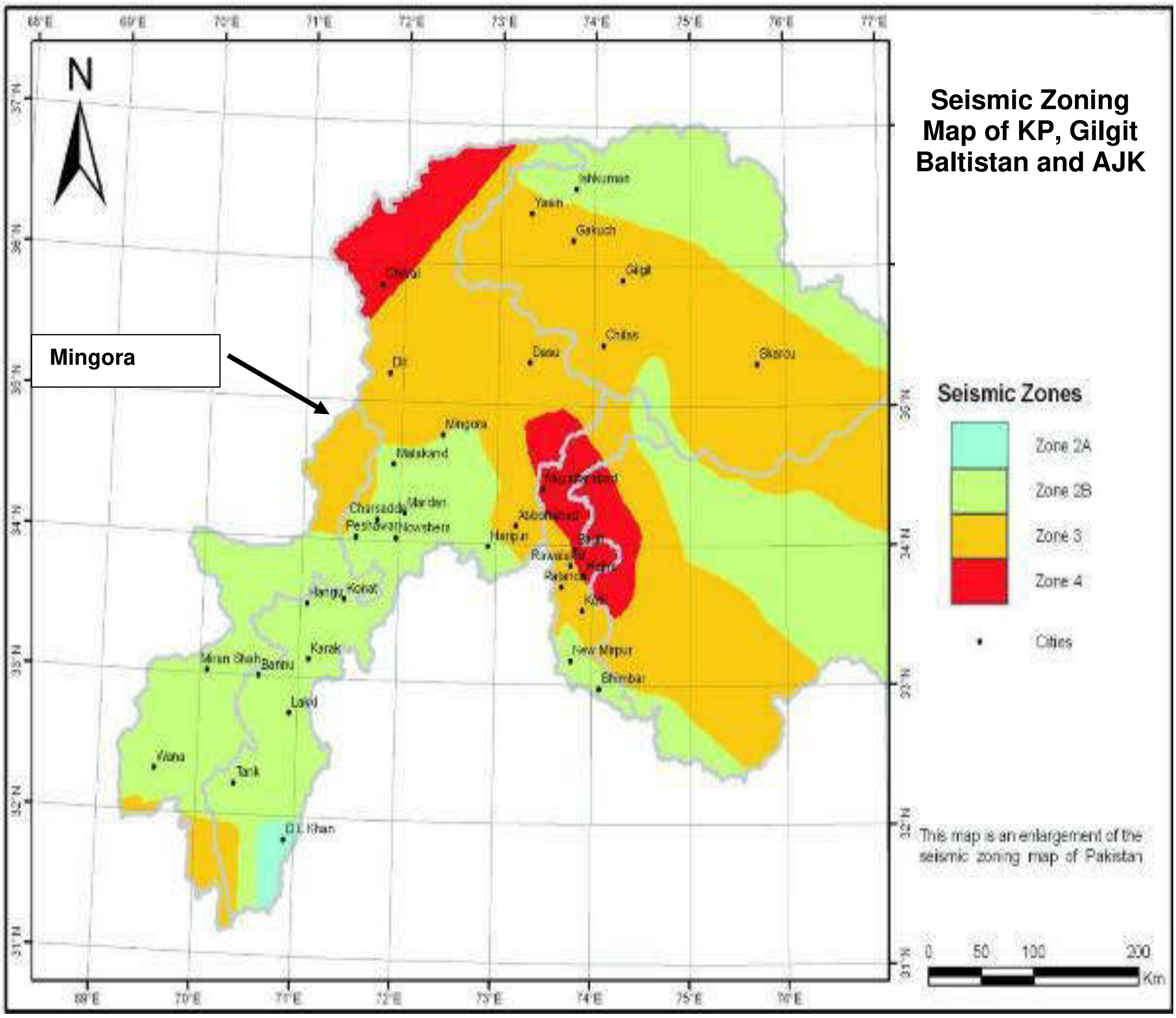
[8] To reduce local fluctuations, LOWESS [53–55] curves were fitted over time based on seasonal and annual precipitation time series data.

[9] D. R. Helsel and R. M. Hirsch, "Statistical methods in water resources," in Techniques of Water Resources Investigations, Book 4, chapter A3, p. 522, U.S. Geological Survey, 2002.

4.2.4 Seismology

230. The seismic zone map of Pakistan is shown in **Figure 4.8** below. Mingora is placed in Zone 3. It is therefore, recommended that the project structures should be designed to cater for the requirements of Zone 3 of Building Code of Pakistan (2007).

Figure 4-8: Seismic Zones of Pakistan



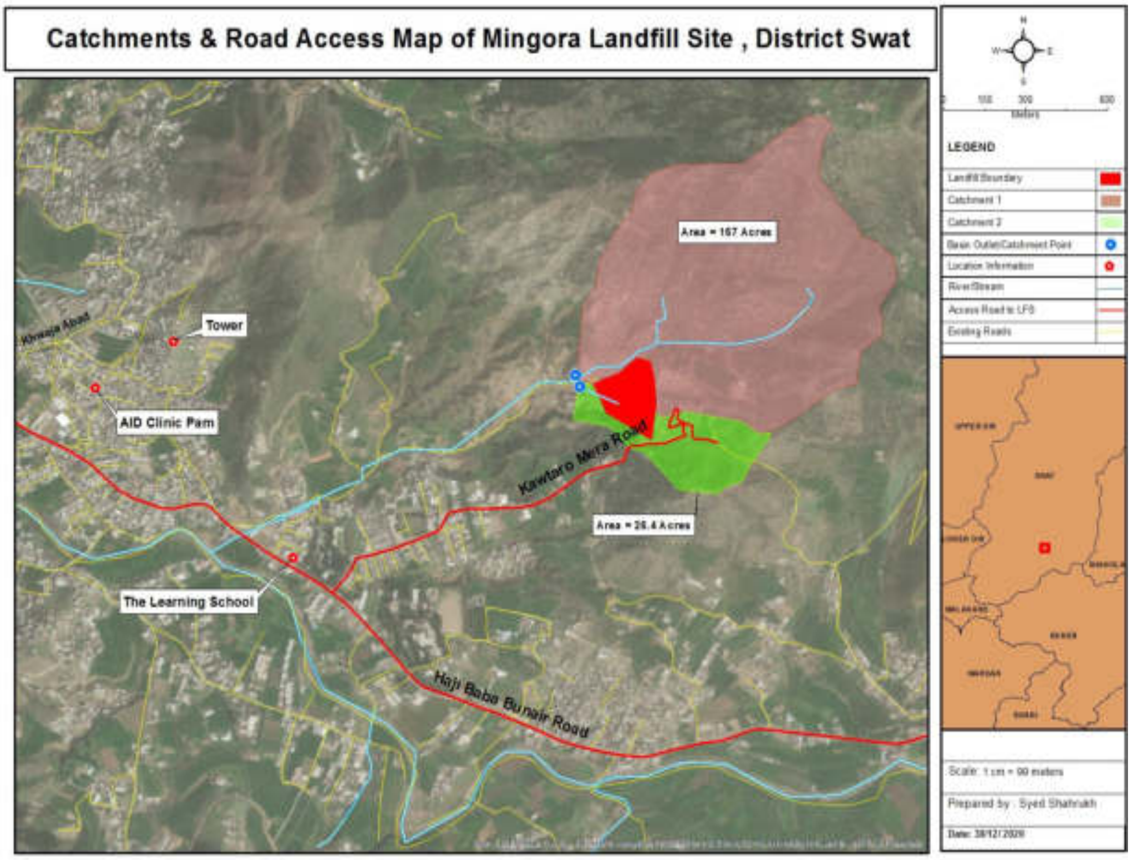
4.2.5 Surface water

231. The project is located in the catchment area of the Swat River. There are many hill torrents and streams which collect the rain water run–off or seepage water in the form of springs that ultimately drain into the Swat River.

232. The Swat River rises from the Shandur or Mashabar Range bordering Swat district with Chitral in the north and flows south and south–west approximately dividing the district into two halves. The other prominent rivers are Harnoi Khwar, Deolai Khwar and Daral Khwar. In addition to this, some small channels also originate from hills and joins Swat River. Village communities have designed irrigation channels and the river water is diverted to these channels for irrigation purposes.

233. As far as the project area is concerned, there are no water bodies lying in close proximity of the project site, apart from one seasonal drain located within 100 m from the site and this drain is dry most of the year. Catchment map of the stream is provided as **Figure 4-9.**

Figure 4-9: Catchment and Road Access Map of Mingora Landfill



4.2.6 Groundwater

234. The boring of tubewells to obtain ground water is a standard practice being implemented by the residents of Mingora to ensure a continuous supply of water which has led to a reduction in the water table of 40 feet over the last 02 years.

235. Presently, water need of Mingora is mainly met by groundwater resources however due to increase urbanization, the residents of different areas of Mingora usually face water shortage particularly during summer season.

236. The WSSC Swat is planning a Gravity Water Supply Scheme to be design for a daily flow rate with capacity of 30 million gallons per day (MGD) to meet the growing requirements of Mingora.

237. As part of EIA baseline, two ground water samples were collected and analyzed from EPA certified lab. The results of the tests are presented as **Annexure D**, which indicates that all parameters of the ground water samples taken are within the applicable NEQS/WHO guidelines with no exceedances observed. Ground water sampling location map is provided as **Figure 4.10.**

238. Ground water table in the project area is at depth of 80 ft. Maximum depth of landfill cell is 3 meters or 10 ft. Ground water table is at reasonable depth from landfill cell and further bottom lining of landfill cells will control seepage of leachate. The likelihood of the liner bursting for a new landfill site is quite remote since high quality liner will be installed and in addition, it will be ensured that all countermeasures in terms of liner design are in place to prevent breakage of liner.

239. Further active life of landfill cell is about 4-5 years and after that Final capping will be placed. After final capping there are minimal chances of percolation of water in the landfill cell and hence limited leachate production. Possibility of a liner breakage is not expected to take place for at least 5 years or so from its time of installation. Further leachate collection system will be in place at bottom lining of the landfill cell and it will work even after final capping of landfill cell to collect and treat any volume of leachate. Keeping in view these design considerations leachate percolation to ground water is not expected. Also, ground water quality monitoring wells are incorporated in the project design. Ground water quality will be monitored on frequent intervals to assess any leachate contamination. If required, ground water samples of surrounding areas will also be analysed to trace any leachate contamination.

4.2.7 Noise

240. The map showing the selected ambient noise monitoring locations are shown in **Figure 4.10** below with the comparison of the results also presented in **Table 4.3** below. While the results indicate the ambient noise levels being within the most stringent guidelines during the daytime, however, exceedances were observed at the night time at two locations in the project area. There are six nearest sensitive receptors (with respect to noise) form the proposed landfill cells which are residential housing however these are located at a distance of 200 meters. During construction phase noise impacts are of short duration and necessary mitigation measures will be adhered to therefore no noise siginifcant noise sensitivities are involved in the project area. Noise monitoring results are attached as **Annexure D.**

4.2.8 Air Quality

241. The map showing the selected air quality monitoring locations are shown in **Figure 4.10** below with the comparison of the results presented as **Table 4.4** below. Ambient air quality has been carried out in all the directions of the landfill site and locations have been selected keeping in view of the wind direction during the monitoring activity. There are six nearest sensitive receptors (with respect to ambient air quality) form the proposed landfill cells for which mitigation measures are proposed in the EIA. Results of 24 hourly Ambient Air Monitoring from EPA Approved laboratory has been attached as **Annexure D**.

242. As can be observed, in general the air shed seems to be of good quality with the ambient air quality within the acceptable NEQS standards with PM_{10} being the only pollutant that is exceeding the guidelines at all monitored locations.

Figure 4-10: Sampling Locations for Environmnetal Monitoring

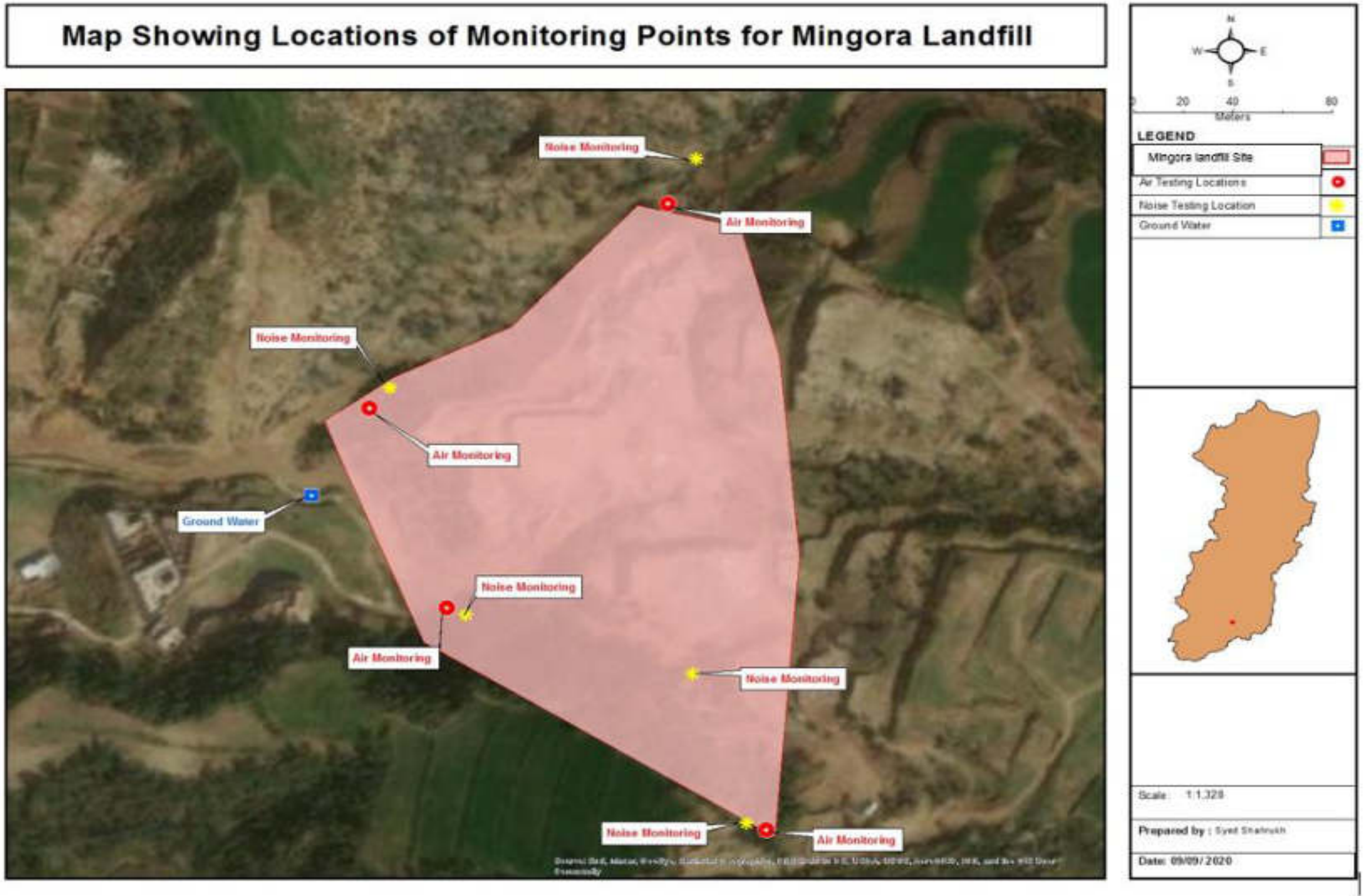


Table 4.3: Ambient Noise Monitoring Results in Project Area

Monitoring Location	Parameter	Noise Reading Results	Noise Guideline (Commercial Area)	Compliance Status for Commercial Areas
Day Time Readings (08:00 AM)			**Day time**	
North Side of Site	dB(A) Leq	**44.2**	65	
South Side of Site		**45.3**		
East Side of Site		**41.73**		
West Side of Site		**44.2**		
Near Grave Yard, Katwaro Maira		**54.55**		
Night Time Readings (08:00 PM)			**Night time**	
North Side of Site	dB(A) Leq	**46.8**	55	
South Side of Site		**47.9**		
East Side of Site		**44.3**		
West Side of Site		**46.8**		
Near Grave Yard, Katwaro Maira		**57.15**		

Exceedance from applicable guidelines

'Within' applicable guidelines

Table 4.4: Comparison of ambient air quality results versus applicable Air Quality standards[10]

Monitoring Location	Parameter	NO (ug/m³)	NO_2 (ug/m³)	CO (ug/m³)	SO_2 (ug/m³)	$PM_{2.5}$ (ug/m³)	PM_{10} (ug/m³)
Applicable Guideline (ug/m³) for 24 hrs	**Average**	**-**	**80**	**-**	**20**	**25**	**50**
North Side	-	11.89	13.14	0.88	15.55	21.17	77.8
South Side	-	10.91	11.69	0.84	14.35	23.02	82.3
South West Side	-	10.8	10.45	0.87	13.17	22.6	81.4
West Side	-	0.72	10.65	10.99	12.59	19.28	78.4

[10] The ambient air quality was monitored using the AQM 65, which is a fully integrated air monitoring station that delivers near reference levels of performance. The AQM 65 offers the optimal balance for measuring crtieria pllutants to WHO air quality limits. With the AQM65 continiously measuring of common air pollutants was carried out and then results are produced on 24 hours average. AQM 65 esnures air quality data is reliabale and robust in compliance to USEPA (40 CFR Part 53) and EU (2008/50/EC).

Exceedance from applicable guidelines

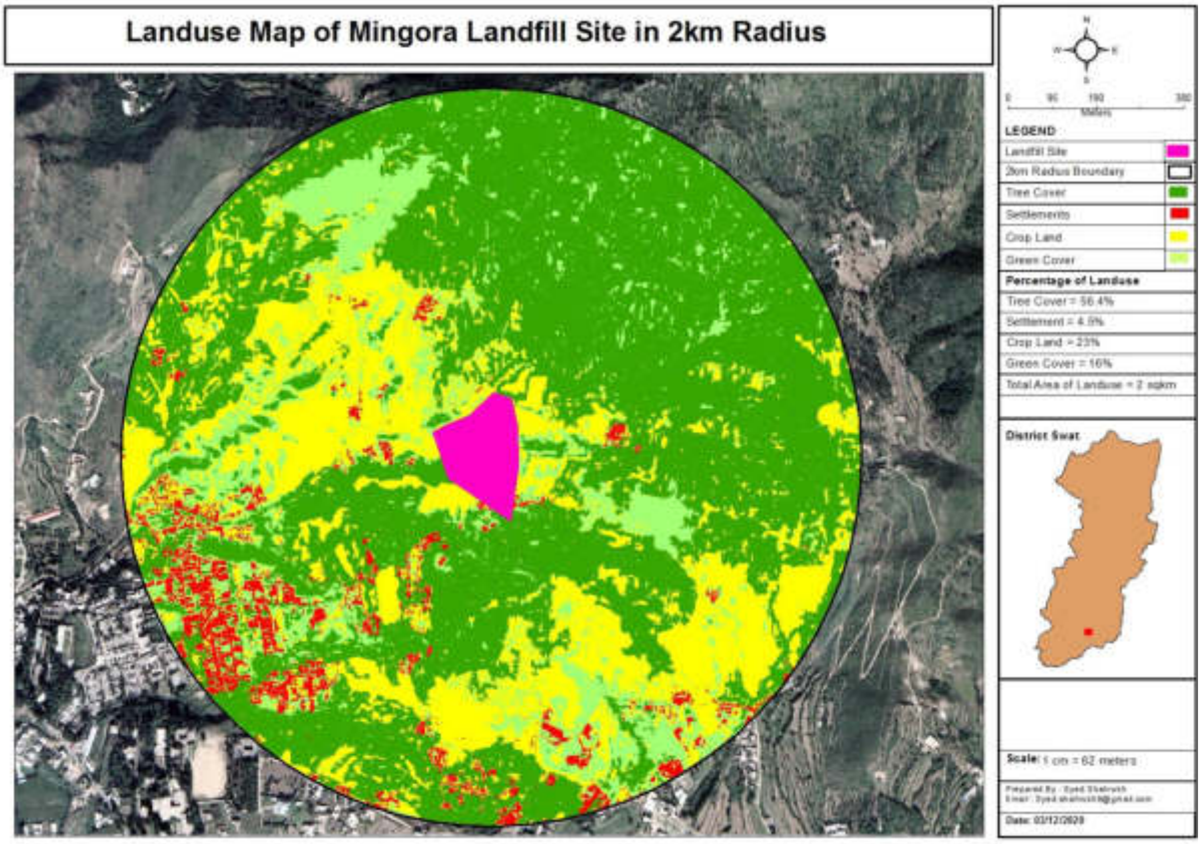
'Within' applicable guidelines

4.2.9 Land Use

243. Current landuse of the project area (2 Km radius for landfill site) shows tree cover (56.4%) followed by crop land (23%), Green cover (16%) and settlements (4.4 %). Land use map of the project area is shown as **Figure 4-11.**

244. Study[11] on Landuse land cover change assessment in Swat valley suggests significant decrease in dense forest cover (13.42 %), snow (8.45 %) and pastures (10.76 %), and significant increase in agricultural landuse (14.59 %) and mixed class (14 %). The decrease in the forest cover and pastures and consequent increase in the agricultural land use is more likely because of urbanization and legislation. There is decreasing trend observed in snow cover due to increased temperature.

Figure 4-11: Land Use Map of the Project area



245. The names of the major settlements falling in the project area are Katwaro Maira village, Dangram village, Sherarai village, Alahabad colony, Labor colony, Govt KPK Housing society etc. These areas consist of small residential colonies with poor road access. Total acquired area is about 66 comprising of cultivated area and barren area as major landuse.

[11] Ali, Sajid, Wajid Ali, Salman Khan, Muhammad Fawad, and M. Waqas Javed. "Landuse-land cover change assessment in Swat valley." *Journal of Himalayan Earth Science* 45, no. 2 (2012).

246. Typical setting and present landuse of the landfill site is provided in **Figure 4-12** below**.**

Figure 4-12: Typical setting and existing landuse of project site

Project area view

Seasonal stream on east side of site

Open dumping of waste at proposed landfill site in Katwaro Maira area

Unconstructed access track to landfill site

4.3 Ecological Environment

247. In order to identify ecological resources, ecological baseline survey was carried out by EDCM team. Detailed surveys were conducted for project scoping during mid of August, 2020. Swat share three major ecological zones of the Himalaya-Karakorum-Hindukush System however due to urbanization at higher pace ecological environment is degrading and mixed class of sub-urban and hilly terrain is increasing.

248. The project area was also screened for ecological sensitivities using the Integrated Biodiversity Assessment Tool (IBAT) with its outputs provided as **Annexure P.** The tool was run for three buffer zones (3, 5 and 10 km). The findings of IBAT were correlated with the primary and secondary data collected as part of the detailed scoping activities conducted during preparation of this study. It was observed that IBAT correctly stated that no protected areas and/or key biodiversity areas are present within these three buffer zones. Furthermore, it stated that within a 50 km area of interest, there are possibly 27 species that are listed in the IUCN Red List, consisting of terrestrial, marine and freshwater species.

249. An official letter from the KPK Wildlife Conservator, confirming that 'Neither wildlife sensitive areas nor corridors for endangered species fall in and around the proposed landfill site' was obtained and is provided as **Annexure R** of this report.

250. There is no protected area/critical habitat in the vicinity of the project area. Project area is rich in avifauna diversity due to dense patches of flora. Most of avian species are found in large numbers as there were many places of shelters for their breeding and other activities. Bird game activities are quite low in the study area due to previous cease fire in Swat valley back in 2009. No migratory birds or their routes were found near the project site.

251. Fizaghat pheasantry was established in 1997 over an area of 2 kanal. It is situated at a distance of about 5 km from Mingora city and about 9-10 Km from the project site. The pheasantry plays an important role in promoting education, awareness, recreation, and captive breeding of important wildlife birds. The pheasantry houses 11 species including pheasants and partridge. Because of its location and easy accessibility, the pheasantry is visited by large number of visitors including students and general public for recreation and awareness.

4.3.1 Flora

252. The present flora of the cultivated areas around Mingora is exotic. The common trees are Phulai, Honey Mesquite, Ber, Jand, Mulberry, Indian rosewood, Tamarisk and blue gum. The most common shrubs Turmeric, Small red poppy and spear grass. Dominant flora species in the project area shown in **Table 4.5** below.

Table 4.5: Existing Flora in Project Area

Scientific Name		Common Name	IUCN Status
Tree	*Acacia modesta*	Phulai	Data Deficient (DD)
	Prosopis glandulosa	Honey Mesquite	Least Concern (LC)
	Ziziphus mauritiana	Ber	Least Concern (LC)
	Prosopis cineraria	Jand	Data Deficient (DD)
	Morus	Mulberry	Data Deficient (DD)
	Dalbergia sissoo	Indian rosewood	Data Deficient (DD)
	Tamarix	Tamarisk	Data Deficient (DD)
	Eucalyptus globulus	Blue gum	Least Concern (LC)
Shrub	*Curcuma longa*	Turmeric	Data Deficient (DD)
	Papaver rhoeas	Small red poppy	Least Concern (LC)
	Heteropogon contortus	spear grass	Data Deficient (DD)
Grass	*Digitaria sanguinalis*	crabgrass	Data Deficient (DD)
	Carthamus balearicus	Wild Safflower	Near Threatened (NT)

Source: EDCM Ecology Survey, August 2020

4.3.2 Fauna

253. The fauna present in the project area of the landfill site is provided in **Table 4.6** below.

Table 4.6: Existing Fauna in Project Area

Scientific Name	Common Name	IUCN Status
Herpestes edwardsii	Indian Grey Mongoose	Least Concern (LC)
Canis Aureus	Golden Jackal	Least Concern (LC)
Capra aegagrus	Wild Goat	Vulnerable (VU)
Phasianus colchicus	Pheasant	Least Concern (LC)
Naja Nigricollis	Black-necked Spitting Cobra	Data Deficient (DD)
Equus asinus × Equus caballus	Mule	Data Deficient (DD)

Source: EDCM Survey, August, 2020

254. Important avian species found in the vicinity of the project area are mentioned below in the **Table 4.7** with their diversity status.

Table 4.7: Avifauna of the Project area[12]

Birds		
Scientific Name	**Local Name**	**Status**
Aythya baeri	Shingare	Summer Migrant, Rare
Apus	Lagarai	Migratory, Rare
Calidris ferruginea	Tum Tel	Summer migrant, common
Ardea cinerea	Bagh	Resident, Rare
Ciconia	Zanrai	Resident, Common
Columba rupestris	Shna Kautara	Summer migrant, common
Coturnix coturnix	Batair	Resident, Common
Grus antigone	Deng	Migratory, Common
Gallicrex cinerea	Khwar chargai	Resident, Common
Acridotheres tristis	Kharoo	Resident, Common
Corvus splendens	Kargha	Resident, Common

[12] Pathan, Amir Jan, Shahroz Khan, Naveed Akhtar, and Kausar Saeed. "Diversity and Distribution of Avian Fauna of Swat, Khyber Pakhtunkhwa, Pakistan." *Advances in Zoology* 2014 (2014).

Pycnonotus atriceps	Balbala	Resident, Common
Motacilla citreola	Sper lakai	Resident, Common
Regulus regulus	Tan tanai	Resident, Common
Pelecanus crispus	Batha	Summer Migrant, Common
Phoenicopterus minor	Deng	Summer Migrant, Common
Psittacula himalayana	Toti	Migratory, Common

4.3.3 Aquatic Fish

255. Although, there is no considerable aquatic life exist within vicinity of project area. Due to industrial pollution major tributaries do not contain the diversity of fish species. The worth mention fish is the Trout (Oncorhynchus mykiss) can be found in upper reach of the streams. This specie is common in the surface water of the area. No other endangered fish species are available.

Figure 4-13: Flora and Fauna of the Project area

Landscape of proposed site

Typical vegetation in the project area

Tree plantation around the LFS

Pycnonotus atriceps

4.4 Socio-economic Environment

256. This section includes a summary of the prevailing socio-economic conditions in the project area and the population that will be potentially affected by the project. To ascertain the socio economic condition of the project area, primary and secondary data was collected including social and physical infrastructure in the project area.

257. To assess the socioeconomic conditions of the project area, total 3 FGDs conducted on Solid waste management system in Katwaro Maira. Out of 3FGDs, 2 (66%) are separately conducted with women. Total 31 men and women participated in these 3 FGDs. Out of 31 participants, 13 (42%) are women. About 66 Kanal land has been acquired by government back in 2014 however compensation has yet to be paid to the landowners. Landowners and local residents along the access route were considered as project affected people and during socio-economic survey, interviews were held with them to brief them about project and to seek their views. In addition, the secondary data, including Economic Survey of Pakistan (2018-19), Bureau of Statistics (2017-18), District Population Census 2017 of KPK, Crop Reporting Services KP (2017-18) and MICS of KP has been consulted. Survey questionarrie for conducting FGDs is provided as Annexure B.

258. Detailed surveys were conducted for project scoping during Mid-August, 2020. For the purpose of the environmental and social assessment and sensitive receptor data collection, a two-kilometer-wide, corridor along the proposed project site has been considered as the area of influence. Most of the field data collection was carried out within this corridor though where relevant data was also collected from a wider area along the proposed project site. The reason for selecting this corridor is to cover those areas that have a potential to be affected by the project activities.

4.4.1 Administrative Setup

259. The project area falls in the jurisdiction of Union Council Dangram Sangota, Tehsil Babuzai, district Swat in Khyber Pakhtunkhwa province. Mingora is the 3rd largest city in the province with a population of 331,091 and the economic, social and cultural center of district Swat. It is located at an altitude of 950 meters and about 2 kilometers away from Saidu Sharif, the present administrative capital of Swat. The city of Mingora serves as a gateway to the popular tourist destinations like Kalam valley, Kumrat valley, Maydan, Bahrain, Marghazar, Miandam, Malam Jabba and Saidu Sharif.

260. District swat is divided into seven tehsils including Babuzai, Matta, Khwaza Khela, Barikot, Kabal, Charbagh and Bahrain. Project are is located at Katwaro Maira which is falling in Tehsil Babuzai. Each Tehsil comprises certain numbers of Union councils. There are 65 Union councils in District Swat: 56 rural and 9 urban.

261. District administration is headed by the Deputy Commissioner (DC), who is assisted by district heads of departments. The main district departments include: administration, judiciary, police, education, health, communication and works, agriculture, forest, irrigation, telecommunication and livestock. The head of each district department is responsible for the performance of his department and is generally designated as the Deputy Director or District Officer.

262. The nearest residential settelments are Kawtaro Maira village, Dangram village, Sherarai village, Alahabad colony, Labor colony, Govt KPK Housing society. These areas consist of small residential colonies with poor road access. The road access to

Swat Landfill passes through congested and populated areas and there is need of widening of the present road.

4.4.2 Demography and Population

263. The population of Swat district in 1998 was 1,257,602. The district's annual growth rate is estimated at 3.24 % per year, and the population of Swat district is 2,309,570 according to the 2017 census. That is making it the third-largest district of Khyber Pakhtunkhwa after Peshawar and Mardan District. Swat is populated mostly by mainly Yousafzai Pashtuns and Kohistani communities. The language spoken in the valley is Pashto, with a minority of Torwali and Kalami speakers in the Swat Kohistan region of Upper Swat.

Districts	Headquarters	Area (km^2)	Population (2017)	Density (people/km^2)
Swat	Saidu Sharif	5,337	2,309,570	433

*Source District wise population Census 2017 by Pakistan Bureau of Statistics: Government of Pakistan.

264. Project area is primarily urban settlement. Most of the families are living in joint family system. Due to joint family system, the family size is large.

4.4.3 Religion

265. In swat 99.5% of people belong to Islam. Over welling majority of the people of swat district or Muslim belonging to hanfi school of Sunni sect, a small number of population in urban areas following irani pattern of Shiasim. An eligible proportion of the population belongs to other religions, including Christians, Hindisam, Qadyani, and Ahmadis.

266. Swat religious history dates back 324-195 BC to Buddhism and it was a famous center of Buddhist religion. After a Buddhist phase the Hindu religion reasserted itself, so that at the time of the Muslim conquest (1000 AD) the population was solidly Hindu. In 1023, Mahmud of Ghazni attacked Swat and crushed the last Hindu King, Raja Gira in battle, along with much of Swat's population[13].

4.4.4 Cultural and Archaeological sites

267. No archaeological and cultural site was observed in close proximity of Mingora landfill site. However, if any archaeological antiquity discovered Archeological Chance Find procedure shall be adopted. Archeological Chance Find procedure has been attached as **Annexure G.**

268. Swat valley conquered by Alexander the great in 327 BC, and over the following centuries by the Indo-Greek, Saka, Parthian, Kushan, Sasanid and Hephthalite kings, was a prosperous region. It constituted a trading center between the plains of Gandahara and the mountains of the northern areas looking towards Central Asia, and at the same time a great Center of Buddhist culture with an ample scattering of Buddhist monasteries, representing an important stopover on the way to the holy places of Buddhism, traversed by numerous Chinese pilgrims (including Faxian in the 5th century A.D., Sangyun in the 6th, Xuanzang in the 7th and Huizhao in the 8th). The

[13] https://en.wikipedia.org/wiki/Swat_District

most famous of all the Chinese pilgrims, Hsuan-Tsang who graced the valley by his presence in the 7th century A.D, mentioned 1400 monasteries in Swat, which eloquently confirmed the extensive remains of the Buddhist period. Even today over 400 Buddhist stupas and monasteries may still be seen in ruins in Swat covering an area of about 160 square km. The Buddhists built mostly their stupas and monasteries higher on the hills with the aim that agricultural economy may not suffer and also to provide a sort of protection and security to them from the invaders.[14]

269. The Swat Museum is on the east side of the G.T road, halfway between Mingora and Saidu Sharif. Japanese aid has given a facelift to its seven galleries which now contain an excellent collection of Gandhara sculptures taken from some of the Buddhist sites in Swat. The galleries have been rearranged and labeled to illustrate the Buddha's life story. Terracotta figurines and utensils, beads, precious stones, coins, weapons and various metal objects are present from ancient Gandhara. The ethnographic section displays the finest examples of local embroidery, carved wood, and tribal jewelry. It is also under renovation with funds from the Pakistani-Italian debt swap agreement.

270. One of the most important Buddhist relics in Swat is near the museum. The stupa, which dates from the 2nd century BC, was possibly built by the Mauryan emperor Ashoka to house some of the ashes of the Buddha. In subsequent centuries, it was enlarged five times by encasing the existing structure in a new shell. Italian excavators working in 1955 exposed the successive layers of the stupa, each layer illustrating a stage in the evolution of building techniques.

271. Centered upon the upper portions of the Swat River, Swat was a major centre of early Buddhist thought as part of the Gandhara kingdom, and today is littered with ruins from that era. Swat was home to the last isolated pockets of Gandharan Buddhism, which lasted until the 10th century, well after most of the area had converted to Islam. Until 1969, Swat was part of the Yusafzai State of Swat, a self-governing princely state. The region was seized by the Pakistani Taliban in late 2007, and its tourist industry decimated until Pakistani control over Swat was re-established in mid-2009. Swat's capital is Saidu Sharif, though the largest city, and main commercial centre, is the nearby city of Mingora.

4.4.5 Ethnicities in Project Area

272. The primary data collected by the EDCM team during EIA baseline survey and public consultation shows the following ethnic diversity in the project area. None of these castes may be considered as indigenous people (IP) based on ADB SPS definition. The ethnicities present in the project area are provided in **Table 4.8** below.

Table 4.8: Ethnicities in Project Area

Settlement	Caste/ Tribe	Decision Making Process in Settlements	Locally Used Language
Labour colony	Yousafzai	Court of Law, Within caste group	Pashto
Katwaro Maira	Yousafzai	Court of Law, within caste group	Pashto

14 http://www.valleyswat.net/tourism/archaeology.html#:~:text=A%20fairly%20large%20number%20of,all%20over%20the%20Swat%20Valley.&text=Even%20today%20over%20400%20Buddhist,of%20about%20160%20square%20km.

Settlement	Caste/ Tribe	Decision Making Process in Settlements	Locally Used Language
Dangaram	Yousafzai	Court of Law	Pashto

4.4.6 Languages

273. The primary native languages spoken in Swat are Pashto, Torwali and Kalami, though English is used in the city's educational institutions, while Urdu is understood throughout the district. The district of Swat is overwhelmingly Pashto-speaking; though the Torwali-speaking minority is concentrated in Swat's old place Saidu Sharif.

274. Pushto is the main language of the project area with over 90.2% of population speaking in Pashto and is easily understood among all the population in the surveyed settlements. Other dominant language in the project area is kohistani which comprises around 8.5% of the total population.

4.4.7 Main Sources of Livelihood/Income

275. Most of the people are farmers in villages. They are engaged in agriculture either directly or indirectly. Industrial labour has increased after the establishment of factories in different places of the district. Some people are engaged in business and government service also. Therefore, the people of the project area are good in socioeconomic point of on the overall basis. Agriculture is one among the livelihood sources but it cannot sustain their living. The land around the project area is quite fertile but unfortunately limited land area due to hilly region. Harnessing of ground water (aquifer) in the form of tube wells is quite expensive. Average land holdings are very small. The people also supplement their income by rearing of goats, sheep and cows on a limited scale. Large number of people earns their livelihood by operating their own transport. While some people run shops. However, some are working in Middle East. Fairly over 50 % of younger generation serves Pakistan Army.

4.4.8 Transport

276. Proposed Mingora Landfill site can be assessed through Katwaro Maira road which originates from Haji Baba-Buner Road. Main transport available in the project area are ford wagon, Suzuki and Taxies.

4.4.9 Distance to nearest airport from project site

277. The nearest airport to the proposed landfill site is the Saidu Shareef Airport, located at an ‘aerial’ distance of 6.5 km from the site however due to hilly terrain no impact on aviation activities due to landfill operations is envisaged.

4.4.10 Industry

278. Tourism and agriculture are major industries in the project area. The city of Mingora serves as a gateway to the popular tourist destinations like Kalam valley, Kumrat valley, Maydan, Bahrain, Marghazar, Miandam, Malam Jabba and Saidu Sharif. Major agriculture produce of the area are Swat Apple and Swat Peaches. Swat is famous for peach production mostly grown in the valley bottom plains and accounts for about 80% of the peach production of the country. Mostly, in the national markets with a brand name of "Swat Peaches". The supply starts from April and continues till September because of a diverse range of varieties grown.

4.4.11 Health Care

279. For health care, facilities including hospitals, dispensaries are available within project area and in Mingora city located at about 4.4 km from the site.

4.4.12 Literacy Rate

280. Swat is famous for its educated and development oriented people. Swat has good literacy rate of 88.6% in 2015. It has excellent ground for education and infrastructure improving its image as a well preserving touristic site. In the last few years, Swat has seen great changes in all aspects of its society including an increase in education, modern health care centers and a new university, along with private sector colleges.

4.4.13 Education

281. Being part of urban UC Dungram Sangota, local community at Katwaro Maira has access to educational facilities. A number of technical colleges and universities are also present in the area of influence. Approximately a total of 10500-12000 students are enrolled in these educational institutes. Both primary and secondary schools for boys and girls are available in the project area. Govt Monotech College Swat, Govt College of technology, Govt Primary School Dungram, Madina Education Academy, Abu Ubaida School Govt Technical and vocational centre (Boys) Muhallah Nadir Khan, Al Azhar Educational Highschool and college, Mashal Children Academy and Govt Primary School No 02 are educational institutes in close proximity of Mingora landfill site.

4.4.14 Types of Dwellings

282. Housing conditions of the respondents have been analyzed according to the type of houses in which they were residing. The house or building constructed with concrete or burnt bricks fall in pacca category whereas house or building constructed with burnt bricks with mud comes under semi-pacca category while house constructed with mud bricks or temporary wooden logs etc. are categorized as kacha house. Project area population is mostly living in semi-pacca and pacca houses.

4.4.15 Energy Supplies

283. The residents of project area are reliant on electricity available from the grid through PESCO (Peshawar Electric Supply Company) located at a distance of 6.5 Km.

4.4.16 Major Source of Drinking Water

284. The major sources of drinking water within the vicinity of the project area include community tube wells, individual and communal hand pumps. Water supply scheme is available in the project area.

4.4.17 Social Amenities in the project area

285. During the field survey, the access/ availability of the social amenities/ basic infrastructure in the vicinity of the proposed landfill site was asked from the surveyed households as well as physically observed at site. It was noted that facilities such as Electricity, Sui Gas, Water Supply, Telephone, sewerage drainage, school are available in the settlement or in its vicinity.

4.4.18 Gender Assessment

286. The focus group discussions with females were made from the main settlements/ villages including Katwaro Maira, Labor colony and Jamila House located in project

area. Detailed gender assessment study will be planned to mainstream gender elements in the development of Mingora SWMF.

287. A Gender Action Plan (GAP) will be proposed to support the gender element of affected as well as the other households in the project area. PMU Gender specialist will facilitate women specifically (elderly and single women without male support) in preparation of requisites for compensation, which may include the following:

- Opening of bank accounts of women in their name and ensure transparency of transferring compensation allowance
- Provide priority to vulnerable women/women headed families in compensation provision
- Maintain gender segregated database
- Ensure that women are aware about the amount of compensation provisions
- Include gender disaggregated data in the monitoring and evaluation system
- Ensure that women specific concerns and priorities are considered in resettlement process.

4.4.19 Existing Scavenging Practices

288. It is estimated that nearly 215 tons of waste is being generated in Mingora, most of it is being dumped in open dumping sites. These open dumping sites are openly accessible to scavengers that search through and collect items of a recyclable nature i.e. paper, metals, plastic. These items they then either sell to scrap dealers or bring to their specific warehouse to be sold onwards.

289. Number of warehouses are being operated at locations such as Makan Bagh, Parn Road and Haji Baba Road, on average employing about 15-17 scavengers. Mostly scavengers in the project area are male but an overwhelmingly high proportion lying in the age bracket of 10-20 years.

290. Studies on a limited scale have tried to assess their socioeconomic conditions, from their mean monthly income figures, to their motivation for this line of work and their working conditions (Alam et al, 2011). Generally, a scavenger on average makes between PKR 2000 and 3000 per month (Dawn, 2017). In most cases, this income supports the primary income source in the household, but there are cases where the scavenger's income is the primary or even sole income of the household (Alam et al, 2011). The major concern observed within this line of work is the overall health and safety risk that scavengers are under, as they constantly have to deal with sharp or dangerous objects with usually no protective measures or gear. Scavenging activities are observed to be mostly concentrated in commercial market areas of the city, with not as much outreach into residential neighborhoods.

291. The Integrated Solid Waste Management (ISWM) system will certainly influence these scavenging practices which is effectively almost an industry in itself. There is a considerable potential to positively channelize the work that these scavengers put in towards waste reduction and recycling, possible immediately after door-to-door collection takes place as well as at a Material Recovery Facility (MRF). The informal networks of scavengers can be brought on board by the WSSC Swat operations by subcontracting them these waste sorting activities. This is likely to significantly secure

both their livelihoods and their working conditions. Some level of vocational training will be required to ensure a uniform basic skill level, however, it is expected that these workers will bring to the job considerable experience from having performed it in an informal and unregulated sector.

292. The images provided below as **Figure 4-14** depict how much of tendency there is in the scavenging industry to employ young children. Once under a formalized umbrella, care will be taken to ensure that Child Labour Laws and best practices are fulfilled. Examples of global brands like Levi's and Nike (Dawn, 2017) retaining their underage workforce in Bangladesh, investing in their education and bringing them to work once they were of legal age, is a good precedent to look up to, determined ultimately by financial feasibility in addition to ethical considerations.

293. Considering all these factors, it is clear that an overall positive effect is anticipated from the ISWM system on scavenging and recycling. In addition, detailed consultations with scavengers, scrap dealers and personnel involved in the waste management business were conducted and the details are provided in **Chapter 8 (Stakeholder Consultations).**

Figure 4-14: Illustrating young children engaged in scavenging as an essential means of their livelihood

4.5 Sensitive Receptor Mapping

294. The proposed landfill site location with the sensitive receptors i.e. residential settlements in the form of clusters and individual settlements are shown in **Figure 4.15**. The respective distances of these sensitive receptors from the proposed site are provided in **Table 4.9** and **Table 4.10** below.

295. Sparsely scattered residential settlements are lying at varying distances around other sides of the proposed landfill site. There are 03 houses in west, 01 house in south and 02 houses in east side of the landfill site which are very close (falling within 250 m distance from landfill cells as per IFC criteria) and considered as sensitive receptors.

296. The settlements regularly feature multiple mosques and some schools of varying sizes. A number of technical colleges and universities are also present in our area of influence. Approximately a total of 10500-12000 students are enrolled in these educational institutes.

Table 4.9: Sensitive Receptor Distances from Proposed Landfill Site

Receptor Number	Receptor Distance (m) from Project Site	Receptor Type
1	135	Residential
2	150	
3	170	
4	219	
5	235	
6	237	
7	253	
8	816	
9	714	
10	539	
11	267	
12	220	
13	407	
14	432	
15	383	
16	552	
17	526	
18	560	
19	626	
20	760	
21	719	
22	601	
23	479	
24	565	
25	519	
26	530	
27	606	
28	747	

Receptor Number	Receptor Distance (m) from Project Site	Receptor Type
29	845	
30	915	

Figure 4-15: Nearest Receptors in Project Area

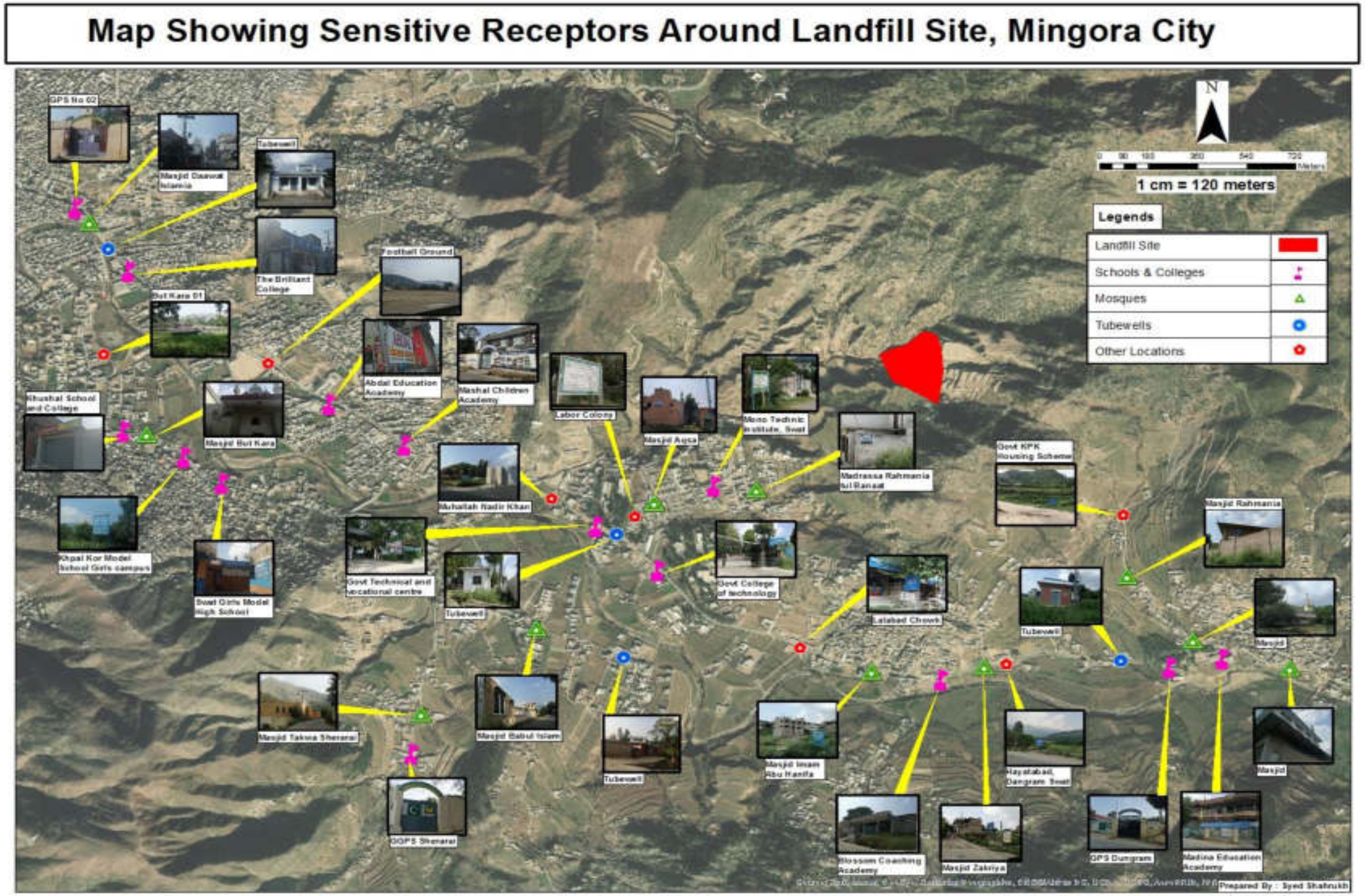


Table 4.10: Nearest Receptors and Prominent Structures within radius of 2 km from the proposed Landfill Site

Sr No	Pictorial View	Coordinates	Distance from site (meters)	Description
1.		X: 72.38920 Y: 34.76057	590	Jamia masjid Madrassa Rahmania tul Banaat
2.		X: 72.38779 Y: 34.76070	670	Working Folks Mono Technic Institute, Swat
3.		X: 72.38582 Y: 34.76012	860	Masjid Aqsa
4.		X: 72.38520 Y: 34.75962	930	Labor Colony Technical Vocational centre for Women
5.		X: 72.38461 Y: 34.75900	1020	Tubewell Govt Monotech college Swat
6.		X: 72.38596 Y: 34.75774	1030	Govt College of technology, Mingora Swat Graveyard

7.		X: 72.39066 Y: 34.75501	1070	Lalabad Chowk
8.		X: 72.39300 Y: 34.75420	1094	Masjid Imam Abu Hanifa
9.		X: 72.39672 Y: 34.75437	1096	Lalabad No 04 Masjid Zakriya
10.		X: 72.39746 Y: 34.75445	1042	Hayatabad, Dangram Swat
11.		X: 72.40124 Y: 34.75456	1135	Tubewell
12.		X: 72.40283 Y: 34.75434	1238	Govt Primary School Dungram Graveyard Tubewell
13.		X: 72.40459 Y: 34.75465	1326	Madina Education Academy Abu Ubaida School

14.		X: 72.40681 Y: 34.75431	1205	Masjid
15.		X: 72.40360 Y: 34.75528	1490	Masjid
16.		X: 72.40144 Y: 34.75753	888	Masjid Rahmania
17.		X: 72.40132 Y: 34.75968	708	Govt KPK Housing Scheme
18.		X: 72.39528 Y: 34.75390	1105	Blossom Coaching Academy
19.		X: 72.38393 Y: 34.75929	1064	Govt Technical and vocational centre (Boys)
20.		X: 72.38247 Y: 34.76024	1060	Muhallah Nadir Khan Al Azhar Educational Highschool and college Masjid

21.		X: 72.37759 Y: 34.76213	1500	Mashal Children Academy Masjid
22.		X: 72.37510 Y: 34.76356	1690	Abdal Education Academy Masjid Rashid Minhas College
23.		X: 72.37311 Y: 34.76501	1850	Football ground
24.		X: 72.36847 Y: 34.76824	2305	The Brilliant College
25.		X: 72.36783 Y: 34.76900	2370	Tubewell
26.		X: 72.36719 Y: 34.76993	2465	Masjid Daawat Islamia
27.		X: 72.36674 Y: 34.77045	2480	Govt Primary School No 02, Mingora Hajiabad

28.		X: 72.36769 Y: 34.76532	2330	But Kara 01
29.		X: 72.36831 Y: 34.76261	2310	Khushal School and College Islamia Collegiate School System
30.		X: 72.36908 Y: 34.76250	2230	Masjid But Kara
31.		X: 72.37030 Y: 34.76170	2130	Khpal Kor Model school Girls campus Masjid
32.		X: 72.37156 Y: 34.76078	2050	Swat Girls Model High School Masjid ALLAH ho Akbar
33.		X: 72.37814 Y: 34.75271	1935	Masjid Takwa Sherarai
34.		X: 72.37782 Y: 34.75131	2055	Govt Girls Primary School Sherarai

35.		X: 72.38194 Y: 34.75570	1450	Masjid Babul Islam
36.		X: 72.38483 Y: 34.75467	1355	Tubewell

4.6 Sensitive Receptor Mapping to assess compliance with IFC EHS Clause[15]

297. The IFC EHS clause specific to Landfill Siting states the following:

''The location of the landfill should take into account potential impacts associated with releases of polluting substances including the following:

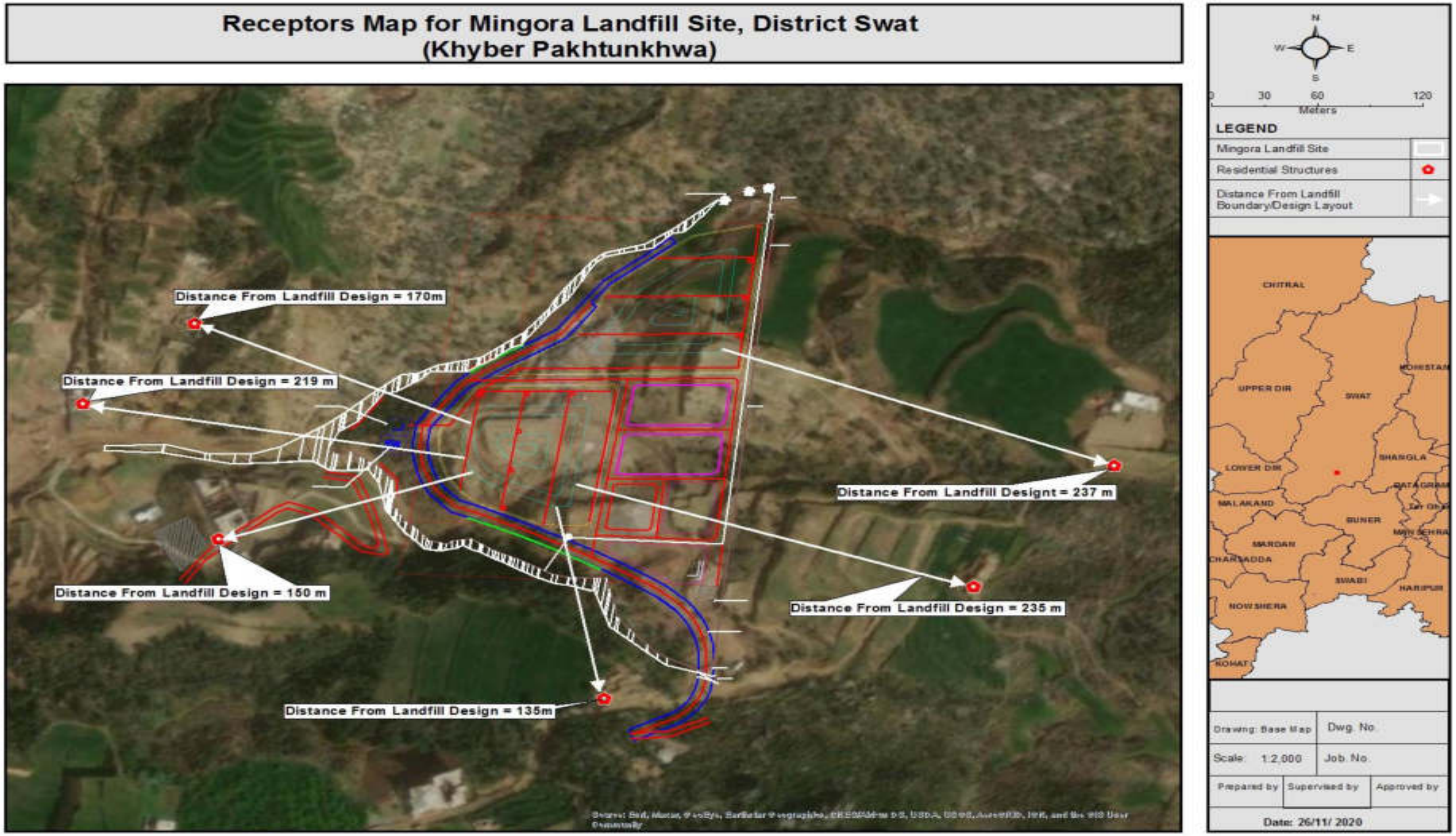
- *Proximity to residential, recreation, agricultural, natural protected areas, or wildlife habitat and areas prone to scavenging wildlife, as well as other potentially incompatible land uses:*
    - ***Residential development should be typically further than 250 meters from the perimeter of the proposed landfill cell development to minimize the potential for migration of underground gaseous emissions.***

298. The field visits for social safeguard assessment by PMU and EDCM team has been carried out in mid of August 2020 to identify any sensitive receptors falling within 250 m distance from landfill cells. Assessment findings shows that there are six nearest receptors form the proposed landfill cells which are residential housing falling within 250 m from the landfill design. These receptors are considered as sensitive and these will be relocated during project execution subject to willingness of owners.

299. The details of sensitive receptors falling within 250 m from landfill cell development are provided in the **Figure 4.16** below.

[15] https://www.ifc.org/wps/wcm/connect/5b05bf0e-1726-42b1-b7c9-33c7b46ddda8/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&CVID=jqeDbH3&id=1323162538174

Figure 4-16: Receptors Map for SWMF, Mingora



5 Analysis of Alternatives

5.1 Overview

300. Project alternatives have been studied as a part of this EIA process. Alternatives analysis has been conducted in detail to foresee environment, economic and social impact of each alternative. This chapter also provides an overview of the various commercially available technologies for the treatment and processing of waste in an environmentally sound manner and are successfully running in developed countries in particular and recommend the most suitable set of options for Mingora city keeping in view its waste generation and composition.

301. Project alternatives has been studied keeping in view number of parameters including; waste quantum, physio-chemical properties of waste, suitability for mixed waste handling, land requirements, technical complexities, social acceptability, environmental and legal compliance, and OPEX & CAPEX requirements.

302. The development of the proposed SWMF is based on detailed feasibility assessments focusing on assessing the city requirements with regards to SWM and then determining the most suitable and effective technology and location for development of the required infrastructure.

303. This process of analysis of the different alternatives for development of the landfill site ensures that a well-informed decision is taken regarding the selection of the most optimal option amongst the possible options that are brought into consideration.

5.2 Alternatives Types

304. Types of alternatives considered for detailed analysis for Mingora SWM facility are given below;

- No Project Option
- Site Selection Alternatives
- Landfill Type Alternatives
- Landfill Construction Alternatives
- Waste Disposal Alternatives
- Technological Alternatives for AD
- Material Recovery Facility
- Scenario Analysis for all possible treatment options for Mingora
- Economic Analysis

5.3 'No Project' Option

305. If 'no project' option is triggered, it will result in loss of all positive impacts caused that project will pose on Mingora city; such as eradicating open dumping of solid waste, improving civic services in terms of integrated waste management, removing existing bottlenecks in the system and improving the aesthetic aspects of the city. If the project

is not implemented, urban environmental quality will be further degraded. It also limits the urban development of the area in a sustainable manner.

306. On the other hand, if the project is implemented, it will result in improved SWM system services and improved urban environment quality. Furthermore, project implementation will also create job opportunities during construction, thereby improving the socioeconomic condition of the local people and help in improving their quality of life. Thus, the 'no project' option is not a viable option.

5.4 Site Selection Alternatives

307. There are many different, often inter-related, criteria that go into the selection of an appropriate site for a landfill. These include technical, environmental, geological-hydrogeological, operational, economic, social and political factors. Environmental Sensitivity (Hydrology, Climate, Fault/fractures, Soil/topography, flora/fauna, and agriculture/nature conservation) is one of criteria which plays critical role while making decision with respect to landfill site selection.

308. Keeping in view this set of considerations, the sites initially considered were:

- **Owgdoo** - Located roughly 3 km west of the city along the Swat river
- **Katwaro Maira** – Located 4.4 Km southeast of the city
- **Islampur Village** - Located 8-10 Km south of the city

309. These sites are shown in the **Figure 5.1** below and the comparison of these different site alternatives is provided in **Table 5.1** below.

Figure 5-1: Location map of site alternatives

Table 5.1: Comparison of Site Alternatives

Parameters	Site Alternatives		
	Owgdoo	**Katwaro Maira**	**Islampur**
Environmental Sensitivity	Extremely high as the site is on the river bed.	Moderately high due to mountainous natural topography.	Fairly high because of mountainous topography surrounding agricultural and residential land use.
Infrastructure	Easy access through existing road network.	Fairly easy road access to the area. Street leading to site may require some widening	Road access slightly difficult, though busier and crowded route from city.
Site capacity	Low, 1-2 acres of land abutting the river water.	10 Acres available.	Specific site location and size was not finalized. Area availability likely to be spatially constrained.
Land Acquisition	Land comes under the ownership of the city's management since it is a natural waterway.	Land has been already acquired by WSSC.	Land acquisition will trigger social safeguard and cause financial burden. Current denser residential settlements likely to be affected.
Social Acceptability	Very difficult since the use of site for waste management raises serious environmental and health concerns.	Relatively easy considering the concerns of the city's population, government and environmental stakeholders. Concerns of the local landowners will have to be addressed regarding financial compensation.	Somewhat lengthy and difficult process of compensation and social safeguards. The area also has some tourist potential which will have to be protected.
Distance from City Centre (km)	3	4.4	10

310. Among these, waste dumping is being practiced by WSSC Swat at Katwaro Maira. Previously waste dumping was also done at Owgudoo however now site is not used for waste dumping.

311. The site at Owgdoo has easy road access but this is the only factor that may be considered remotely positive about the site. This is because the site exists on the Swat River and within a short period since dumping was initiated, many environmental groups and media platforms have highlighted the gross detrimental effects to public health and environment, most notably Al Jazeera. Water and Sanitation Service Company Swat (WSSCS), the body responsible for the city's waste management operations, has since halted this dumping and has been proactively pursing a proper

landfill site. The social acceptability, and in general the environmental sustainability, of this site for the purpose of waste management is therefore none.

312. The site at Katwaro Maira, which has some amount of open space away from by residential settlements, is where WSSC Swat is most keen to establish the landfill. The population in the vicinity is not dense yet but some of the open space surrounding the site is being utilized for agricultural purposes by the land owners, The road network does service the area well but the final half kilometer leading to the site will require some level of paving or widening to be able to accommodate the waste transporting vehicles.

313. The area near the village of Islampur, around 8 to 10 km away from Mingora city, was an alternate location which the environmental team studied. There is some open space in the area which could accommodate a landfill but on the whole the area features a mountainous landscape with steep slopes and residential settlements scattered around much of the area. The road network does provide access to the area but the distance is considerably greater compared to the Katwaro Maira site and the narrow right of way is likely to become congested easily unless significant investment is made into upgrading the roads so that they may be able to accommodate large transportation vehicles. For this site, land acquisition will be longer and more tedious process since land demarcation and social safeguards have not been planned yet. The area does see some tourist activity which will be adversely affected by a landfill.

314. In comparison to the extremely dangerous waste dumping activity at the Owgdoo site, the two other alternative sites studied will both be considerably better options given the environmental groups' and media uproar witnessed as a result of the dumping. Among the two sites Katwaro Maira meets the aforementioned sustainability criteria to a greater extent than Islampura and will therefore be selected as the best available option for the purpose of the landfill.

5.5 Landfill Type Alternatives

315. There are various types of landfills that are designed and constructed worldwide to manage MSW like sanitary landfill, bio-reactor landfill and secured landfill. The safe and effective operation of landfill depends on sound planning, administration, and management of the entire MSW management system and selection of appropriate landfill type.

5.5.1 Sanitary Landfill

316. An engineered disposal location fully equipped and operation with leachate and landfill gas collection and treatment system. A disposal technique resulting in burial of waste using an engineered method intended to protect the environment, typically employing plastic liner and drains in the bottom to collect the liquids and cover on the top to keep rain water out and to keep methane and other gases to escaping.

5.5.2 Bioreactor Landfill

317. A bioreactor landfill is a municipal solid waste landfill (MSWLF) in which liquids are added to help bacteria break down the waste. The increase in waste degradation and stabilization is accomplished through the addition of liquid and air to enhance microbial processes.

5.5.3 Secured Landfill

318. Secured landfill is a carefully engineered depression in the ground (or built on top of the ground) into which wastes are dumped to avoid pollution to the surrounding environment. Secured MSW landfill should be restricted to non-biodegradable, inert waste and other waste not suitable for recycling or for biological processing.

319. Based on above information, the project design consultant suggested to construct a sanitary landfill for Mingora as it is relatively low in cost and requires less technical and operational maintenance as compared to other options.

5.6 Landfill Construction Alternatives

5.6.1 Lining

320. The purpose of the liner system is to prevent migration of leachate generated inside a landfill from reaching the soil and ground water beneath the landfill. Thus, the function of leachate collection facility is to remove leachate contained within the landfill by the liner system for treatment and disposal, control and minimize leachate heads with in the landfill, and avoid damage to the liner system. The drainage layer comprises of granular soil having an appropriate permeability. The geo-membrane and layer of compacted clay barrier below must also have an appropriate thickness to protect the soil and water.

321. The alternative of concrete lining is not as favorable as the HDPE (high density polyethylene) geo-membrane due to its higher erosion factor, indirectly amounting to a higher maintenance cost and greater harm to the environment.

5.6.2 Leachate Collection and Treatment

322. The most suitable option is to spray the daily leachate back on the surface of the solid waste dumped at the landfill site. This is an economical and environmentally friendly leachate handling method. If the volume of the leachate production goes beyond the spraying capacity, leachate treatment will be required.

323. The alternatives regarding leachate management itself are:

- Discharge to lined drains
- Discharge to waste water treatment system
- Recirculation
- Evaporation of leachate
- Treatment of leachate

324. There are various pros and cons to each option being studied and experimented with, including one in particular where the practice of recirculation functions as a catalyst to increased gas production (Kumar et al. 2011) to assist in energy recovery.

325. For Mingora, a combination of leachate management options has been selected, which include leachate spraying and leachate treatment. Leachate will be primarily used for spraying on the waste and remaining leachate will be collected and sent to preliminary treatment and then sent to DTRO plant for final treatment.

326. Incorporating additional technology in the form of remote monitoring equipment to the leachate management system, as well as to the gas management system can include having remote sensor on pumps and storage tanks to transmit real time data and alerts to an online system, that will reduce the requirement for round the clock surveillance to only when required in emergency scenarios.

327. The use of control technologies within these systems will allow facility operators and supervisors to be able to remotely address routine or emergency issues, whenever notified, without physically being present at the site.

5.6.3 Gas collection and Treatment

328. Landfill gas can migrate laterally and potentially cause explosions. Landfills are therefore provided with gas collection and processing facilities. The rate of gas production varies depending on the operating procedure. The rate and quantity of gas generation with time, is difficult to predict. Gas production rates of 60 m^3 per hour have been reported from landfill sites in India having an area of 8 hectares and a depth of 5 to 8 m (Dutta et al. 2012). The decision to use horizontal or vertical gas recovery wells depends on the design and capacity of the landfill. The decision to flare or to recover energy from the landfill gas is determined by the capacity of the landfill site and the opportunity to sell power produced.

329. Gas outputs of 10 to 20 m^3 per hour (corresponding to 50 to 100 KW of energy) have been recorded in wells of 15 to 20 cm diameter drilled 10 m into waste at spacing of 30 to 70 m. For 1 MW output from a landfill site, 15 to 20 such wells are required.

330. Alternative plans for gas management can be one of the following:

- Uncontrolled release
- Controlled passive venting
- Controlled collection and treatment/reuse

331. The selection among these alternatives has to take into account not just the monetary cost incurred to apply the plan but also the environmental impact associated with it. In the case that using the gas for energy is feasible than even the more expensive management plan can produce financial paybacks.

332. For Mingora, flaring has been proposed for landfill gas management. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.

5.7 Technological Alternatives for Anaerobic Digestion System (AD System)

333. The Anaerobic Digestion System (AD system) is controlled biological conversion and treatment of organic material by bacteria and other microbes in the absence of oxygen. Oxygen is toxic to anaerobic bacteria and other micro-organisms (anaerobes). The AD process produces biogas (about 50-60% methane or natural gas, 40-45% carbon dioxide and traces of other gases), liquid effluent and a solid, partially stabilized organic material known as digestate which is generally sent for further aerobic composting to yield a stabilized product (compost).

334. Many AD system designs are available in the marketplace. AD system vendors/EPC contractors will choose between:

- Wet or dry AD
- Single or two stage ADS
- Thermophilic or mesophilic AD
- Continuous, plug flow or batch AD

335. The design decisions would need to be combined with pre-treatment decisions to create an overall AD design which would best meets the needs of the Mingora SWMF depending upon the waste characterization. Project design consultant advised not to prescribe or limit the design options at the pre-feasibility stage of the assessment. AD vendors/EPC contractors may provide customized approaches to AD and pre-treatment options.

5.8 Technological Alternatives for Material Recovery Facility (MRF)

336. Having already discussed their site selection criteria above, the analysis of technological specifications within MRF or composting facilities within the ISWMS will also determine how effectively they operate from both a financial as well an environmental point of view. The facilities for the proposed landfill can range from labour-intensive, lower initial costs but lower efficiencies, to machine-intensive, higher initial costs but greater efficiencies.

5.9 Waste Disposal Alternatives

337. Broadly, four technologies including i) direct burn technologies, ii) physical processing technologies, iii) biological processing technologies and iv) combined treatment have been considered and assessed for their suitability for the proposed landfill site.

5.9.1 Thermal/Direct Burn Technologies

338. Technologies involve the thermal decomposition of waste into gaseous, liquid and solid conversion products with release of heat energy. The main thermal processing technologies adopted internationally for the treatment of municipal waste are incineration, gasification (pyrolysis) and plasma gasification. However, keeping in view the costs and regional scenarios, only incineration would be taken into account for the purpose of technological assessment of direct burning in the Mingora case.

5.9.2 Physical Processing Technologies

339. Physical technologies involve altering the physical characteristics of the MSW feedstock. The MSW may be separated, shredded, and/or dried in a processing facility. The resulting material is referred to as refuse-derived fuel (RDF) and if the quality of the RDF is improved to meet the minimum criteria for required BTU. It may be densified or pelletized into homogeneous fuel pellets and transported and combusted as a supplementary fuel for industrial boilers, cement manufacturing facilities, brick kilns or even waste to energy incineration plants.

5.9.3 Biological Processing Technologies

340. Biological treatment involves micro-organisms to decompose the biodegradable fraction of the waste. The biological process can be aerobic or anaerobic, and the main biological technologies adopted internationally for the treatment of municipal solid waste are composting and methanation (anaerobic digestion).

5.9.4 Combined Treatment

341. These include technologies like Mechanical Biological Treatment (MBT), which is a combination of technologies including material recovery facilities, refuse derived fuels and aerobic/anaerobic digestion. All the aforesaid technologies have been reviewed in the following section and their suitability for Mingora city has been assessed.

5.9.5 Qualitative Assessment of Various Technologies

342. In order to qualitatively assess the suitability of the technology for Mingora city, technology assessment criteria/ filters used are provided as **Table 5.2** below.

Table 5.2: Qualitative Assessment criteria for waste treatment options

Criteria	Description
Scale of Application (tpa) and with respect to population	Minimum quantum of waste for financial viability
Waste Suitability, moisture and organic fractions	Technologies that are suitable for MSW characteristics of Mingora city Technology must be capable of handling high organic waste & high moisture content – Waste Assessment and Composition (WAC) Study conducted under this project in May 2020 show high organic (50%) and moisture content (64 %).
Suitability of technology for mixed waste and segregated waste and specific waste avoidance	Though there is no regulatory binding for the segregation of waste, putting segregation into practice requires a lot of efforts from WSSC Swat side and is a time-consuming process to make resident adhere to waste segregation practices. In addition, it requires additional infrastructure for segregated collection and transportation and has high operation cost due to increase in transportation cost and deployment of additional manpower
Volume reduction %	Effectiveness of the technologies for reducing the volume of the waste
Land requirements	Area per tons of the waste required
Technology Reliability	Technologies that are proven internationally and have successful application in the region and could be considered without reservations for Mingora
Operational Complexity	Least complex technology is mostly suitable for the developing counties owing to the fact that the little or no expertise are available to operate and maintain the system
State of Art and Clean Technology	Technologies with low emission & low negative environmental impacts (Low carbon footprint)
Waste technology value chain assessment	Technologies that requires value addition of the MSW chain for sustainability against following parameters: ▪ Technology that can process mixed waste ▪ Technology that requires pre-processing of waste to make it compatible ▪ Technology that requires source-segregated waste and a higher degree of pre-processing

Criteria	Description
Compliance with the regulatory requirement	The technology is in compliance with the regulatory requirements
Reject Diversion to the Landfill	Technologies with low diversion of rejects to the landfill are more acceptable
Social acceptability	Technology should be socially acceptable
Market sounding	Market for products and by products
Flexible	Modular and flexible plant to address the increasing waste supply in future
Lock-in Effect	Generally, refers to as a dedicated investment in a WtE project, and the requirement of a fixed amount of waste for incineration over the plant's life. The lock-in effect could lead to undermining waste prevention, reuse and recycling policies and programmes due to lack of funds to develop those systems, or "put or pay" contracts that mandate municipalities provide a fixed/minimum guaranteed amount of waste to the incinerator or pay a fine.
3Rs Trade-of	Technology be selected that is not impacted by the future recycling programs
Sustainability	Although it would be difficult to have a fully sustainable model. However, the CAPEX and OPEX of the system have to be looked in comparison with the cost per m^3 available airspace for landfill (with landfill infrastructure and maintenance and operational costs)

343. All the prevalent waste processing technologies discussed were assessed in comparison with landfill as per the above-mentioned criteria and details are presented in **Table 5.3** below.

Table 5.3: Qualitative/Subjective assessment of various technologies for Mingora City

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
1	**Scale of Application (tpd)**	- Minimum waste tonnage should be 25 TPD and above. For Mingora the waste tonnage is 215 TPD and thus composting is a suitable option	- 275-500 TPD and above (smaller plants are not techno-economically - Viable, given the cost of required environmental control equipment & Boiler technology. - For Mingora, due to less waste availability (215TPD) direct incineration is NOT feasible without tipping fee of about 30-3%US$ per tonne	- 275-500 TPD and above (smaller plants are not techno-economically - Viable, given the cost of required environmental control equipment & Boiler technology. - For Mingora, due to less waste availability (215TPD) direct incineration is NOT feasible without tipping fee of about 30-3%US$ per tonne	Centralized up to 500 tpd plant as well as decentralized plants are operational in the region. Therefore, scale of application may vary from 1-500 TPD. Suitable for Mingora	Centralized up to 500 tpd plant as well as decentralized plants are operational in the region and globally. Therefor scale of application may vary from 1-500 TPD Suitable for Mingora	Applicable for small to large scales and there is no minimum waste tonnage required
	Applicable with Population Size	- Suitable for cities with population more than 0.1 Million while Mingora is city with population less than 0.366 Million.	Suitable for cities with population more than 1 Million while Mingora is city with population less than 0.366Million.	Suitable for cities with population more than 1 Million	- Suitable for cities with population more than 0.366 Million as Mingora has same or more population than minimum suggested.	- Suitable for cities with population more than 0.366Million	Suitable for city of any size
2	**Waste Suitability/acceptability**	Food waste (including wastes from households, restaurants and markets), fats/	High moisture and organic content make it unsuitable. Requires waste with calorific value > 3000 BTU/lb.	High moisture content makes it unsuitable Calorific value requirement is 3000-6000 BTU/lb for RDF	Food waste (including wastes from households, restaurants and markets), fats/ oils/grease,	Most suitable technology to handle heterogeneous waste with no initial	Municipal solid waste, construction and demolition

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
		oils/ grease, paper and cardboard, landscaping and garden waste (e.g. hedge-clippings, leaves)	Calorific value of the waste is higher than 6000 BTU but due to high moisture content, it would be unsuitable without pre-drying of the waste.	with moisture less than 20% which is difficult to achieve without preprocessing/pre-drying of the waste and that would add additional costs	slaughterhouse waste Mingora's waste contains high organic content (approximately 50%), Moisture content (>50%) – suitable	requirement of segregation at source	waste, wastewater sludge, nonhazardous industrial wastes
3	**Organic waste composition threshold or moisture content**	Higher fraction of organic content is required. Mingora's waste contains high organic content (approximately 52%) and Moisture content (>50%) – suitable	50%moisture content Moisture content in Mingora's Waste is (>50%) which makes it unsuitable for incineration	<12% moisture content	>50% of the MSW Mingora's waste contains high organic content (approximately 50%) and Moisture content (>50%) – suitable	Low as possible to make the sorting process easier.	Low as possible to keep the leachate production lower. However, with leachate collection system in place moisture content does not impact the process of the landfilling and its operations
4	**Waste to Avoid**	Non-biodegradable	Yard leaves or source separated food waste	C&D waste and sludge from the desilting of the drains	Non-biodegradable wastes (plastic,	Medical infectious waste	Medical infectious waste

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
		wastes (plastic, glass, metal, inserts) Mixed waste in Mingora			glass, metal, inserts), tree clippings		
5	**Suitability of technology for mixed waste and segregated waste**	High – Feed stock should be free from non-biodegradable and debris and low on moisture	High – Feed stock should be free from inert and debris and low on moisture Content. In Mingora, due to mixed waste/sludge collection and higher moisture content, it's unsuitable	High – Feed stock should be free from inert and debris and low on moisture content. In Mingora, due to mixed waste/sludge collection and higher moisture content, it's unsuitable	Unsuitable for mixed waste Pre-sorting/segregation is required for Mingora.	Most suitable technology to handle heterogeneous waste with no initial requirement of segregation at source	Ultimate treatment for the mixed waste
6	**Pre-Processing**	High Required for mixed waste	Low Required for mixed waste	High Required for mixed waste	High Required for mixed waste	Not required	Not required
7	**Volume reduction %**	>50-70%	80-85%	>80-85%	10-50% of the input depending upon the type of technology - Biogas (50-65% methane, 50-30%CO2) can be used to generate electricity in gas engines. - An average biogas production rate of 112 Nm3/tonne of digester feed has	>80-85%	Nil

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
					been reported - Net energy surplus range of 40 –170 kWh per tonne of organic waste input		
8	**Land requirements**	High (For 500 tpd of MSW, 6 ha of land is required)	Low land requirements 16-40 Sq.m per tons of the waste[16]	Low land requirements 16-40 Sq.m per tons of the waste[17]	Low to Moderate For small units: 500 sq. m for 5MT unit For large scale: 300 TPD of MSW: 2 ha of land is required)	High (For 500 tpd of MSW: 6-8 ha of land is required)	Generally large
9	**Labor Requirements**	Labor intensive and Requires considerable technical capacity	Not labor intensive but Requires considerable technical capacity	Not labor intensive but Requires considerable technical capacity,	Labor intensive (based on current practice)	Labor intensive (based on current practice)	Not labor intensive but Requires considerable technical capacity
10	**Energy Requirements**	Moderate	High	High	Moderate	High	Low
11	**Reject**	30-50%	Up to 25-30%	Up to 15%	Up to 50-90%	Up to 15%	100%
12	**Reliability - proven internationally for large scale**	Proven technology	Internationally proven Developed countries moving away from mass burn	Proven technology	Internationally proven and many plants under operation	Highly sensitive process and plant performance is	Proven technology

16 Incineration of Municipal Solid Waste February 2013, DEFRA UK

17 Incineration of Municipal Solid Waste February 2013, DEFRA UK

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
			technology to cleaner technologies			impacted by slight contamination	
13	**Operational Complexity**	Least technically complex	Technically complex, requires highly skilled training and careful maintenance	Technically complex, requires highly skilled training and careful maintenance	Technically complex, requires highly skilled training and careful maintenance	Technically complex, requires highly skilled training and careful maintenance	Requires specialized training, careful maintenance, and post-closure care
14	**State of Art and Clean Technology**	High percentage of rejects i.e. 30-50% requires more space for disposal of the reject and have higher emissions.	High emission from waste incineration (SOx, NOx, heavy metals, Dioxins, Furans) Emission control system has high capital and operating cost	High emission from waste incineration (SOx, NOx, heavy metals, Dioxins, Furans) Emission control system has high capital and operating cost	No harmful emissions	No harmful emissions	Methane Emissions
15	**Leachate Pollution**	High	Low	Low	High to slurry production. However, with the composting process, can be managed easily at site.	High	High
16	**Carbon Foot Print**	Low	Least	Moderate	Low	Low	High
17	**Predominant skills for Operation**	Skilled & Semiskilled labour	Highly Skilled Labor required	Highly Skilled Labor required	Skilled & Semiskilled labor	Skilled & Semiskilled labor	Skilled & Semiskilled labor

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
	and Management						
18	**Compliance with the regulatory requirement**	Low environmental pollution	High environmental pollution if not the air purification system is substandard and temperature is maintained below 850 °C	High environmental pollution if not the air purification system is substandard and temperature is maintained below 850 °C	Low environmental pollution	Low environmental pollution	High environmental Pollution if leachate and gas collection system is inadequate
19	**Social acceptability**	Odour issues in case of improper aeration Public acceptance higher than waste to energy technologies	Negative public perception & low acceptability	Negative public perception & low acceptability	High public acceptance	High public acceptance	Negative public perception & low acceptability
20	**Market sounding**	Market for Products and byproducts. In Pakistan compost market is very low	Readily available market for energy form waste	Readily available market for energy form waste	High demand for energy and Bio-CNG	High demand for recyclables while low to moderate demand for RDF and compost	None
21	**Flexible/Modular and capable to adjust for lock-in effect**	Highly flexible and capable to adjust according to the quantum and composition of the waste as well the possible	Not flexible and prone to lock in effect	Not flexible and prone to lock in effect	Flexible and capable to adjust according to the quantum and composition of the waste as well the possible	Flexible and capable to adjust according to the quantum and composition of	None

Sr #	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
		future intervention for source separation intervention.			future intervention for source separation intervention.	the waste as well the possible future intervention for source separation intervention.	
	Preliminary Concept Level costs	Capital Investment	Capital Investment - $200,000 $250,000 per design tpd - Cost per design tpd has an inverse relationship to nominal capacity of unit O&M - $40 per ton - $80 per ton (not including pre-processing). - Economy of scale can benefit facilities with larger unit capacity	Capital Investment - $200,000 $250,000 per design tpd - Cost per design tpd has an inverse relationship to nominal capacity of unit O&M - $40 per ton - $80 per ton (not including pre-processing). - Economy of scale can benefit facilities with larger unit capacity Additional $40 per ton -$80 per ton for RDF production via sorting line	Capital Investment - $50,000$100,000 /tpd (not including pre-processing or tipping fees) O&M - $10-15/ton (excluding pre-processing) - Additional $25 per ton -$40 per ton for pre-processing		

Green – Highly favorable
Light Blue – Moderately favorable
Brick red – Least favorable

5.10 Proposed Solution for Mingora City

344. Comparison of the prevalent technologies and waste characterization results for Mingora city indicates that incineration may not be suitable considering the high moisture content and organic fraction; composting and bio-methanation are relatively more suitable technologies for treatment of the organic fraction of the MSW after sorting the mixed waste in a MBT facility. Bio-methanation as a technology is highly sensitive and requires highly segregated waste or pre-processing of waste to make it successful. Bio-methanation may be suggested as a technology for processing the entire organic waste of Mingora (can be used only for segregated waste from hotels and market places that can be up to 30 tons/day and the organic reject of the MSF facility making a total of around 90-100TPD).

345. However, dry AD system makes the anaerobic digestion process least complex as compared to the wet AD process. Composting technology is also a proven technology, but it failed badly with respect to the amount of rejects it transfers to the landfill (up to 25%) and in terms of acceptability of the compost from the mixed waste. Mechanical Biological Processing Technology is found relatively more suitable, adaptable and flexible technology for the type of waste generated in Mingora.

5.10.1 Scenario Analysis for all possible treatment options

346. Based on the quantum of waste and composition, there are five possible scenarios which could be further ruled out through alternate technological comparative analysis. Landfill cannot be replaced because it would be needed in any case for the disposal of the reject and/or disposal of unsaleable compost and no single technology would be suitable for mixed waste.

347. **Scenario-1** can be without any intermediate treatment and 100% waste collected is landfilled as shown in **Figure 5.2** below.

Figure 5-2: Scenario-1-No Intermediate treatment

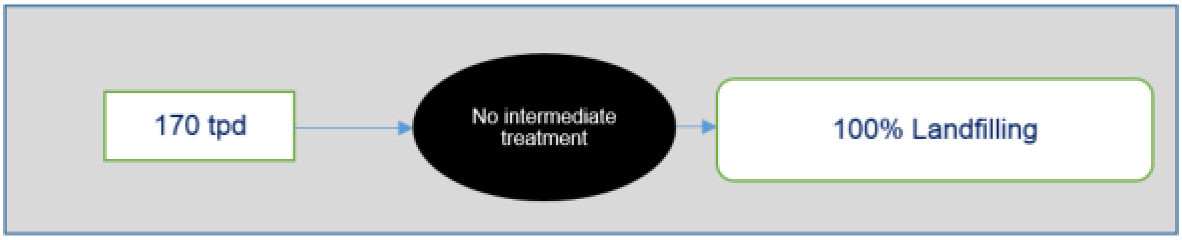


Table 5.4: Pros/Cons of Scenario-1

Pros	Cons
▪ Most common method for ultimate treatment of the mixed waste in Asian countries. ▪ Less technicalities involved as compared to advanced treatment options. ▪ Lower risk of technology failures.	▪ Higher methane emissions in case of non-LFG capturing project. ▪ No remedy in case of landfill liner failure ▪ Higher O&M and life cycle cost ▪ 100% landfilling would require more land

▪ Easy to operate and maintain, however, institutional competencies must be gauged for O&M of the landfills. ▪ Less capital investment required as compared to other technologies	▪ 100% landfilling of the MSW is not in line with the SGDs and National Action plan ▪ Limited opportunities for harnessing economic potential of the waste.

348. **Scenario-2** is to look for options considering the highest volume reduction and energy production and landfilling only debris and ash produced in combustion process as shown in **Figure 5.3** below.

Figure 5-3: Scenario-2

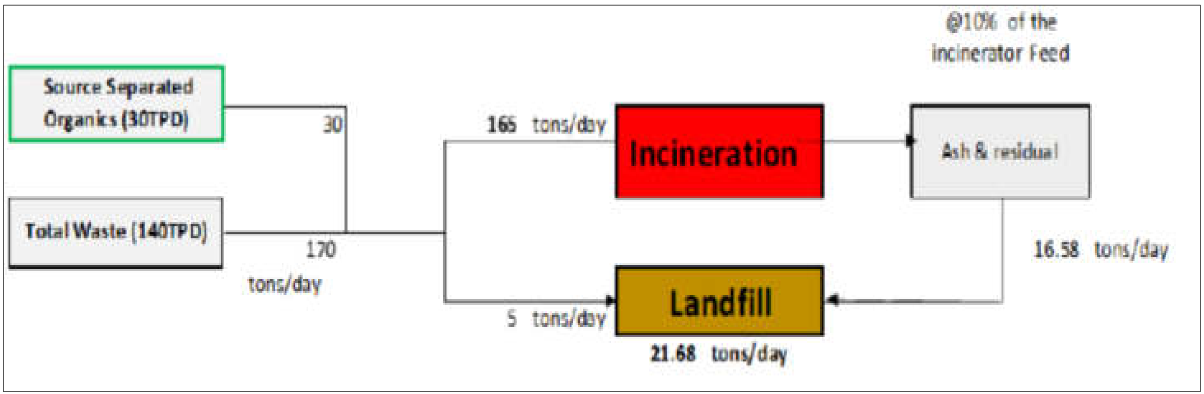


Figure 5-4: Mass balance and %age waste treatment by different options with scenario-2

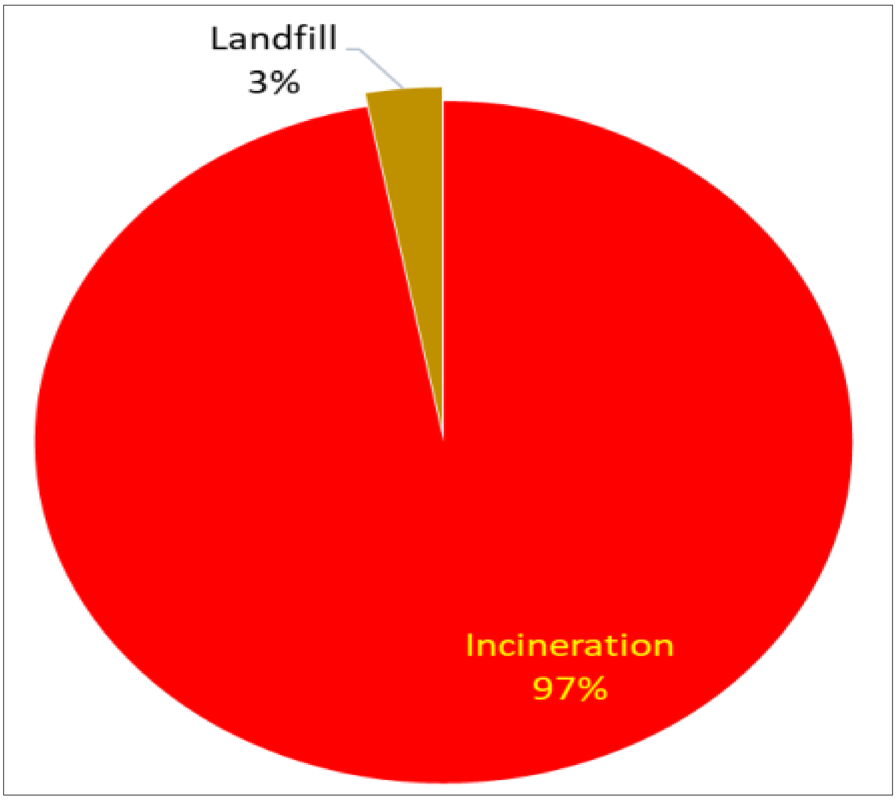


Table 5.5: Pros/Cons of Scenario-2

Pros	Cons
▪ Suitable option for mixed MSW ▪ Less land requirements ▪ Can handle infectious and industrial wastes too ▪ Energy recovery	▪ Highly expensive and not financially viable due to low quantum of waste. ▪ Not suitable because of higher moisture and lower calorific values ▪ Low energy tariff

349. **Scenario-3** considers the recovery of the recyclables through sorting the mixed waste through mechanical means on conveyor belt after fine and coarse screening using trommels. Sorting may be done though magnetic separator and manual processes. Remainder organic fraction can be used for biological treatment using windrow composting (with sales of 50% of compost produced while using 50% as soil cover for landfill).

Figure 5-5: Scenario 3 – Composting, Recycling and landfilling (3 streams)

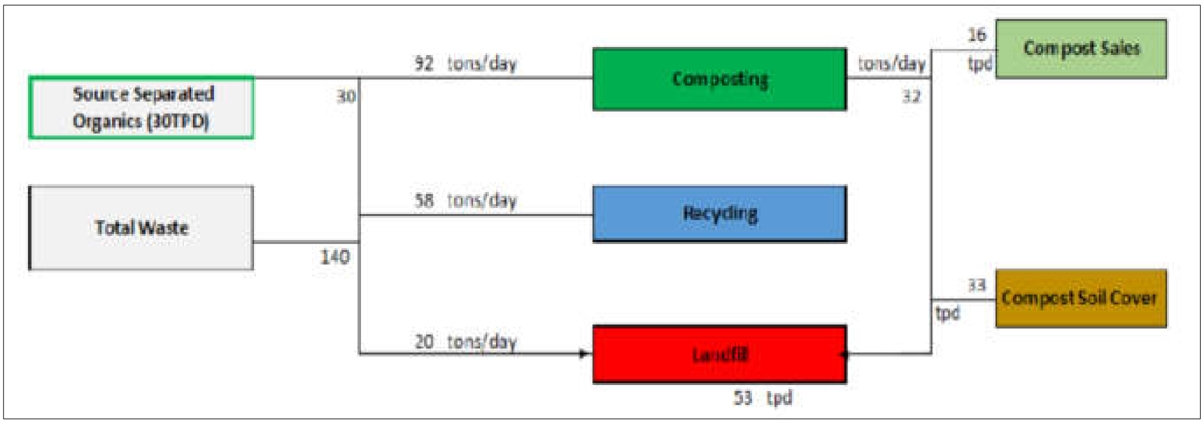


Figure 5-6: Mass balance and %age waste treatment by different options with scenario-3

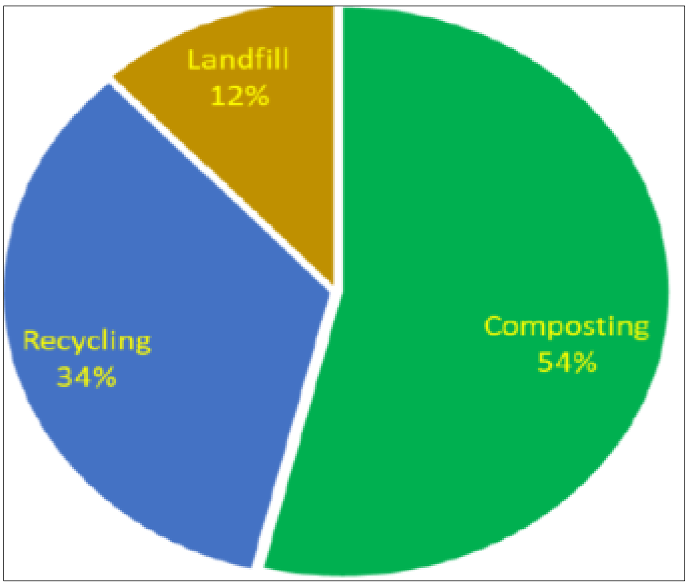


Table 5.6: Pros/Cons of Scenario-3

Pros	Cons
▪ Suitable for mixed municipal waste with higher organic fractions ▪ Can recover recyclables ▪ Organic stream can be converted to compost which can be sold as soil enrichment material or can be used as soil cover for the landfill. Composting helps to reduce the mass of the organic waste by 60-75% by volume. Even if there are limited compost sales, it's still economically and environmentally beneficial to convert the organic waste to the compost saving environmental emissions, landfill air space (improving the life of the landfill) and reducing the O&M cost of the landfill. ▪ Least expensive Option ▪ Easy to operate and maintain the facility ▪ Sorting facilities are available for manual to-semi-automatic to fully automatic.	▪ Without removal of the combustible fraction, the impurities (particularly plastic) may deteriorate the quality of the compost, Therefore, furthermore removal of combustible to prepare RDF will be beneficial but this would be a trade-off between the recyclables and combustible for a better calorific value RDF. ▪ Recyclables entering the mixed waste stream and collected by the compactors are low quality and therefore would have limited sales and revenue potential. ▪ Composting process does not recovery the energy potential of the organic waste. It means, CO_2 produced during the aerobic composting process is emitted in the air, though CO_2 is 21 times less harmful than CH_4 ▪ Feedstock management for composting might be challenging especially maintain the required CN ratio, moisture content an organic matter %age for better sales

350. **Scenario-4** is to employ mechanical and biological treatment process for recovery of recyclables and compostable and conversion of the organic waste to the compost using biological process of windrow composting. Although, recovery of the recyclable would be low when targeting for high quality RDF however it is necessary for removing the impurities from the organic waste stream.

Figure 5-7: Composting, RDF, Recycling and Landfill (4 streams)-scenario 4

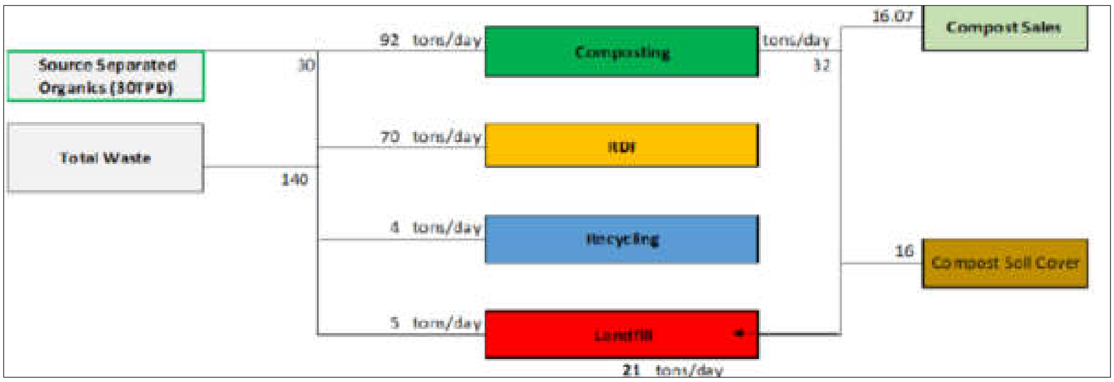


Figure 5-8: Mass balance and %age waste treatment by different options with scenario-4

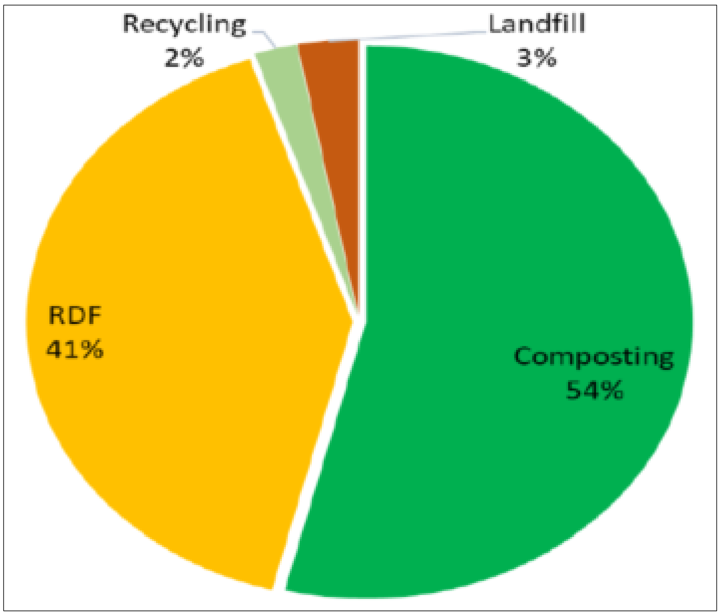


Table 5.7: Pros/Cons of Scenario-4

Pros	Cons
▪ Suitable for mixed municipal waste with higher organic fractions ▪ Can recover recyclables ▪ Organic stream can be converted to compost which can be sold as soil enrichment material or can be used as soil cover for the landfill. Composting helps to reduce the mass of the organic waste by 60-75% by volume. Even if there are limited compost sales, it's still economically and environmentally beneficial to convert the organic waste to the compost saving environmental emissions, landfill air space (improving the life of the landfill) and reducing the O&M cost of the landfill. ▪ Least expensive Option ▪ Easy to operate and maintain the facility ▪ Sorting facilities are available for manual to-semi-automatic to fully automatic.	▪ Recyclables entering the mixed waste stream and collected by the compactors are low quality and therefore would have limited sales and revenue potential. ▪ Composting process does not recovery the energy potential of the organic waste. It means, CO_2 produced during the aerobic composting process is emitted in the air, though CO_2 is 21 times less harmful than CH_4 ▪ Feedstock management for composting might be challenging especially maintain the required CN ratio, moisture content an organic matter %age for better sales ▪ No or limited market for the compost sales ▪ NO or limited market for the RDF sales. ▪ Environmental emission due to direct burning of the RDF by the Cement factories and brick kilns are not monitored.

351. **Scenario-5** is again based on MBT technologies employing sorting of the recyclables and combustibles and diverting the organic waste toward dry anaerobic digestion process for biogas/energy production and then treating digestate with aerobic

composting process used aerated piles. Benefits and risks associated with this scenario are summarized in **Table 5-8** below.

352. **Scenarios 4 and 5** are suitable options for Mingora keeping in view the analysis done. However, it's recommended to adopt and implement the option-5 for sustainable solid waste management. Institutional arrangement, operational plan business model would be key factors for the success of the proposed system. It's therefore necessary to review and develop an enabling environment for the implementation and success of the advanced treatment option.

Figure 5-9: Digestion/Methanation, RDF, Recycling and Landfill (4 Streams)

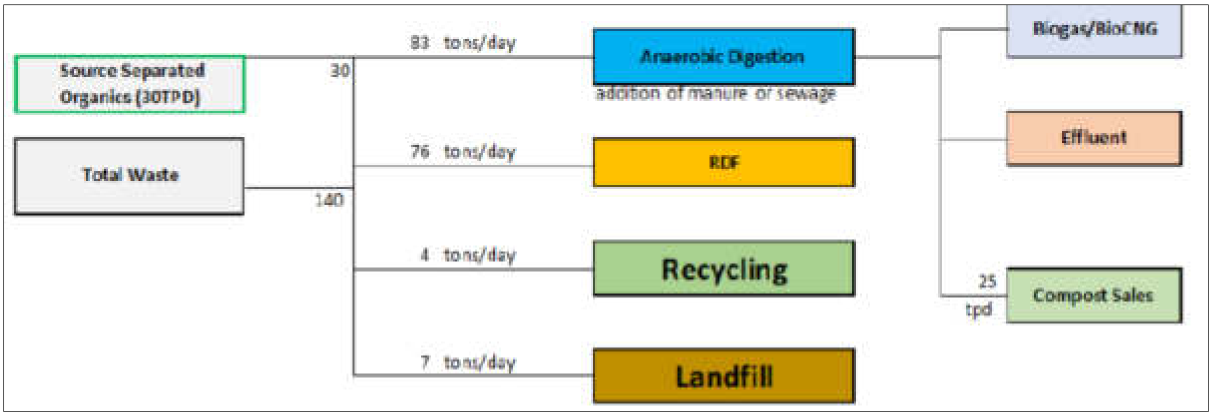


Figure 5-10: Mass balance and %age waste treatment by different options with scenario-5

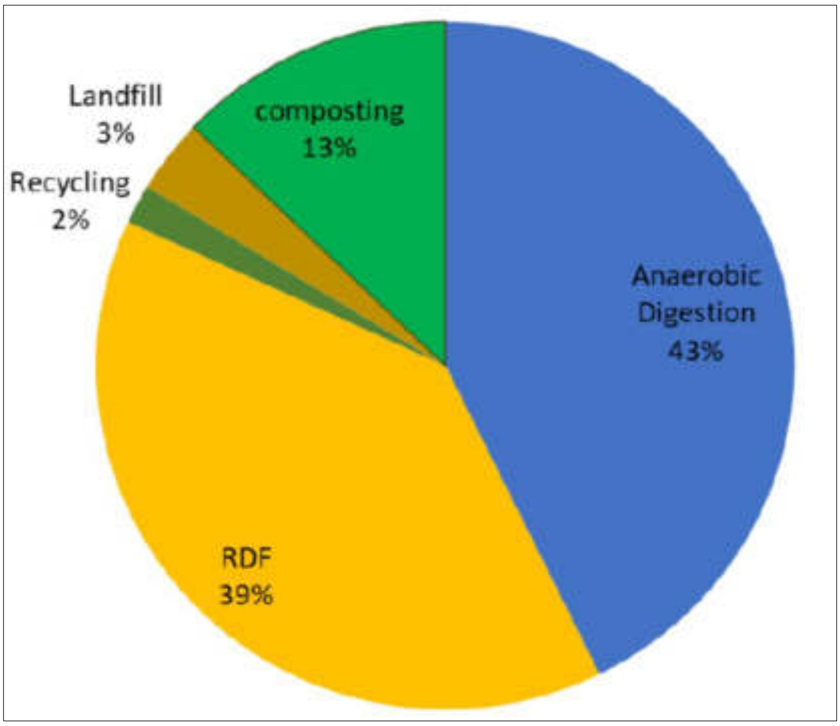


Table 5.8: Pros/Cons of Scenario-5

Pros	Cons
▪ Suitable for mixed municipal waste with higher organic fractions ▪ Can recover recyclables ▪ Easy to operate and maintain the facility ▪ Sorting facilities are available for manual to-semi-automatic to fully automatic. ▪ Recovery of the Biogas and thus further reducing the environmental emissions ▪ Digestate from the AD process can be converted to compost which can be sold as soil enrichment material or can be used as soil cover for the landfill. Composting helps to reduce the mass of the organic waste by 60-75% by volume and combined by AD process can go up to 85-95%. Even if there are limited compost sales, it's still economically and environmentally beneficial to convert the organic waste to biogas and the compost saving environmental emissions, landfill air space (improving the life of the landfill) and reducing the O&M cost of the landfill. ▪ Can handle the animal and sludge from the wastewater treatment plants. ▪ Less land footprint. ▪ Several success stories from region (India) as well as from the Europe and USA	▪ Recyclables entering the mixed waste stream and collected by the compactors are of low quality and therefore would have limited sales and revenue potential. ▪ No or limited market for the compost sales ▪ No or limited market for the RDF sales. ▪ Environmental emission due to direct burning of the RDF by the Cement factories and brick kilns are not monitored. ▪ Comparatively expensive Option ▪ AD process is highly sensitive toward feedstock. maintain the required feedstock quality might be a challenging task

353. Summary analysis of the all possible scenarios for Mingora city is provided in **Table 5.9**

Table 5.9: Qualitative Evaluation of Possible Scenarios for Mingora City

Scenario	Discussion	Recommendation
Scenario-1: **No treatment**	▪ Landfilling of the waste is not in line with the SGDs and National Action plan. ▪ 100% disposal of the waste to the landfill will require large landfill infrastructure. Furthermore, the approach is not in align with the sustainable development goals and national vision 2025. ▪ Several landfills were developed under different initiatives, particularly in Punjab and majority of these are failures due to technical in competencies of the concerned waste management companies.	Not recommended
Scenario-2: Incineration & landfilling	▪ Given the fact that waste produced in Mingora is less than minimum threshold of 275tpd for financially viable WtE intervention. Furthermore, as discussed earlier incineration is not suitable for WtE due high organic fraction (50%) and moisture content (64%) ▪ It is highly expensive options ▪ There is not a single MSW incitation facility in Pakistan. Though there are several very small-scale incineration units available with the healthcare facilities and that too are poorly managed and are non-compliant to the environmental emission standard (NEQS).	Not possible
Scenario-3: Composting, Recycling and Landfilling	▪ Semi-Automatic sorting line to segregate the recyclables & combustibles from organic stream is possible that would result in improving of the compost quality as well. ▪ In addition to recyclables, there is fraction of combustible waste too. If it's not separated from the reminder organic stream it might impact the compost quality. ▪ As discussed in the previous sections, there are several small -large scale composting initiatives by the private as well as on PPP basis. Small scale initiatives by the private sector are successfully running while the large-scale intervention in Lahore (1000tpd) failed due to the mixed waste processing and unable to meet the required quality.	Not recommended

Scenario	Discussion	Recommendation
Scenario-4: Composting, RDF, Recycling and Landfilling	▪ With manual sorting of the recyclables it would be possible to segregate the combustible fraction as well leaving only pure organic stream that would have high C:N ratio, moisture content and further additives like animal manure, fecal sludge from WWTP bulking agents like rice husk could be added to improve the quality of the waste. ▪ Mingora is not purely agricultural city and therefore, marketability of the compost is questionable. The marketability of compost and RDF in Mingora region must be explored via consultations with the possible buyers. ▪ Furthermore, keeping in view the failure of LCL, composting process may be replaced with other technology like AD process to produces end product having economic value higher than compost and have strong market potential.	Recommended
Scenario-5: RDF, Recycling, Dry Anaerobic Digestion followed by composting and Landfilling	▪ After sorting of the MSW using the semi-automatic sorting line to segregate the recyclables and the combustible fractions, the remaining fractions could be subjected to Anaerobic Digestion. ▪ Sorting line will help in improving the quality of the organic waste. ▪ Supply of source segregated organics and sludge from the wastewater treatment units can improve the biogas production. ▪ Anaerobic digestion process is highly sensitive process, a slight change in the feedstock might disrupt the entire process. Therefore, high quality feedstock would be required. ▪ Anaerobic digestion would require highly technical skills to manage the process which are currently not available with the WSSC Swat nor with the local private operators of biogas plants. An international expertise may be acquired through engaging European or similar technology provider.	Highly Recommended

5.11 Economic Aspect Analysis

354. Economic aspect analysis of different waste treatment methods has been carried out which also shows that for low income countries like Pakistan sanitary landfilling is the most economically viable option. The **Table 5-10** shows the estimated total cost of waste per ton for different waste treatment methods.

Table 5.10: Economic aspect analysis of waste treatment methods[18] (UNEP, 2015)

World Bank Project Data	Low Income Countries	Lower Middle Income	Upper Middle Income	High Income Countries
Total Cost in US$/ton				
Sanitary landfilling	10-30	15-40	25-65	40-100
Composting	5-30	10-40	20-75	35-90
Waste-to-energy incineration	NA	40-100	60-150	70-200
Anaerobic digestion	NA	20-80	50-100	65-150

Disclaimer: All estimates are for comparative purposes only and are not indicative of actual costs at any particular local site. Costs for reduction, reuse and recycling are not captured in this table.

18 Incineration of Municipal Solid Waste February 2013, DEFRA UK

6 Potential Environmental Impacts and Mitigation Measures

355. Potential impacts arising from designing, construction and operation phase of Mingora SWMF have been identified and assessed on the basis of field data, secondary data, expert opinion and examining previous similar projects in Pakistan. These include effects on physical, biological and socio-economic environments. Impacts associated with design, construction, operation and closure/post closure phases of SWMF components such as landfill cells, leachate collection network, landfill gas collection and venting system, AD and compositing plant, material recovery facility, admin building and associated road network have been detailed in the section. The impact assessment of Mingora SWMF has been carried in accordance with the requirements of KP EPA, 2014, Pak EPA-1997 and ADB SPS, 2009.

356. Impact-screening matrices during each of the SWMF development phases i.e. project design, construction and operation and closure/post closure are presented below.

6.1 Methodology for impact screening

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

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

Risk = Likelihood × Consequence

Likelihood Scale

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

Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities	5
Major	The action will cause major adverse damage on the environment or surrounding communities	3
Moderate	No or minimal adverse environmental or social impacts	2
Minor	No or minimal adverse environmental or social impacts	1

Risk Score Table

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

Risk: Significant: 15-25

Medium: 6-10

Low 1-5

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

6.2 Design/Pre-Construction Phase

Impact Screening Matrix

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

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

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Improper designing of landfill site leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)	Likely	Moderate	Medium	Long Term
2	Improper selection of landfill site due to non-compliance with IFC guidelines for Landfills	Likely	Moderate	Medium	Long Term
3	Lack of integration of EIA/EMP requirements into Construction bid documents	Likely	Moderate	Medium	Short Term
4	Material Haul Routes	Likely	Moderate	Medium	Short Term
5	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium	Short Term
6	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium	Short Term
7	Cultural Heritage & Religious Sites, Social Infrastructure	Unlikely	Moderate	Low	No residual Impact
8	Land acquisition and resettlement impacts	Likely	Moderate	Medium	Long Term

9	Impacts due to Natural Hazards	Likely	Moderate	Medium	Long Term

Critical Risk Level
Significant Risk Level
Medium Risk Level
Low Risk Level

6.2.1 Improper landfill design leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)

Impacts

361. The possibility exists that in case the landfill is not designed in accordance with international standards and guidelines for landfill development, particularly with regards to EHS aspects, such as the IFC Guidelines on Waste Management Facilities for Landfills[19], it could result in multiple potential impacts that could adversely affect the project area and all receptors located in it, with the most notable being the residential settlements.

362. If Project design shall not take into account the consideration related to ground conditions, the geology and hydrogeology of the site, long term potential environmental impacts may arise.

363. Consideration like the nature and quantity of waste that will be landfilled is crucial for landfill operations, any change in waste stream may result in possible contamination to soil and water and other operational complexities.

364. It Project design shall not take into account visual aspects, environmental and social receptors it will result in public grievances about environmental nuisance in the project area.

Mitigation Measures

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

- Landfill has been designed in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills.
- Consideration shall be given to the stability of the sub-grade, the base liner system, the waste mass and the capping system. The sub-grade and the base liner will be sufficiently stable and thick as per international standards to prevent excessive settlement or slippage.
- Bottom and cap lining system for each landfill cell must be designed for the protection of soil, groundwater and surface runoff.
- An efficient leachate collection system must be provided to ensure leachate

[19] https://www.ifc.org/wps/wcm/connect/5b05bf0e-1726-42b1-b7c9-33c7b46ddda8/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&CVID=jqeDbH3&id=1323162538174

accumulation at the base of the landfill and keep it to a minimum.

- The accumulation and migration of gases from landfill facility must be controlled. Landfill gas will be collected through installation of perforated pipes within the cells.
- Consideration will be given to the visual appearance of the landfill site during operation and at termination of landfill site and its impact on the surrounding landforms. Necessary plantation will be carried out which will act as buffer zone from surrounding environment. Reasonable area will be allocated for plantation within and at boundary of facility to improve landscape of the area.
- Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill.
- One groundwater monitoring well will be maintained out of the drills made for geotechnical investigation. However, more wells may be constructed if required once the landfill starts operations.
- In order to incorporate advancement in technology and changes, a periodic review of the design will be carried out, as the lifespan of a disposal site from commencement to completion is long compared to other construction projects.

6.2.2 Improper selection of landfill site due to non-compliance with IFC Landfill guidelines

Impacts

- The IFC Guidelines contain specific criteria related to site selection for landfill sites that have been developed to ensure any potential Impacts resulting from landfill operation are minimized as far as possible. In case these Guidelines are not strictly implemented for the development of the proposed landfill, it could result in considerable irreversible, diverse or unprecedented impacts.
- Proposed landfill site should be selected on the basis that it must comply basic KP government regulations, IFC EHS guidelines for waste management facilities, ADB SPS 2009.
- Proposed selection of landfill site must take into accounts impacts from leachate, litter, dust, vector and odors on surrounding environment.

Mitigation Measures

366. The following mitigation measures will be implemented:

- Site selection for the proposed landfill site has been conducted in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills.
- Factors such as site capacity, accessibility, acceptability, stability, environmental sensitivity, land use, socio-economic receptors and climate hazards have been studied and site has been selected accordingly.
- Site for Mingora Landfill has been selected keeping in view environmental and social sensitive receptors and necessary design considerations have been provided to manage impacts related to leachate, litter, dust, vector and odors on

surrounding environment.

6.2.3 Lack of integration of EIA/EMP requirements into Construction bid documents

Impacts

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

Mitigation Measures

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

369. EIA/EMP implementation and monitoring requirements must be part of bidding documents and necessary contractual binding must be agreed by project contractors before award of contract.

370. Project contractors shall have qualified and experienced environmental staff to plan, arrange, implement, monitor and report EIA/EMP requirements.

6.2.4 Material Haul Routes

Impacts

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

Mitigation Measures

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

6.2.5 Contractor's Environmental Safeguards Capacity

Impacts

373. Lack of contractor's environmental safeguard capacity or selection of environment non-responsive contractors may result in failure of EMP implementation and may be a source of number of non-compliances.

374. The responsibility of the PMU KP LGE&RDD in collaboration with the focal agencies is to review and finalize the bidding documents relating to environmental issues.

375. Contractors that do not possess the required capacity for safeguards management must not be pre-qualified and selected.

Mitigation Measures

376. PMU KP LGE&RDD shall review the contractor capacity with respect to safeguard management and contracts shall be awarded accordingly.

377. The Contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures should be developed and approved by the PMU in collaboration with the focal agencies before the Contractor commences any physical works on ground.

378. PMU KP LGE&RDD shall ensure the project contractors are selected on merit and necessary funds has been allocated in the contract documents for EMP implementation and monitoring.

6.2.6 Identification of Locations for Labor camps and ancillary facilities

Impacts

379. The duration of the construction activity for the landfill development is expected to be 24 months and 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

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

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

6.2.7 Cultural Heritage & Religious Sites, Social Infrastructure

Impacts

382. No temples or religious sites are located in proximity of Mingora landfill site.

383. The nearest sensitive receptors already identified in the project areas have been mapped and a minimum buffer distance of 250 meters from all boundaries of the landfill site will be maintained, as required by the IFC EHS Guidelines on Waste Management Guidelines for landfilling. As a result, no major significant impact would be expected from the works on any social infrastructure. However, consideration will be made not to construct at night, from 7 pm onwards till 6 am in the morning, to avoid nuisances.

Mitigation Measures

384. No mitigation measures are required.

6.2.8 Land Acquisition and Resettlement Impacts

Impacts

385. Land acquisition process of the project has been initiated in 2014 by KP government through notification which was denotified in 2017 and again renotified in 2018. There are no residential unit, no trees and non-land assests within the acquired land. Although land acquisition process has been notified however no compensation has been paid yet. Compensation related to land acquisition will be paid by the KP government to displaced persons as per market rates. Landowners and local residing along the Katwaro Maira road are of the view that proposed landfill facility development will result in environmental nuisance and the price KP government is offering is very low as per market value of land.

386. Sparsely scattered residential settlements are lying at varying distances around other sides of the proposed landfill site. There are 03 houses in west, 01 house in south and 02 houses in east side of the landfill site which are very close (falling within 250 m distance from landfill cells as per IFC criteria) and considered as sensitive receptors. It will be ensured that no sensitive receptor is residing within 250m landfill cell development subject to willingness of the residents.

Mitigation Measures

387. The PMU KP LGE&RDD shall ensure the following:

- Land acquisition process including compensation to land owners must be completed before start of the construction work of SWMF.
- Social safeguard unit shall ensure that project affected people has been paid following appropriate procedures and there are no grievances about land acquisition process.
- Accelerating the resettlement process in collaboration with DC Mingora and WSSC Swat.

6.2.9 Impacts due to natural hazards

388. Site is located outside of seismically active area as it falls in Zone 2B with peak ground acceleration (PGA) in range of 0.16g to 0.24g on seismic map of Pakistan. No fault lines or significantly fractured geologic structure is present within 500 meters of the perimeter of the proposed landfill cell development that may allow unpredictable movement of gas or leachate.

389. Site is located outside of 100 year flood plain. As site is located in depression therefore there are chances of flash flooding however there is natural seasonal drain passing adjacent to the landfill site which carries rainwater downstream in hilly terrain. Surface drainage network has been provided in detail design of landfill site to avoid risk of surface runoff and contamination. Further retaining wall to limit enterance of water into landfill facility is provided along the boundary of landfill site.

390. Significant increasing trends in precipitation over time have been detected during the monsoon season for project area however as site has natural seasonal drain to carry rainwater down to Swat River. Keeping in view eleveation of the site from Swat River and additional retaining wall provided in the design there are limited chances of flash flooding to the site. Extreme precipitation event analysis to suggest further design changes/improvements will be carried out during operation phase of the project.

Mitigation Measures

- The PMU KP LGE&RDD shall ensure the following:

- Mingora SWMF infrastructure shall be designed keeping in view the seismic zone 3 building considerations.
- Retaining wall provided in project design shall be constructed in such way that during extreme precipitation events no flash flooding is entering the site.
- Surface water diversion shall be included in the design to protect landfill from urban/flash flooding.
- Extreme precipitation events analysis shall be performed for landfill life i.e. 10 years, to predict and manage impacts of flash flooding.
- On site waste storage at loading bay shall be kept to minimum during high precipitation events.
- Emergency response plan shall be prepared by construction and operation phase contractors and will be submitted to PMU for approval to manage impacts of natural hazards such as earth quakes and floods.

6.3 Construction Phase

Impact Screening Matrix

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

Table 6.2: Screening of Possible Impacts during Construction Phase

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Construction of landfill not in accordance with finalized design	Likely	Major	Medium	Long Term
2	Degradation of air quality due to construction works	Likely	Moderate	Medium	Short Term
3	Potential accidents and injuries to communities in project area during construction works	Likely	Moderate	Medium	Short Term
4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Moderate	Medium	Short Term

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
5	High noise levels from construction activities	Likely	Moderate	Medium	Short Term
6	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium	Short Term
7	Untreated disposal of effluent from worker camps and batching plant(s) and construction sites	Likely	Moderate	Medium	Short Term
8	Soil Erosion and Sedimentation	Likely	Moderate	Medium	Short Term
9	Soil Contamination	Likely	Moderate	Medium	Short Term
10	Employment Conflicts	Likely	Moderate	Medium	Short Term
11	Communicable diseases incl. COVID-19	Likely	Moderate	Medium	Short Term
12	Vegetation and Wildlife Loss	Unlikely	Moderate	Low	No Residual Impact
13	Historical/Archaeological Sites	Unlikely	Moderate	Low	No Residual Impact
14	Construction of Administeration Building and Other Infrastructure	Likely	Moderate	Medium	Short Term
15	Construction/Widening of Access Road	Likely	Moderate	Medium	Short Term
16	Sexual Abuse, Exploitation and Harrassment (SEAH)	Unlikely	Moderate	Low	No residual Impact

Critical Risk Level	Significant Risk Level
Medium Risk Level	Low Risk Level

6.3.1 Construction of landfill not in accordance with finalized design

Impacts

392. If the proposed landfill is not developed in accordance with the finalized design and its corresponding design parameters, it could lead to a number of unanticipated impacts such as groundwater contamination due to inadequate liner installation etc.

Mitigation measures

393. The following mitigation measures will be implemented:

- Method statements must be prepared by the Contractor and approved by the Construction Supervision Consultant (CSC) prior to commencement of construction works.
- The CSC must closely monitor the construction works being conducted by the Contractor to ensure the finalized design is implemented in full and the landfill design is developed completely in compliance of the approved finalized designs.
- Any deviation by the Contractor from following the finalized design must be immediately highlighted and corrective measures must be implemented to ensure full compliance with the finalized design of the landfill.
- PMU KP LGE&RDD shall ensure that construction activities are being carried out in compliance to project design following best international practices. It will closely review and monitor the activities of CSC and contractors involved in construction activities.

6.3.2 Degradation of Ambient Air Quality

Impacts

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

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

396. Vehicles carrying construction material are expected to result in increased Suspended Particulate Matter (SPM) levels near the haul roads. This can be of potential importance if the vehicles pass through the areas with a high concentration of sensitive receptors, such as residential areas, in this particular case.

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

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

399. The quantity of dust that will be generated on a particular day will depend on the magnitude and nature of activity and the atmospheric conditions prevailing on the day. Due to the uncertainty in values of these parameters, it is not possible to calculate the quantity from a 'bottom-up' approach, that is, from adding PM_{10} emissions from every activity on the construction site separately. Typical and worst-case PM_{10} emissions from construction sites have been estimated[20] as 0.27 megagram per hectare per month of activity (Mg/ha-month) and 1.04 Mg/ha-month, respectively.

Fugitive Dust Control

400. The source wise fugitive control measures are provided in **Table 6.3** below. The Dust Management Plan has been attached as **Annexure H.**

Table 6.3: Control measures for Fugitive Dust emissions

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

Mitigation Measures

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

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

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

national and local regulations.

- Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions.
- Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions.
- Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin.
- Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area should be avoided.
- Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors.
- Stack height of generators will be at least 3 meters above the ground.
- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area.
- A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community.
- The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m^3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use.
- Dust emissions due to road travel shall be minimized through good construction practices (such as keeping stock piles down wind and away from communities) and sprinkling water over the access road.
- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects. ·
- Developing and implementing work practices to minimize release of contaminants into the work environment including:
    - Direct piping of liquid and gaseous materials
    - Minimized handling of dry powdered materials; Enclosed operations
    - Local exhaust ventilation at emission/release points
    - Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
    - Indoor secure storage, and sealed containers rather than loose storage

Vehicular & Equipment Emissions

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

- Periodically check and conduct maintenance of the construction machinery and haul vehicles. Generators, compressors and vehicles used during construction works will be maintained in a good condition to ensure that emissions are kept to a minimum level.
- Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics.
- Controlled technology generator and batching plants will be used to avoid excessive emissions.
- Burning of wastes at any site will not be allowed.
- The stack height of generators will be at least 3 meters above the ground.
- Training of the technicians and operators of the construction machinery and drivers of the vehicles.
- All type of machinery and generator must comply with the NEQS. Vehicles, which are not in compliance with NEQS are not allowed to use.
- Periodic emission monitoring of vehicles, generator and batching plants is proposed.
- Project activities should be planned to avoid harsh weather conditions.

6.3.3 Community Health and Safety

Impacts

403. The landfill development will involve the use of considerable heavy machinery at the project site along with posing the risk of community members falling into trenches. In addition, the risk to commuters on the road during the construction works will be significant and thus a number of precautionary measures will be necessary to minimize the risk of possible accidents. Community Health & Safety may be compromised during road travel particularly in night hours if adequate barriers and lighting is not provided at construction sites.

Mitigation Measures

404. The following mitigation measures will be implemented:

- Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for landfill. Landfill related infrastructure will be cordoned off. Also, no machinery will be left unattended, particularly in running condition.
- Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.

- Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible.
- Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.
- 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.
- PMU KP LGE&RDD 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.

6.3.4 Occupational Health and Safety (OHS)

Impacts

57. There is invariably an OHS risk when construction works for the landfill are conducted, and precautions will be needed to ensure the safety of the workers. Occupational Health and Safety Plan has been attached as **Annexure E**

405. The major OHS hazards expected during the proposed activities are as follows:[21]

Accident Hazards

- Falls from height, especially when standing/working on ladders;
- Slips, trips and falls, especially while carrying heavy or bulky loads;
- Cuts and injuries caused by sharp instruments and tools;
- Hazard of suffocation from asphyxiant gases released or from oxygen deficiency, during maintenance and cleaning operations;
- Burns caused by hot parts of equipment, steam lines etc, by release of hot water or steam;
- Electric traumas, caused by defective installations and equipment, especially portable;
- Musculoskeletal injury (especially of back), resulting from lifting and moving of heavy loads;

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

Physical Hazards

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

Chemical Hazards

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

Biological Hazards

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

Ergonomic, psychosocial and organizational factors

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

Mitigation Measures

General

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

407. Monitoring will be required to ensure that the health and safety plan based on contract specifications is followed.

- Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.
- Surfaces (including flooring and work surfaces) in camps, kitchens, dining areas and workshops should be solid and easy to clean. Flooring for work camps must be float finished concrete or better.
- All drivers engaged by Contractors must hold a valid license for the vehicle they are operating.
- Work in confined space shall be executed with available safety standards. Adequate monitoring and equipment shall be available to detect deficient oxygen levels.
- The Contractor shall submit to the Engineer of CSC for approval an emergency evacuation plan and practice the procedure annually.
- The Contractor shall submit to the Engineer of CSC for approval a site layout plan,

identifying work areas, accommodation, kitchen, dining area, sanitary facilities, location of generators, plant and vehicle parking, transport routes through the camp, pedestrian routes through the camp, evacuation routes, emergency exits, batching plants, storage areas, waste facilities etc.

- Fire extinguishers should be provided throughout camps and work sites. Fire extinguishers should be inspected monthly and maintained as necessary.
- An adequate and reliable supply of safe drinking water shall be made available at readily accessible and suitable places including at all camps.
- The Contractor shall take samples from each supply of drinking water and arrange for analysis of these samples at EPA certified laboratory prior to its use by the Contractor's staff. The results of these tests for each supply must be submitted to the Engineer of CSC and must demonstrate that each water supply meets national and World Health Organisation standards for drinking water.
- The Contractor shall provide and maintain adequate hygienic kitchens which are sheltered and separated from the living quarters. Kitchens shall include raised and washable surfaces suitable for food preparation.
- The Contractor shall provide and maintain adequate hygienic dining areas for staff. Work places and camps should be provided with both natural & artificial light. Artificial lighting should be powered by generator in the event of power cuts.
- Public sensitization training should be provided to workers to avoid social conflicts between residents and the construction contractor, Occurrence of any such impacts can be avoided by community sensitive project planning and implementation and through effective involvement of local administration.
- All OHS protocols should be implemented in true letter and spirit.
- Contractor must appoint an OHS resource to implement, monitor and report the HSE management plan to concerned authorities.
- Contractor must ensure the provision of first aid facility at construction site and camps through hiring medics and establishing a dispensary at the campsite.
- Reasonable number of first aid kits should be available on construction sites and within contractor camps.
- Site personnel will be provided appropriate type of personal protective equipment (PPEs). Contractor will ensure consistent use of PPEs.

408. Based on the type of hazard applicable during the proposed works at site, the following mitigation measures as per IFC guidelines for Occupational Health and Safety (OH&S) must be implemented:[22]

409. Emergency response plan to provide measures and guidance for the establishment and implementation of emergency preparedness plans during project execution is provided as **Annexure F.**

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

410.

Mitigation Measures for Physical Hazards

Rotating and Moving Equipment

411. Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Mitigation measures related to rotating and moving equipment hazards for workers are provided below:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions.
- Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance.
- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.

Vibration

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

413. Other sources of vibration at construction site are rollers, compactors or any loose part of machinery exposure which may cause serious injury or workplace sickness. No equipment and machinery with loose or vibratory parts will be allowed to work. Such issues will be fixed through maintenance of the machinery on periodic basis. Use of rollers for land grading will be carried out during day times and with intermittent intervals to reduce the impacts of vibration on surrounding environment.

414. Considering the project setting, which is not in a congested urban environment and instead is a hilly terrain with vegetation cover, there is no potential risks with regards to vibration.

Electrical

415. Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles

or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

- Marking all energized electrical devices and lines with warning signs;
- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance;
- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools;
- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits; ·
- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas; ·
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work.

Eye Hazards

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

- Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full-face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should conform to standards published by organizations such as CSA, ANSI and ISO.

Welding/Hot Work

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

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. ·
- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by

fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated.

Industrial Vehicle Driving and Site Traffic

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

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

Ergonomics, Repetitive Motion, Manual Handling

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

- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind.
- Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds.
- Selecting and designing tools that reduce force requirements and holding times and improve postures.
- Providing user adjustable workstations.
- Incorporating rest and stretch breaks into work processes and conducting job rotation.
- Implementing quality control and maintenance programs that reduce unnecessary forces and exertions.
- Taking into consideration additional special conditions such as left-handed persons.

Working at Heights

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

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

Fire and Explosions

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

- Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area should be equal to 120% of the total volume of fuel stored.
- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
  - Remote from entry and exit points into camps
  - Away from facility ventilation intakes or vents
  - Have natural or passive floor and ceiling level ventilation and explosion venting
  - Use spark-proof fixtures
  - Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time.
- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment). ·
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.

Corrosive, oxidizing, and reactive chemicals

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

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

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

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

Mitigation Measures for Biological Hazards

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

- 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 wok 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.

6.3.5 High Noise Levels

Impacts

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

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

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

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

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

428. The construction activities will include use of a large number of trucks, generators, excavators etc., which can generate significant noise.

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

430. Depending on the construction equipment used and its distance from the receptors, the community and the workers may typically be exposed to intermittent and variable noise levels. During the day, such noise results in general annoyance and can interfere with sleep during the night. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level.

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

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

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

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

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

Notes:

a. Where typical value is not cited in literature, mean of the peak noise range is assumed
b. Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB reduction is assumed

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

434. There are six nearest sensitive receptors (with respect to noise) form the proposed landfill cells which are residential housing however these are located at a distance of 200 meters. During construction phase noise impacts are of short duration and necessary mitigation measures will be adhered to therefore no noise siginifcant noise sensitivities are involved in the project area.

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

Mitigation Measures

436. The following mitigation measures will be implemented:

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

6.3.6 Hazardous and Non-Hazardous Waste Management

Impacts

437. During construction/civil works potential sources of waste will include spoils generated during landfill cells excavation, excavation waste for other civil works, domestic wastes (solid & wastewater), fuel or oil leakages or spills, onsite effluents from vehicle wash & cleaning, and cement spills.

438. Waste disposal of materials containing contents of both hazardous and non-hazardous nature such as scrap wood, bricks, concrete, asphalt, plumping fixtures, piping, insulation (asbestos and non-asbestos), metal scraps, oil, electrical wiring and components, chemicals, paints, solvents etc. can potentially become a serious environmental issue, particularly with the local contractors. To avoid any potential

issue, the PMU in collaboration with focal agencies will need to impose adequate internal controls.

439. Domestic wastes generated during construction of Mingora MSWF will include sewage, grey water (from kitchen, laundry, and showers), kitchen wastes, combustible wastes and recyclable wastes from contractor camps.

Mitigation measures

440. A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility i.e. designated area with secondary containment.

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

- Excavated material from landfill cells will be stored at site and it will be used as daily cover within landfill cells.
- All types of combustible and non-combustible waste including plastic or glass bottles and cans will be temporarily stored on site and later sold/handed over to a waste/recycling contractor who will utilize these wastes for recycling purposes.
- Waste management training for all site staff to be included in Contractor's training plan.
- Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area should be equal to 120% of the total volume of fuel stored.
- Fuel and hazardous material storage points must be included in camp layout plan to be submitted for approval. Hazardous material storage areas shall include a concrete floor to prevent soil contamination in case of leaks or spills. Fuel tanks will be checked daily for leaks and all such leaks will be plugged immediately.
- Designated vehicles/plant wash down and refueling points must be included in camp layout plan to be submitted for approval.
- Hazardous waste will be initially stored on site at designated area and then handed over to EPA certified contractor to final disposal.
- Record of waste generation and transfer shall be maintained by project contractors.
- Spill kits, including sand buckets (or other absorbent material) and shovels must be provided at each designated location.
- At the time of restoration, septic tanks will be dismantled and backfilled with at least 1m of soil cover keeping in view landscape of surrounding natural surface.
- It will be ensured that after restoration activities, the campsite is clean and that no refuse has been left behind.
- Clinical wastes will be temporarily stored onsite separately and will be handed over to approve waste contractor for final disposal.

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

- The structure of a framework waste management plan has been prepared for the project and attached as **Annexure O** and contractors will be required to prepare waste management plan for the site in light of guidelines provided in the waste management plan and submit to PMU for approval.

6.3.7 Camp & Batching Plant Effluent

Impacts

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

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

Mitigation measures

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

- A closed sewage treatment system including soak pits and septic tank will be constructed to treat the effluent from the construction/labor camps.

- Sewage treatment system will be installed at each respective labor camp based on the number of laborers residing at the respective camp.

- Wastewater from laundry, kitchen washings and showers will be disposed-off into soak pits or septic tank (where soak pit cannot be constructed) and after treatment it will disposed of in TMA provided drains in the project area.

- Soak pits will be built in absorbent soil and shall be located 300 m away from a water well, hand pump or surface water body. Soak pits in non-absorbent soil will not be constructed.

- Ensure that the soak pits remain covered all the time and measures are taken to prevent entry of rainwater into them.

- Sprinkling of grey water or sewage will not be allowed; in case the septic tank gets filled with sludge, septic tank shall be emptied through vacuum truck and material shall be transferred to treatment facility or approved municipal drain.

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

- Sewage at the end of construction period to be disposed of in nearest municipal drains after getting approval from concerned municipal authorities.

6.3.8 Soil Erosion and Sedimentation

Impacts

444. 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. Excavated soil will be stored at site and will be used as daily cover during landfill operations. Approximately 917,700 ft^3 of soil will be generated from excavation of the two landfill cells and this soil will be stored at designated area for use as daily cover.

Mitigation measures

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

6.3.9 Soil Contamination

Impacts

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

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

Mitigation measures

- It will be ensured that spill prevention trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil.
- Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities.
- Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.

6.3.10 Employment Conflicts

Impacts

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

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

Mitigation measures

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

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

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

6.3.11 Communicable diseases incl. COVID-19

Impacts

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

451. Ministry of National Health Services, Regulations and Coordination, GoP has issued guidelines in April, 2020 for Health & Safety of Building and Construction Workers during COVID-19 outbreak. These guidelines are prepared for the workers involved in building and construction work during the current epidemic of COVID-19. These guidelines provide the safety measure to be implemented at the construction site having a dusty environment, continuous flow of different materials and make-shift type of arrangements for storage, food and sanitation calls for implementation of safety precautions at the very basic level of personal hygiene only.

452.

Mitigation measures

453. A communicable diseases prevention program will be prepared for construction workers or residents near the construction sites. The WHO guidelines on biosafety and use of masks are provided as **Annexures M and N.**

COVID-19 specific measures WHO

- All workers must perform complete sanitization at the site as per SOPs/guidelines issued by WHO and the national guidelines issued by the Government of Pakistan (GOP)[23].

- All workers must wear a mask and gloves as soon as they arrive at site and must keep wearing it at all times while present at the work site/hospital premises. The WHO guidelines on biosafety and use of masks are provided as Annexures M and N.

- As soon as workers arrive at work site, their body temperature must be checked and in case any worker is assessed to be running a fever or suffering from a flu or cough, he must be informed to leave immediately and self-isolate for a two week period and not report for work until this two week mandatory period has been

[23] https://covid.gov.pk/guideline

completed.

- At the work site(s), social distancing measures must be strictly implemented and gathering of workers at any location at the work site(s) must be strictly forbidden. In case of workers not taking this measure seriously, strict penalties must be imposed to ensure implementation.
- The work tasks must be divided into shifts, as far as possible, to reduce the workforce present at the work site(s) at any one moment and improve the working speed/efficiency.
- All workers will be strictly advised to wash their hands as frequently as practicable and not to touch their face during work.
- A supply of safe drinking water will be made available and maintained at the project site(s).
- Chlorinated disinfecting spraying must be conducted at the work site(s)
- COVID awareness sign boards must be installed at the camp clinic and at the work site(s).
- Contact details of all workers will be kept in a register on site in order to efficiently trace and manage any possible workers that might experience symptoms of COVID-19.
- Prohibition of entry for local community/any unauthorized persons at work sites.
- Proper hygiene practices in the toilets and washrooms will be implemented with proper and adequate use of soaps and disinfectant spray.
- Social distancing must be maintained during the pick-up and dropping off of workers from their residences to and from the work site(s).

COVID-19 specific measures GOP

Advice for Site Managers:

- Every construction project shall make proper arrangements for uninterrupted building services including but not restricted to, electricity, fuel, water supply, water disposal and sanitation, communication links, washrooms with hand hygiene and shower facility and with proper and adequate supply of soaps and disinfectants.
- Workers should not use biometric attendance machines or crowd during attendance, entry or exit to the premises of the construction site.
- Ensure the availability of the thermal gun at the entry and exit of the construction site and no worker should be allowed without getting his/her temperature checked.
- Site manager must maintain a register of all contact details with NID number and addresses of all present at the site in case a follow up or tracing and tracking of contacts is required at a later stage.

- Develop the employee roaster to decrease the number of people on the site very day. Split the shifts of the workers in morning and evening with limit of each shift to 8 working hours.
- Every worker must change into standard working attire at the time of commencement of duty and change back to their regular dress after taking shower when their duty hours end.
- In addition to all other internationally recognized safety precaution for construction workers and other staff, every individual must be provided with a face mask. It must be ensured that everyone during his or her presence at the site continues to wear the mask. Face mask shall be replaced as and when soiled or otherwise removed. Outer surface of face mask must not be touched with hands.
- Non-essential work trainings must be postponed avoiding gathering of people.
- Ensure the physical distance by creating more than one route of entry and exit to the site.
- Instruct the workers to inform the construction manager (or authorities) if
  - They develop any symptoms of cough, flu or fever.
  - They have been exposed to someone suspected or confirmed with COVID 19.
  - They have met someone who has a travel history of COVID 19 endemic country. They have travelled in last couple of days or plan to travel soon.
- All incidences of appearance of the symptoms of COVID-19 shall be immediately documented and maintained at the site and information regarding which shall be immediately communicated through e-mail or else, to the designated health facility, and the sick worker shall be transported to the health facility for further advice and action. The site manager must establish a link with a nearby healthcare facility with arrangements for quick transportation of workers in case of an emergency.
- Persuade the workers to inform the authorities for their safety and of other if they observe any signs and symptoms in a colleague
- Do not allow any worker at the construction site who has the symptoms
- Display the awareness banners about hand hygiene and physical distancing, where you can, around the work site.
- Everyone on the construction site must observe sneezing and coughing etiquettes. • Workers shall be requested and required to wash their hands as frequently as

practicable and shall also be advised not to touch their face with their hands during work.

- Workers must maintain no less than two arm lengths between them before, during after work at all the times. They shall not make physical contact and shall be required to maintain separate personal gears and assets which must be clearly labelled and stored without intermix.
- Only sanitize-able dinning surfaces shall be used, which must be cleaned before each service. Food must be heated to a temperature to no less than 70o C before consumption and shall preferably be served in disposable utensils. If reusable utensils are used, these must be washed with soap and water immediately after use and stored at a safe place.
- The lunch breaks and stretch breaks of the workers must be staggered to avoid the clustering of workers. Workers must not sit at less than 2 meters distance while having meals and while any other activity requiring interpersonal communications.
- In the wake of current restrictions on transportations site mangers will ensure safe transport arrangements for worker which should not be crowded and should have social distancing in place during the entire process from pickups till drops at destination.
- In case of workers sleeping in at the site of construction, a safe distance of 2 meters must be ensured in the sleeping rooms
- A supply of safe drinking water must be made available at the project site and maintained.

Advice for Construction Workers:

- All possible and prescribed measures shall be taken to ensure your and others health. Enter your contact details in the register maintained at the site, in case a follow up or tracing and tracking of contacts is required at a later stage.
- Follow hygiene practices at washrooms and shower facility with proper and adequate use of soaps and disinfectants.
- Every worker must change into standard working attire at the time of commencement of duty and change back to their regular dress after taking shower when their duty hours end.
- In addition to all other internationally recognized safety precaution for construction workers and other staff, every individual must use face mask. Face mask shall be

replaced as and when soiled or otherwise removed. Outer surface of face mask must not be touched with hands.

- Workers should wash their hands as frequently as practicable and shall not to touch their face with their hands during work.
- Everyone on the construction site must observe sneezing and coughing etiquettes.
- Workers must maintain no less than two arm lengths between them before, during after work at all the times. They shall not make physical contact and shall be required to maintain separate personal gears and assets which must be clearly labelled and stored without intermix.
- Sick worker should immediately inform the site manager and must get medical advice from nearby health centre.
- Only sanitize able dinning surfaces shall be used. Food must be heated to a temperature to no less than 70 °C before consumption and shall preferably be in disposable utensils. If reusable utensils are used, these must be washed with soap and water immediately after use and stored at a safe place.
- Do not sit at less than 2 meters distance while having meals and while any other activity requiring interpersonal communications.
- Do not use biometric attendance machines or crowd during attendance, entry or exit to the premises of the construction site.
- Use safe transport arrangements which should not be crowded and should have social distancing in place during the entire process from pickups till drops at destination.
- In case sleeping in at the site of construction, a safe distance of 2 meters must be ensured in the sleeping rooms.

Deliveries or Other Contractors Visiting the Site:

- Non-essential visits to the construction sites should be cancelled or postponed.
- Delivery workers or other contractors who need to visit the construction site must go through temperature check before entering and should be given clear instructions for precautions to be taken while on site.
- Designate the workers, with protective gears or at least gloved and mask, to attend to the deliveries and contractors.
- Make alcohol-based hand sanitizer (at least 70%) available for the workers handling deliveries.

- Instruct the visiting truck drivers to remain in their vehicles and whenever possible make use of contactless methods, such as mobile phones, to communicate with your workers.

6.3.12 Vegetation and Wildlife Loss

Impacts

454. The project consists of a semi-urban environment located in the outskirts of Mingora city with sparse human settlements and activities and thus contains limited vegetation cover and limited wildlife of any significance as common in areas located close to urban centers. There is no extensive vegetation removal involved during construction of SWMF. Any tree cut will be compensated through plantation plan of the project.

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

Mitigation measures

- Consideration will be given to the visual appearance of the landfill site during operation and at the time of closure of the site and its impact on the surrounding land forms. Necessary plantation will be carried out, which will act as buffer zone from surrounding environment. Reasonable area will be allocated for plantation within and at boundary of facility to improve landscape of the area.
- Inside the boundary wall, tree plantation will be conducted to create an environmental barrier between the external and internal environment. Buffer zone of 10 meter tree lining is proposed for Mingora landfill site within and at boundary of facility to improve landscape of the area. Indigenous tree plantation will be carried out, which will serve as the buffer zone. For the landfill, to present a clean and aesthetically pleasing view, buffer zone with tree plantation and landscaped berms will be developed. Plantation will commence as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds have been mobilized, plantation activity will be started in collaboration with Swat District Development Authority (SDDA) or WSSC Swat may outsource the activity separately.
- Camp/s will be located in existing clearings; as much as possible.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project. and
- Vehicles speed will be regulated and monitored to avoid excessive dust emissions.
- No hunting or killing of animals will be permitted.
- No cutting down of vegetation or using vegetation or trees as firewood will be permitted.

6.3.13 Historical/Archaeological Sites

Impacts

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

Mitigation measures

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

6.3.14 Construction of Administeration Building and Other Infrastructure

Impacts

458. Mingora LFS will have proper facilities like administration building, waste reception areas, weigh bridge, CCTV, RFID, access roads, daily soil cover, security, lighting for 24 /7 usage and professionally trained workers to operate and supervise.

459. A 3 story Administration building will be constructed within SWMF to house administration staff and manage the facility operations within Mingora SWMF. It is planned such that it can accommodate landfill operations team, has a laboratory for quality control and MIS monitoring room for data acquisition and transfer to head office. The building also contains a conference room for meetings at landfill, an inventory room for storing supplies for repair and maintenance of landfill machinery and vehicles. There are showers, prayer area, rest rooms and a kitchen in the building. A car park outside the building will be constructed for personnel's' vehicles. The area of the administrative building is surrounded by landscaping and greenery. The building has a look-out tower on 4^{th} level for viewing operations at the facility. Lookout tower of height 49'-6'' will be constructed for visual surveillance of the landfill facility.

460. Roads inside the premises will be constructed. Road 10 m wide with two lanes each 4 m for two-way traffic of waste carrying vehicles will be constructed. Access roads within cells (8 meters wide) will be constructed at 1:10 longitudinal slope. Vehicle parking shed for waste vehicles, a workshop for routine repair and maintenance work will be constructed.

461. Soil erosion is main impact during construction of admin building and associated infrastructure. Construction of roads or other facilities has also been historically perceived and in some cases has actually led to soil erosion. The possibility of soil erosion has been assessed in detail in the following paragraphs.

462. The possibility of soil erosion from a human activity increases when soil particles are detached from the soil mass. This is true for agricultural lands where a certain landscape is changed and the area is left exposed to wind and water erosion and also for dirt tracks which are developed through continual use by vehicles and the soil surface is subject to continual erosion for as long as the track is used. However, these cases are different from scenarios in which the soil surface initially disturbed is sealed or compacted by engineering means. For example, metalled roads are not subject to soil erosion, similarly neither would the gravel-topped roads which will be compacted to sustain loads.

463. Other environmental impacts from construction of administration building include construction debris, unattended concrete and cement waste, brick waste, littering and

empty cement bags which required to be disposed off as per waste management plan. Flooring works will add slurry waste resulting from grinding activiites. Noise from mixing plants, steel fixing works, wood works is another source of environmental nuisance which need to be managed. Use of generators, vehicles and machinery may be source of air pollution if not managed.

464. On the basis of the above it can be assessed that on a macro level environmental impacts from construction of admin building and associated infrastructure will not be a significant issue as all these impacts will be managed through implementation of site specici EMMP prepared by contractors and approved by CSC/PMU.

Mitigation measures

465. Following are the mitigations measures that will be employed to mange impacts from construction of building and associated infrastructure.

- Water will be sprinkled regularly to suppress dust emissions. Off road travelling of vehicles will be prohibited.
- Stock piles will be appropriately located and out of wind to avoid dust emissions. Dry dusty materials should be sprinkled with water and properly covered to avoid dust emissions.
- No cement and concrete waste will be left unattended. Construction debris will not be thrown from height to avoid dust emissions. Return unpaved areas to original or improved contours following construction.
- Solid waste gernated from construction of admin building will be managed through site specific EMMP and no waste will be stored at site to improve housekeeping at site and to avoid environmental nuisance.
- Set protocols for proper and regular maintenance of construction machinery, vehicles and generators. Generators that will be used will be placed at suitable locations.
- Contractor will not be allowed to store bulk quantities of fuel or hazardous material at site.
- Any fuel or chemicals stored at site (in small quantities) will be stored at designated site and containers/storage vessels be properly marked for their contents. Storage area will be provided with hard impervious surface and secondary containment.
- Equipment and machinery with loose vibratory parts will not be allowed to use. Used equipment and machinery will be in compliance to NEQS.
- Waste bins will be provided at appropriate places to mange waste. Daily housekeeping of the construction area will be carried out.
- CSC will ensure that proper amounts of insulation in the walls and roof will be used.
- Proper weather stripping and caulking will be carried out to ensure energy efficiency.
- High quality windows that utilize low-e coatings and gas filling will be installed.

- CSC will ensure that energy efficient appliances such as LED lights, energy savers, inverters) are installed in the buildings.

6.3.15 Construction/Widening of Acces Road

Impacts

466. Proposed Mingora landfill site can be accessed through road passing from Katwaro Maira which originates from Haji Baba-Buner Road. The approach road of about 4.4 km in length from National Highway to the landfill is available however it should be widened as part of external development component of landfill construction. The road access to Swat Landfill passes through congested and populated areas at some places and there is need of paving/widening of the present road to accommodate the waste transporting vehicles. Road construction may impact physical and chemical soil conditions, water flow, and air and water quality, as well as plants and animals.

467. Major activities of raod widening works include preparation of sub-grade, sub-base, base and wearing course. Major equipment involve in road widening works are tractor, bulldozer, roler, compactor, shovel, grader, dumper, aggregate distbutor and spreader, asphalt mixer, bitumen boiler and sprayer, concrete mixer and paver, batching plant and finishers. Operation of such machinery will cause noise, dust and vibration and may be source of public nuisance.

468. The proposed widening of road will involve earth works and transporting and dumping large quantities of debris material. This will likely lead to an increase in SPM (Suspended Particulate Matter) at the road construction site. Construction of roads has been historically perceived and in some cases has actually led to soil erosion. The landfill development will involve the use of considerable heavy machinery at the project site along with posing the risk to commuters on the road during the construction works. Landowners and local residing along the Katwaro Maira road are of the view that proposed landfill facility development will result in environmental nuisance and the price KP government is offering is very low as per market value of land.

469. Main impacts associated with road widening are noise, dust, vibrations and construction waste. Noise mainly occurs during road construction phases but it can also occur to a lesser degree during maintenance operations. Dust is created during the construction of roads and unbound aggregate layers. Dust is an almost inevitable consequence of roadwork. Gravel and crushed gravel and hard rock aggregates always contain a proportion of fines, and if the material is dry, a fairly heavy dust cloud can be raised when it is mobilized. The resulting dust can disturb both the population and the local environment. Excess dust production can be treated by a range of means such as watering, the use of alternative materials, and by using dust binders near houses. Vibration can be caused by compaction on uneven road surfaces. Vibrations disturb people close to roads but they may also cause damage to buildings and sensitive equipment. Scarification, material cutting, formworks, foundation works and poor material management are the sources of waste generation during widening of roads.

470. RoW alignment of propose access road to landfill site that requires widening works is provided as **Figure 6-1.**

Figure 6-1: Existing alignment for widneining of acces road to Mingora LFS

Mitigation Measures

471. Following are the mitigations measures that will be employed to mange impacts from construction of access road.

- The road widening will be to a standard that is suitable for movement of high capacity waste carrying vehicles.
- WSSC Swat/PMU will maintain close coordination with the residents falling close to road widening works, project information leaflet will be distributed to them and awareness with respect to impacts (noise, dust and vibrations) associated with construction will be provided. If people are notified, their acceptance of the disturbance is usually higher.
- WSSC Swat/PMU will arrange community consultation session before commencement of construction works to make public sensitization which will facilitate smooth execution of project activities.
- Compaction with heavy vibration rollers should be avoided or minimized in built-up areas.
- 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.
- Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.

- Traffic diversions will be planned in such way that it does not create traffic congestion during road widening works. Road closure for the works will be avoided.
- PMU KPCIP through CSC will ensure that road widening structure shall be as similar as existing part.
- Proper drainage system will be provided in order to achieve sustainability.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project.
- Vehicles speed will be regulated and monitored to avoid excessive dust emissions.
- Blowing of horns will be prohibited on access roads to work sites.
- Periodic sprinkling on access road at least twice per day during construction phase and restrict vehicle speed to 20 kmph.
- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area.
- Traffic is not disrupted by labor camps being set up roadside next to the construction sites.
- 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.
- PMU KP LGE&RDD 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.
- Record of waste generation and transfer shall be maintained by project contractor.
- Periodic water sprinkling will be carried out during widening works to suppress dust.
- Fuel-efficient and well-maintained equipment and machinery shall be employed to minimize exhaust emissions.
- The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m^3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use.
- Prior to starting of work, the contractor should prepare a method statement for road

widenining works. This should be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns.

- Method Statement is very important, particularly for the road widening works.
- Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area.
- Method Statement should be in a Table format with appended site layout map and cover the following:
- Work description
- No. of workers (skilled & unskilled)
- Details of Plant, equipment & machinery, vehicles
- Work duration (total, and activity-wise, for example for preparation of sub grade, sub-base, base and wearing coarse
- PPE (helmet, gloves, boots, etc.) details for each type of work
- Details of materials at each site (type & quantity)
- Risks/hazards associated with the work
- Construction waste/debris generated (details & quantity)
- Detail the sequence of work process (step-by-step) including specific details of each work
- Contractor's supervision & management arrangements for the work
- Emergency: Designate (i) responsible person on site, and (ii) first aider
- Typical site layout plan including placement of material, excavated earth, barricading etc.

▪ The following should be included in the site layout plan:
  - Provide barricading/security personnel at the site to prevent entry/trespassing of pedestrian/vehicles into the work zone.
  - Location of temporary stockpiles and provision of bunds
  - Separation of stockpiles areas with workers/vehicle movement paths to avoid disturbing the stockpiled material
  - Wetting of soil to arrest dust generation by sprinkling water
  - Waste/surplus soil utilization and disposal plan – indicate expected duration of temporary stockpiling along the road and identify final surplus soil

utilization/disposal site in consultation with CSC/PMU.

- PMU KPCIP will ensure the identification of disposal sites for unsuitable excavated material in consultation with WSSC Swat.
- CSC will inspect and monitor the borrow material areas prior to procurement to ensure that it is being used in sustainable way and no significant disfiguration of landscape is going on at quarry site.
- Stock piling of excavated material at places that are congested will be avoided as these piles can create traffic issues and public nuisance.
- Already available quarry sites for additional backfill material will be utilized. Development of new quarry site will be discouraged.
- Record of borrow materials will be maintained including details of quarry site, agreement and necessary approvals from concerned government authorities.

6.3.16 Sexual Abuse, Exploitation and Harrasement (SEAH)

Impacts

472. Acts of violence committed against women and children including, *inter alia*, sexual violence, sexual harassment and other discriminatory practices based on gender, all fall within the ambit of SEAH. Sexual harassment against women might occur as a consequence of mixing of men and women at the construction site however keeping in view the culture of the area women involvement in construction works is not expected.

Mitigation Measures

473. The contractor will manage the potential risks of sexual exploitation and abuse, and sexual harassment by taking following actions:

- The contractor's COC shall cover a program to promote awareness of the construction workers on avoiding any gender-based violence;
- The contractor's monthly training program will cover topics related to COC such as sexual harassment particularly towards women and children, violence, including sexual and/or gender-based violence;
- Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers;
- The contractor will make sure that no discrimination is made on the basis of gender while hiring of workers;
- The contractor will set the employment relationship on the code of equal opportunity and fair treatment and develop COC for workers to address these issues;
- The employment decisions will not be made on the basis of personal characteristics unrelated to inherent job requirements, including race, gender, nationality, religion or belief, disability, age, sexual orientation, or ethnic, social and indigenous origin;

- Special measures will be taken to address harassment, intimidation, and/or exploitation, especially in relation to women;
- No Sexual Harassment Policy will be established and strictly endorsed in accordance with provincial law;
- World Bank Good Practice Note on Addressing GBV will be used as guidance.[24]

6.4 Impacts Associated with Operation of SWMF

474. The potential impacts from operation of the SWMF are provided as **Table 6.5** below.

Operation Phase

Table 6.5: Screening of Possible Impacts during Operation Phase

S/No.	Potential Issues	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Generation of Leachate	Likely	Major	Medium	Long Term
2	Possible Contamination of Soil and Groundwater	Likely	Major	Medium	Long Term
3	Generation of Landfill Gas	Likely	Major	Medium	Long Term
4	Generation of objectionable odor and impact on air quality	Likely	Major	Medium	Long Term
5	Attraction of Vermin and disease vector generation	Likely	Major	Medium	Long Term
6	Occupational Health and Safety	Likely	Major	Medium	Long Term
7	Waste collection and hauling impacts	Likely	Major	Medium	Long Term
8	Wind Blown Litter	Likely	Major	Medium	Long Term
9	Impacts on Scavengers and Waste Pickers	Likely	Major	Medium	Long Term
10	Improved management	Positive impacts expected			Long Term positive

[24] http://documents.worldbank.org/curated/en/399881538336159607/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Gender-based-Violence-English.pdf

S/No.	Potential Issues	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
	of solid waste & health and sanitation				residual impact
11	Improvements in Public Health	Positive impacts expected			Long Term positive residual impact
12	Improvements in Aesthetic Impacts	Positive impacts expected			Long Term positive residual impact

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

Positive Impacts

6.4.1 Generation of Leachate

Impacts

475. 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.

476. The generation of leachate is inevitable in most landfill areas. Leachate generation rates are completely dependent on the amount of liquid the waste originally contains and the amount of rainfall in the area. Some factors that can influence leachate generation are the following:

- Climate;
- Site topography;
- Final landfill cover material;
- Vegetative cover;
- Site phasing and operating procedures;
- Type of waste materials in the landfill.

477. The climate at the site will significantly influence the rate of leachate generation in the landfill. Since the site is located in an area of High precipitation, it can be expected that leachate generation is relatively high, although plans to handle and treat such quantities are incorporated in the design.

The temporary and final landfill covering can also influence the amount of water percolating into the landfill.

478. Proposed Mingora landfill site is located in low depression therefore it is expected that surface runoff may encounter during high precipitation event, therefore necessary measures including diversion of surface runoff should be in place. Retaining wall along the boundary of landfill site shall be provided to manage surface run off.

479. Finally, it is a given that vegetation will, by evapotranspiration, re-direct a portion of the infiltrating precipitation back into the atmosphere. The presence of vegetation in the landfill can also influence the generation of leachate in the landfill.

Mitigation measures

480. Depending on moisture content of the waste, leachate can be generated from the dumped waste. On the other hand, as envisaged that with the low expected precipitation, it is expected that leachate generation will be relatively low. Nonetheless, the following control measures will be implemented:

- A leachate holding tank of 500 m3 (sufficient to store 5 days leachate production) will collect the leachate before it enters the treatment plant. Leachate treatment is based on DTRO, which is potable arrangement for treatment of leachate and can be operationalized during monsoon for 24/7 basis. During monsoon season, recirculation of leachate will be increased to avoid operational constraints of leachate collection, storage and treatment system at landfill site.

- Operate the landfill in accordance with applicable internationally recognized standards to minimize leachate generation, including the use of low-permeability landfill liners to prevent migration of leachate as well as landfill gas, a leachate drainage and collection system, and landfill cover (daily, intermediate, and final) to minimize infiltration;

- Minimize the daily exposed working face and use perimeter drains and landfill cell compaction, slopes and daily cover materials to reduce infiltration of rainfall into the deposited waste;

- Leachate collection will be augmented by a leachate recirculation system in the landfill design.

- 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.

- The final vegetative cover plays an integral part in leachate production control. Its basic functions are to limit infiltration by intercepting precipitation directly, thereby improving evaporation from the surface, and to reduce percolation through the cover material by taking up soil moisture and transpiring it back to the atmosphere. Preferred plant species should be of those that do not have deep roots in order to protect the surface sealing. Further, these species should require minimal maintenance and human intervention.

- Landfill operators must be properly and adequately trained to operate and maintain the installed control system.

- A procedure for the rapid repair of leaks in the pipes, pumps and other equipment must be part of landfill operations.

- An inventory of spare parts and repair equipment must be continuously in place to ensure immediate remedial action against breakdowns.

- Strict quality assurance and construction guidelines during the installation of the HDPE liner should be implemented.

6.4.2 Possible Contamination of Soil and Groundwater

Impacts

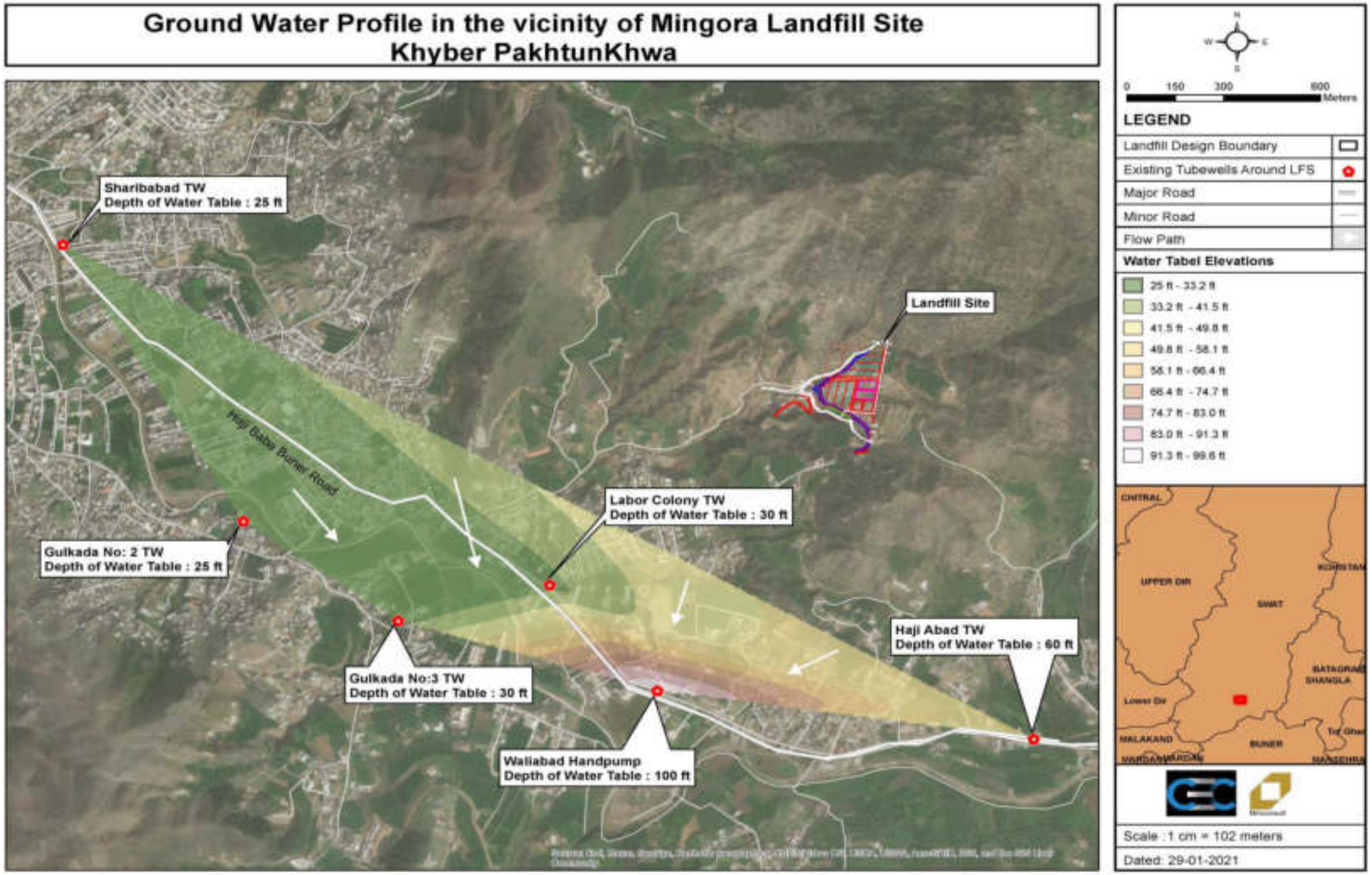
481. Contamination of the groundwater resources is among the most recognized impact of landfill development. In cases of leakages, the contaminated leachate will percolate into the ground and may find its way into existing groundwater resources.

482. However, in the case of the proposed landfill site, the groundwater resources appear to be deep (greater than 25 meters) with a substrate that acts as a natural barrier. Also, there is no water extraction locations such as wells in close proximity to the proposed SWM site. The closest well for water abstraction is located 1 km from the boundary of the proposed site.

483. The likelihood of the liner bursting for a new landfill site is quite remote since high quality liner will be installed and in addition, it will be ensured that all countermeasures in terms of liner design are in place to prevent breakage of liner. Furthermore, active life of landfill cell is about 4-5 years and after that Final capping will be placed. After that, there are minimal chances of percolation of water in the landfill cell and hence limited leachate production.

484. Two (2) storage cells are proposed by the designer of LFS in Mingora. A leachate leak from any of the storage cells may result in the contamination of the water table below the LFS. The geology of the site is Silty Clay (Moderate to high permeability) overlaying Silty-Sand aquifer with high permeability. The water table, based on actual data from site as well as the surroundings of LFS, shows that the water table is sloping towards nearby tube wells and passes underneath the Labour Colony, Gulkada community and Waliabad Community. **Figure 6-2** below shows the location and water table depths at existing water tube wells at the site and in the surrounding of the LFS. The figure also shows the water table sloping from LFS towards the nearby tube wells i.e. Labour Colony Tube well, Gulkada No: 3 Tube well and Waliabad Hand pump site. Data of existing water resources around LFS is shown in Table 6-6.

Figure 6-2: Location of Tube-wells and ground water level showing underground direction of flow



485. Project design consultant EDCM has estimated the leackate leaking effect on ground water quality of Peshawar LFS. This report focuses on checking the source, identify transport mechanisms and potential targets affected by the contamination using a qualitative and quantitative risk assessment of the problem. This involve computation of contaminant concentration at the targets identified in a conceptual model, estimating the concentration at various target points. Analysis findings are discussed below and detailed working for estimation of leachate leaking effect on ground water quality is provided as Annexure Q.

Table 6.6: Data of Existing Water Resources around LFS

S.No	Name of TW	Depth of Water Table (ft)	X	Y
1	Sharibadad TW	25	34.7691	72.368
2	Gulkada number 2 TW	25	34.7607	72.3743
3	Gulkada number 3 TW	30	34.7578	72.3797
4	Labour colony TW	30	34.759	72.3847
5	Waliabad Handpump	100	34.7558	72.3885
6	Haji Abad TW	60	34.7546	72.4013

486. As per **Figure 6-1** above, the nearest communities with respect to the proposed LFS is at risk in the direction of the flow are about 1000 Residential houses (Distance 750 to 1200m), Labour Colony (Distance 800m), and Jammi Masjid Rashagatta (Distance 1200m), Madina Public School (Distance 1275m) and AlAzher Educational Institute (Distance 1215m) all supplied by various tube well identified as Labour colony TW (Distance 1200m), Gulkada number 3 TW (Distance 1680m) and Waliabad Hand pump (Distance 1270m). There are surface water sources within the reasonable distance in the direction of flow however the depth of water table is greater and they may remain largely unaffected unless there is spring flow due to the steep gradient of ground. Contaminant concentration graph at target tubewell locations vs. time in days is shown as **Figure 6-3.**

487. The schools and community taking water from the Labour colony TW (Distance 1200m), Gulkada number 3 TW (Distance 1680m) and Waliabad Hand pump (Distance 1270m) identified as target of possible breach in the case due to the direction of the groundwater flow. The water is also used to supply water for household use (including drinking) to nearby houses. Also, the water level is very deep in this case and contamination by Plant/vegetation uptake is unlikely in this case.

488. Possibility of a liner breakage is not expected to take place for at least 5 years or so from its time of installation. Furthermore, leachate collection system will be in place at bottom lining of the landfill cell and it will work even after final capping of landfill cell to collect and treat any volume of leachate. Keeping in view these design considerations, leachate percolation to ground water is not expected. Input data for Otaga and Banks equations used for calculation of leachate contamination is given in Table 6.7. Travel time and leachate contamination from the LFS is provided in **Table 6-8.**

Table 6.7: Input Data for Otaga and Banks Equation

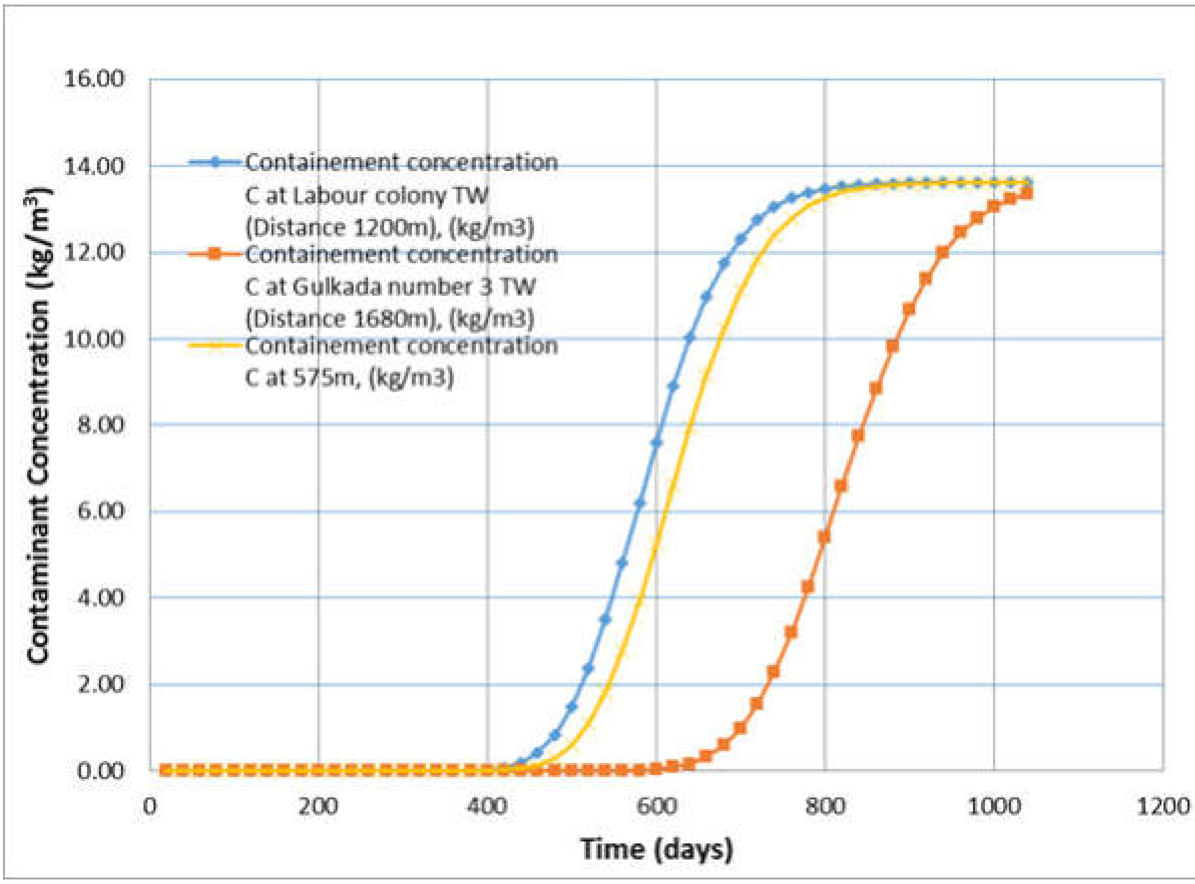
Using excel to calculate the expected concentration of a contaminant at Labour colony TW (Distance 1200m), Gulkada number 3 TW (Distance 1680m) and Waliabad Hand pump (Distance 1270m) from a source I days after the source started emitting contamination based on the following data			
Inputs	Co	13.62	kg/m3
	K	30	m/day
	dh	3.33	m
	dx	100	m
	porosity	0.49	
	D, Dispersion Coefficient	21.45	
	x, Distance from Source	1200, 1270 and 1680	m
Calculations			
	Darcy Velocity	0.999	m/day
	v, True Velocity	2.03877551	m/day

Table 6.8: Travel time and Leachate concentration at tubewell locations around LFS

Time t (days)	Containment concentration C at Labour colony TW (Distance 1200m), (kg/m3)	Containment concentration C at Gulkada number 3 TW (Distance 1680m), (kg/m3)	Containment concentration C at 575m, (kg/m3)
20	0.00	0.00	0.00
40	0.00	0.00	0.00
60	0.00	0.00	0.00
80	0.00	0.00	0.00
100	0.00	0.00	0.00
120	0.00	0.00	0.00
140	0.00	0.00	0.00
160	0.00	0.00	0.00
180	0.00	0.00	0.00
200	0.00	0.00	0.00
220	0.00	0.00	0.00
240	0.00	0.00	0.00
260	0.00	0.00	0.00
280	0.00	0.00	0.00
300	0.00	0.00	0.00
320	0.00	0.00	0.00

Time t (days)	Containment concentration C at Labour colony TW (Distance 1200m), (kg/m3)	Containment concentration C at Gulkada number 3 TW (Distance 1680m), (kg/m3)	Containment concentration C at 575m, (kg/m3)
340	0.00	0.00	0.00
360	0.00	0.00	0.00
380	0.01	0.00	0.00
400	0.02	0.00	0.00
420	0.07	0.00	0.01
440	0.19	0.00	0.05
460	0.42	0.00	0.12
480	0.84	0.00	0.29
500	1.48	0.00	0.59
520	2.38	0.00	1.09
540	3.51	0.00	1.82
560	4.81	0.00	2.78
580	6.21	0.01	3.94
600	7.60	0.03	5.25
620	8.89	0.07	6.61
640	10.03	0.16	7.94
660	10.99	0.32	9.17
680	11.75	0.58	10.24
700	12.33	0.98	11.14
720	12.75	1.55	11.85
740	13.05	2.29	12.39
760	13.26	3.20	12.79
780	13.40	4.25	13.08
800	13.48	5.39	13.27
820	13.54	6.57	13.40
840	13.57	7.74	13.49
860	13.59	8.84	13.54
880	13.60	9.83	13.57
900	13.61	10.69	13.59
920	13.62	11.41	13.60
940	13.62	11.99	13.61
960	13.62	12.45	13.62
980	13.62	12.80	13.62
1000	13.62	13.05	13.62
1020	13.62	13.24	13.62
1040	13.62	13.37	13.62

Figure 6-3: Contamination Concentration at target tubewell locations vs. time in days



489. As a result of this leachate leakage estimation at ground water quality, the following key findings were made:

- The hydrogeological analysis was based on conservative estimate of contaminant movement through strata considering no bio decay, diffusion or retardation is occurring to model worst-case scenario.
- Based on analysis, It will take a total of **380 Days** for contamination to start appearing at the nearest tube well located in the direction of flow at the Labour colony TW, Distance 1200m away from the landfill site.
- Once the contamination start appearing in the water supply from the tube well it will take about 540 more days to reach full concentration.
- However, there is a significant chance of harm if the amount of groundwater flow reduces or the contamination level increases above the current levels. Therefore it is recommended to use observation boreholes to monitor groundwater quality and also additional checks should be made on monthly basis by collecting water samples from the nearest tube well for detection of any contamination.
- The leachate discharge should be measured on regular basis to indicate barrier breach from loss of leachate.

Mitigation measures

490. The following measures will be implemented:

- Appropriate liner and collection systems in compliance with international guidelines/criteria are part of the design and will be installed.
- 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.
- The leachate system will consist of a leachate collection layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) with pipe network to convey the leachate to treatment facility.
- A total of 600 mm clay liner of permeability of $1x10^{-6}$ cm/sec will be compacted at the bottom in series of 150mm layers each compacted to 95% of compaction, followed by 150 mm base layer. This layer will be topped by 1.5 mm HDPE geomembrane.
- As soon as HDPE is placed, 200 mm silty sand or geostextile will be covered on top of HDPE for the protection of the HDPE on the side slopes.
- Above this 300 mm PEA gravel layer will be placed followed by 150 mm compacted (85-90%) sand layer.
- Leachate collection pond shall be in opposite direction from nearest surface water body.
- A leachate treatment facility with a design capacity of 50 m^3 /d will be constructed. Leachate treatment is designed on activated sludge treatment with advance level treatments (Disc Tube Reverse Osmosis-DTRO) for heavy metals and other pollutants potentially present in leachate.
- Slope of the landfill site shall be away from nearest surface water body.
- Cut-off drains around active landfill site and peripheral drains around landfill site should be provided
- Ground water monitoring wells should be drilled keeping in view of the flow of ground water on both upstream and downstream of the disposal site and monitor the ground water quality of the upper strata for any contamination for disposal site every month.
- In the worst case scenario, if leachate contamination is detected during ground water monitoring after few years of landfill operation, Ground water modelling to determine possible contamination of leachate will be carried out and necessary design changes will be implemented.
- Detailed ground water quality baseline will be developed during operation phase of the project to trace any ground water contamination from landfill operations.
- Waste hauling vehicles shall be covered during transport of waste to landfill site
- Hauling vehicles shall not wash at the surface water bodies along the route as the wash water shall drain into the canal and will pollute the surface water source which is used by the animals of the nearby communities and for agriculture purpose.

- Domestic sewerage of Mingora facility shall not be discharged untreated in open area and drains,
- Waste water generated from vehicle wash area shall be contained and treated before final discharge
- In order to augment this system, regular quality control checks on the equipment /accessories will be implemented and incorporated during construction and operations.

6.4.3 Generation of Landfill Gas

Impacts

491. Studies and research indicate that landfill gas is approximately 40-60% methane (CH4) and the remaining being mostly carbon dioxide (CO_2). There is another group of chemicals, called non-methane organic compounds (NMOCs), which may be present in the air near a landfill, though they are not likely to reach harmful levels. They are nitrogen, oxygen, water vapor, sulfur and hundreds of other contaminants. NMOCs may occur naturally, or be formed by chemical processes. There is concern that long-term exposure to high levels of NMOCs could lead to health problems, but health studies have been largely inconclusive. The **Table 6.6** shows a list of the various components of a typical landfill gas.

492. Though NMOCs usually make up only less than 1% of landfill gas, many of these are hazardous chemicals like benzene, toluene, chloroform, vinyl chloride, carbon tetrachloride and 1,1,1 trichloroethane. At least 41 of these are halogenated compounds. Many others are non-halogenated toxic chemicals. More exhaustive test for contaminants in landfill gas has found hundreds of different NMOC contaminants.

Table 6.9: Typical Landfill Gas Components

Component	Percent by Volume	Characteristics
Methane	45-60	Methane is a naturally occurring gas. It is colorless and odorless. Landfills are the single largest source of U.S. man-made methane emissions
Carbon Dioxide	40-60	Carbon dioxide is naturally found at small concentrations in the atmosphere (0.03%). It is colorless, odorless, and slightly acidic.
Nitrogen	2-5	Nitrogen comprises approximately 79% of the atmosphere. It is odorless, tasteless, and colorless.
Oxygen	0.1-1	Oxygen comprises approximately 21% of the atmosphere. It is odorless, tasteless, and colorless
Ammonia	0.1-1	Ammonia is a colorless gas with a pungent odor
NMOCs (non-methane organic compounds)	0.01-0.6	NMOCs are organic compounds (i.e., compounds that contain carbon). (Methane is an organic compound but is not considered an NMOC.) NMOCs may occur naturally or be

Component	Percent by Volume	Characteristics
		formed by synthetic chemical processes. NMOCs most commonly found in landfills include acrylonitrile, benzene, 1, 1-dichloroethane, 1, 2-cis dichloroethylene, dichloromethane, carbonyl sulfide, ethyl-benzene, hexane, methyl ethyl ketone, tetrachloroethylene, toluene, trichloroethylene, vinyl chloride, and xylenes
Sulfides	0-1	Sulfides (e.g., hydrogen sulfide, dimethyl sulfide, mercaptans) are naturally occurring gases that give the landfill gas mixture its rottenegg smell. Sulfides can cause unpleasant odors even at very low concentrations
Hydrogen	0-0.2	Hydrogen is an odorless, colorless gas
Carbon Monoxide	0-0.2	Carbon monoxide is an odorless, colorless gas

Source: *Tchobanoglous, Theisen, and Vigil; EPA 2015*

493. These landfill gases are released into the atmosphere. Whenever unabated, these gases might affect the general environment, including the welfare of its employees and host community in general. Landfill gas is the main carrier of landfill generated odor, which is classified to be objectionable.

494. Landfill gas may cause temporary discomfort, but it is not likely to cause permanent health effects. At extremely high concentrations, persons exposed may experience eye irritation, headaches, nausea, and soreness of the nose and throat. People with respiratory ailments such as asthma are especially sensitive to these effects. However, these temporary conditions are reversed as soon as the gases are reduced or eliminated. Engineered Sanitary Landfills normally have landfill gas capture systems.

495. Land GEM results for pollutant emissions resulting from the flaring operations at the site are presented as Figure 6-3 Land GEM results shows that emissions of Sulphur dioxide (SO_2) and Methane (CH_4) are both minimal with only 0.9 kg/day (0.01 g/s) of SO_2 and 22.2 kg/day (0.26 g/s) of CH_4 being emitted. Also result shows very limited yearly volumes of emissions of NMOC and Hazardous Air Pollutants (HAPs) from landfill site. Keeping in view these limited volumes and after controlled flaring no deterioration to air quality is expected from the facility. Further the project area consists of a rural and open setting with no built area located in close proximity to the site, thus any minimal pollutant emissions will be rapidly diluted upon release and thus will not result in any significant impact on the airshed of the project area. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.

Figure 6-4: Potential Emissions from LFS

Landfill Name: Mingora landfill Treatment : None			
LANDFILL INFORMATION			
Type of Landfill ■ New ☐ Existing ☐ Closed		■	Used EPA's Software (Landgem) (Attach summary)
	Time since closure (yrs): c = 0		
Type of Control ■ Flare ☐ Control System ☐ Enclosed Combustor ☐ None	Age of Landfill (yrs): t = 2.292288	☐	Based on estimated life
	Capture Efficiency (%): 90		
Destruction Efficiency (%):	98	Landfill Design Capacity (cubic meters):	263,985
Average Annual Waste Acceptance Rate (Tons/yr): R =	97,888	Mass of Solid Waste in Landfill (Tons):	224,387
Area (Acres) of Landfill:	4.53	Gas Sent off-site (mmcf):	0
CALCULATION OF EMISSIONS			
Default values are 100m^3/Tone for L (Methane Generation Rate Potential), and 0.04/yr for k (Methane Generation Rate Constant)			
Methane Generation Rate (QCH4): (m3/yr)- Before Flaring	686,103	Methane Generation Rate: Before Flaring (mmcf)	24.23
Methane Emission After Flaring (m3/y)	12,350	Methane Emission After Flaring (m3/y)	0.44
SO2 Emissions (Kg/yr):	138	HCl Emissions (Kg/yr):	67.6
NMOC (VOC) Fugitive Emissions (Kg/yr):	177.3	NMOC (HAP only) Fugitive Emissions (Kg/yr):	22.52
NMOC (VOC) Collected, Uncontrolled (kg/yr):	1,595.3	NMOC (HAP only) Collected Uncontrolled (Kg/yr):	270.3
NMOC (VOC) Emissions From Control (Kg/yr):	31.9	NMOC (HAP only) Emissions from Control (Kg/yr):	71.6

Here

HAP	Hazardous Air Pollutants	NMOC	Non-Methane Organic Compounds
VOC	Volatile Organic Compounds	HCl	Hydrocholric Acid

CALCULATION OF EMISSION FACTORS			
VOC Fugitive Emission Factor: (Kg/acre)	20.3	HAP Fugitive Emission Factor: (Kg/acre)	2.6
VOC to Control Emission Factor: (Kg/mmcf)	73.2	HAP to Control Emission Factor: (Kg/mmcf)	12.4

Mitigation Measures

- Landfill gas capture and flaring systems will be in place as part of the landfill design and thus no significant impacts on occupational or community health and safety are envisaged from landfill gas exposure.
- Landfill gas will be collected through installation of perforated pipes within the cells. This gas transferred to gas recovery unit where it receives subsequent treatment and utilization, or disposal in a safe manner through flaring or venting.
- The vertical gas recovery wells will be designed keeping in view the capacity of the landfill.

- The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate considering that only a small quantity of gas will be produced. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For KPCIP landfills, Open flame flare technology, consisting of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology.

- For Mingora flaring is proposed for landfill gas management. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed. As presently amount of gas generation is not known, therefore, quantitative assessment is not possible at this stage.

- PMU KP LGE&RDD 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 based on the monitoring results necessary design changes will be incoproated to avoid air quality impacts from flaring.

- As part of closure plan of existing dumping site, GHG monitoring will be carried out and necessary gas venting system will be done.

- Periodic GHG monitoring will be carried out during operation phase of the project and accordingly, necessary design changes will be incorporated, if required.

- PMU KPCIP/WSSC Swat will explore the waste to energy options keeping in view the future waste generation rate of Mingora.

6.4.4 Generation of objectionable Odor and impact on air quality

Impacts

496. Objectionable odor is expected at the landfill site from landfill cells, compositing facility and material recovery facility depending on various factors. Some of which are the types of wastes being handled, humidity, temperature and moisture content, among others. Uncontrolled compositing and poor house keeping at site will be the source of objectionable odor. Furthermore, ambient dust may be generated from sorting lines of MRF which need to be managed through proper ventilation and necessary arrangements for dust collection/suppression. Haphazad waste tipping at unloading bay and weighbridge will create nuisance and objectionable odour, if not attended at frequent intervals.

497. At composting plant, odors originate with the incoming ingredients, which may have been stored anaerobically (without oxygen) for a week or more before transport to the site. Once these ingredients are incorporated into the composting system, subsequent odor problems are usually a result of low oxygen or anaerobic conditions. Anaerobic odors include a wide range of compounds, most notoriously the reduced sulfur compounds (e.g. hydrogen sulfide, dimethyl sulfide, dimethyl disulfide, and methanethiol), volatile fatty acids, aromatic compounds and amines. Ammonia is the most common odor that can be formed aerobically as well as anaerobically, and thus has its own set of management options.

498. The closest receptors will be the personnel who will be onsite monitoring the status of the facility. Some of the anticipated problems that may be raised during the operation of the landfill are as follows:

- Discomfort of working with offensive odors; and
- Concerns for the mental or psychological welfare of exposed communities

499. It is noted that based on the prevailing wind patterns, communities or settlements lying around the site may be affected however impact will be limited due to hilly terrain within the project area.

500. The Wind Rose for Mingora City shows that the predominant wind direction is from the North to North-East directions. As a result, the potential impact on the households from any airborne related impacts, particularly during landfill operations, such as odor, can be seen in the Corridor of Impact provided as **Figure 6.4** below. Since most of the houses which are being used for residential purposes are located at different elevation/locations from the proposed landfill and also upwind side therefore, no significant impacts from objetionable odor are anticipated.

501. Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. Working surface of waste will be covered with a soil layer called “daily cover” at the end of each working day. Amount of soil to be used in daily cover will be about 10% of the waste volume. Suitable quality of excavated material will be used as daily cover material.

502. Keeping in view these design considerations and operational modalities, no significant impact of odour and air quality is anticipated.

Mitigation measures

503. Best management practices and good housekeeping measures will be implemented to minimize the release of objectionable odours. Potential odours impacts can be minimized or eliminated by adopting the following measures:

- Daily cover will be placed on working surface of waste in order to reduce the risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill.
- Suitable amount of daily cover will be stocked at the landfill site.
- Final capping of landfill cells will be carried out in order to limit and control the amount of precipitation that enter the waste and to limit wind and water erosion and burrowing animal activity. This will not only prevent the odor of decaying waste from escaping from the landfill but also protect the site against intrusion of vermin and pests.

504. The top cover system consists of following arrangements.

- Thick top soil layer of 45 cm capable of supporting vegetation in order to protect the landfill surface from wind and water erosion.
- Drain Layer of 15 cm at bottom to maximize runoff of precipitation while minimizing infiltration and preventing ponding of water on the landfill.
- Compacted soil layer or barrier of 60 cm of low permeability to limit and control the

amount of precipitation that enters the waste.

- Vent layer of 15 cm thickness comprised of sand and gravel
- Appropriate and regular housekeeping (i.e. cleaning) will be done in all areas where solid waste will be processed (i.e. weigh bridge area).
- Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, MRFs, material handler and waste compactor operators) must be ensured.
- All the incoming ingredients that are anaerobic will be converted to aerobic state through combining them with a coarse, dry bulking amendment to increase the porosity and allow oxygen penetration.
- Air should be thoroughly dispersed throughout the organic waste. This is done by frequently turning and mixing the wastes.
- Oxidizing chemicals like hydrogen peroxide, potassium permanganate, and chlorine will be used by the wastewater treatment industry for odor control.
- Organic waste lot which is creating objectionable odor will be attended immediately and introduced in the composing system on priority basis.
- Controlled compositing conditions will be maintained throughout the operation.
- Mandatory health and medical check-ups for all employees especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health (10 mg/m3 as an 8-hr TWA). This should ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;
- Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment (RPE);

6.4.5 Attraction of Vermin and disease vector generation

Impacts

505. 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 foxes, feral cats and 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.

506. 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 important control measure used to minimize vector problems at landfills is the application of daily cover. Cover should be present on all solid waste at all times, except the tipping face while it is being worked. Daily cover of at least 150mm of compacted soil or similar material or an effective layer of alternate daily cover (ADC) should be applied on finished portions of the daily cell during operation and at the conclusion of daily operations, and not less frequently than once per day. Alternative daily cover materials such as tarpaulins, foams, granular waste, etc, can be effective as vector control after careful site-specific evaluation.

- Intermediate cover of 300mm (minimum) compacted soil should be used on all areas not at finished levels, but not to be further landfilled for a period of 30 days or more.

- Final cover is typically applied as each area is brought to finished level through the operational life of the landfill.

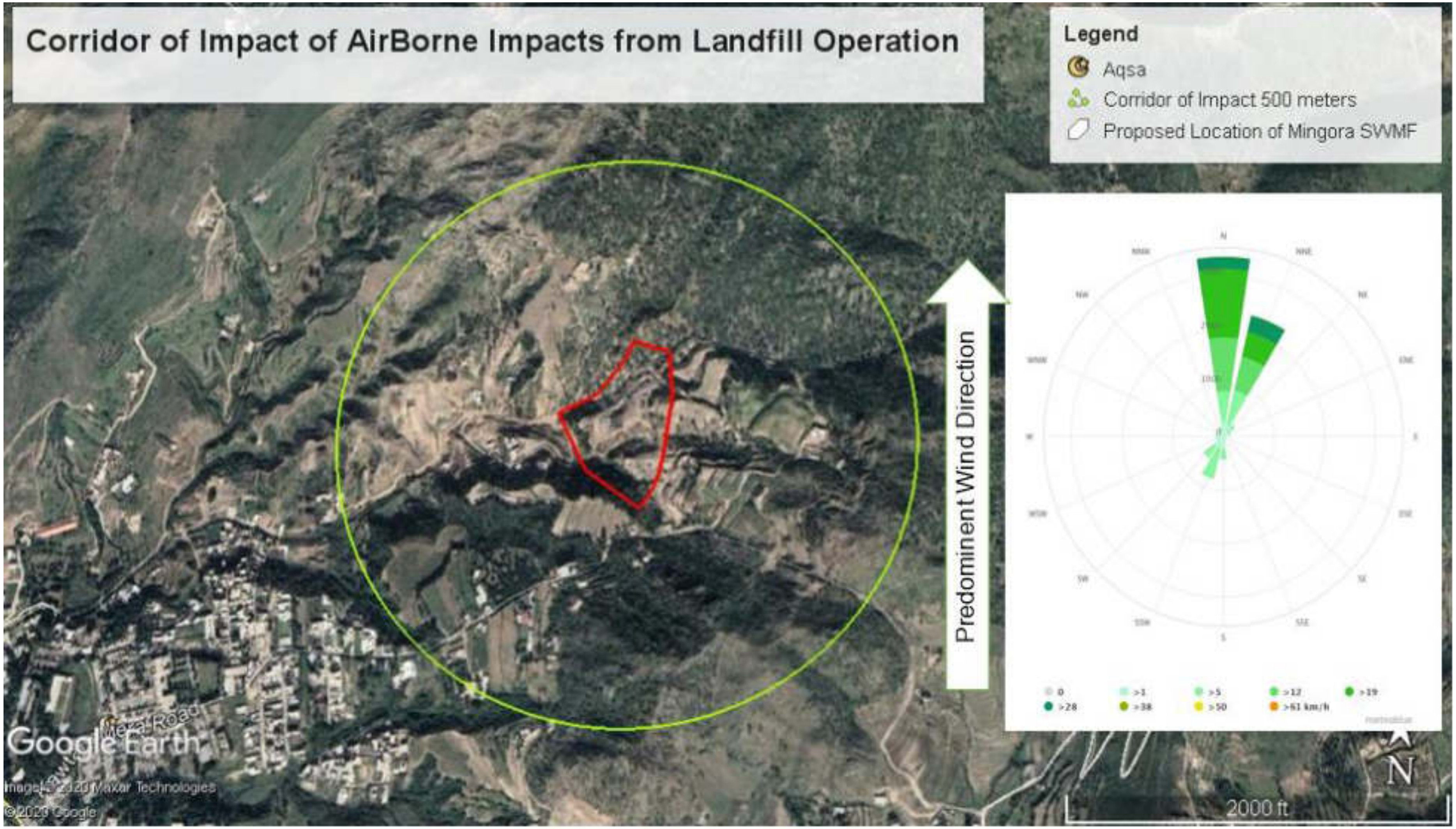
- There should be no uncontrolled or uncovered (stockpiled) waste, including litter, tyres, brush, appliances, construction/demolition waste or even inert industrial waste on the landfill property. The only exception is compactable soil-like inert wastes, such as ash, but even this waste must be graded and compacted to avoid ponding water.

- 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 minimize stagnant water, nutrient build-up and plant growth.

- Finally, the waste must be compacted and graded at reasonable maximum slopes (see the Working Face Guideline) to minimize voids within the waste that can harbour rodents in particular. Rodents and foxes can readily dig into cover soil, but have much more difficulty digging into compacted solid waste.

- 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.

Figure 6-5: Corridor of Airborne Impacts from Landfill Operation



6.4.6 Occupational Health and Safety

Impacts

507. There are considerable risks associated with the operation of the proposed landfill site from an occupational health and safety perspective, keeping in view the scope of work to be conducted on a daily basis and the use of heavy machinery to be involved in the daily operations. Moreover, Organic dust which may lead to exposure to airborne microorganisms and their toxic by-products exposure cause work-related symptoms and effects among waste recycling workers in Materials Recovery Facilitiy (MRF) is also a concern.

508. The equipment in a MRF is likely to expose employees to excessive noise levels. Unless suitable precautionary protocols in accordance with international good practices are put in place, there is a high risk of injury and accidents taking place at the landfill site during its day-to-day operations. Draft Occupational Health and Safety Plan has been attached as **Annexure E**.

Mitigation Measures

509. In order to ensure a safe and healthy working environment for the employees of the landfill and all its auxiliary facilities, the following measures have to be strictly enforced, implemented and monitored:

- OHS management system will be prepared and implemented prior to commencement of operation of the SWMF.
- Designation of an Environment, Health and Safety (EHS) officer dedicated to the site;
- All employees must be able to reach their work stations safely. All path, walkways, staircases, ladders and platforms must be stable and suitable for the tasks to be undertaken;
- Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, MRFs, material handler and waste compactor operators) must be ensured.
- Mandatory health and medical check-ups for all employees, especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health (10 mg/m3 as an 8-hr TWA). This should ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;
- Develop a written program (i.e. health information, instruction and training) which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards of working in a landfill and its auxiliary facilities;
- Mandatory monitoring of air quality and noise levels in the working stations i.e MRFs, compactors and bailer etc to maintain the same within local standards and whenever possible near ambient levels;
- Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate

use of respiratory protective equipment (RPE);

- Accidental fires must be addressed immediately. Appropriate operational procedures involving the spreading and smothering of burning waste, rather than the use of water, must be implemented;
- Emergency plan (including fire management) must be developed and implemented;
- Availability of first-aid kits and vehicles that can be used to bring any injured employee to the nearest doctor in cases of accidents;
- Mandatory reporting of all accidents or incident of near misses of accidents and immediate adoption of corrective measures; and
- Management must provide all the necessary financial and manpower resources for the implementation and enforcement of all health and safety programs and activities of the project;
- Regular training and orientation on safety practices will be implemented to impart knowledge of safe and efficient working environment. Furthermore, regular health checkups of all employees including contract workers will be conducted. Effective and proper housekeeping is recommended to reduce dust exposures to its direct vicinity. Heat levels must be monitored as well. Spot checks should be done to ensure that workers' welfare is addressed especially during summer months.

6.4.7 Waste Collection and Hauling Impacts

510. 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 between Mingora city and the proposed landfill site. 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.

511. Inreased 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 puropose built vehicles or waste transport on dirt roads will result in increased dust levels.

512. There is general practice by citizens to throw waste on streets instead of communal bins. WSSC Swat workers needs to collect all scattered waste manually. There are multiple transactions of waste till disposal site resulting in poor waste management.

513. Communal storage constraints include shortage of containers, lack of financial resources leading to broken and ill maintained bins; Lack of planning for waste storage depots or temporary storage locations and Inaccessible areas and narrow lanes that do not allow sufficient space for container. If such constraints are not addressed it will result in poor waste management and environmental/public nuisance.

514. Currently WSSC Swat is under capacity with respect to daily manual sweeping and waste collection on Sunday and public holiday resulting in poor waste collection and environmental nuisance.

515. There is lack of public/civic sense with respect to waste management at source, segregation of recyclables and waste collection system. Public don't practice responsible behavior and throw litter outside their premises in open streets, along roads, canals and other places which is resulting in operational constraints for WSSC Swat towards solid waste management.

Mitigation measures

516. The following measures will be implemented to ensure that no traffic related issues take place due to the landfill operation:

- Capacity of WSSC Swat will be increased though increase in its collection fleet. It will be done through procurement of both solid waste and non-solid waste carrying machinery under this project.
- Door to Door collection of waste will be enhanced through media compaigns. Communication programs would be developed to encourage better management of waste. Proper PPEs will be provided to waste handlers. Key performance indicators will be developed to monitor improvements in the system.
- All type of waste hauling will be carried out in purpose built vehicles to avoid scattering of waste at hauling routes. Drivers of waste carrying vehicles will be trained with resepect to environmental sensitization. Drivers are allowed to commute only on designated routes through purpose built vehicles for waste hauling.
- Multiple transactions of waste will be avoided through use of main and mobile transfer stations. Improved segregation practices will be introduces once door to door collection desired effieciency achieved. Necessary legal bindings with respect to waste storage by Public will be introduced.
- A comprehensive traffic management plan (TMP) must be developed and implemented;
- As part of the TMP, it will be ensured that the movement of heavy vehicles related to landfill operations is minimized during the peak traffic hours of the day in order to prevent congestion and accidents as far as possible;
- Furthermore, the movement of heavy vehicles within Mingora city related to landfill operations must be restricted to specific routes containing least number of sensitive receptors and low traffic volumes.
- Waste hauling through dirt tracks will be strictly prohibited. Waste hauling though mechanically unfit vehicles or noisy vehicles will not be allowed.
- Waste transporters will be directed to use designated routes and follow recomended speed limit for waste hauling and such routes will be metalled roads instead of dirt tracks.
- Traffic Management Plan has been attached as **Annexure K**

6.4.8 Wind Blown Litter

Impacts

517. One of many operational concerns in the management of a landfill is the control and management of litter. Litter includes blowing papers and other solid materials that may become airborne and carried by the wind away from the working face where solid waste is being deposited.

518. The control of litter is an integral part of the daily operations of the facility. The goal of the facility operations is to implement best management practices and have all blowing litter contained at the working face. However, due to the type of facility operation and waste materials received, total containment of litter at the working face may be difficult to achieve. The secondary goal of the facility is to strive to pick up all blowing litter that has escaped the working face at the end of each operating day.

Mitigation measures

519. The facility operator, as necessary, will implement the following procedures and techniques to control litter:

- All trucks must be tarped upon entering and exiting the facility. They should only untarp and tarp at the active area. This policy will be strictly enforced.
- Daily waste entering the landfill site will be subject to immediate compaction to minimize the area and debris subject to the impacts of wind.
- If possible, on windy days, the daily fill face tipper locations shall be selected for its protection to minimize effects of wind.
- Waste that is more susceptible to windblown distribution may, on windy days, be worked immediately into the fill face and covered with a layer of daily cover, as needed, or the waste may be excluded from the site.
- Portable skid-mounted litter fences may be provided for deployment downwind as close as practical to the working area, as needed.
- Semi-permanent fencing may be provided around the fill area as an additional barrier to the migration of litter off-site when litter has not been contained by the portable litter fences. (Examples of additional barriers include but not limited to, a four-foot minimum temporary construction fence and/or a ten-foot or higher semi-permanent fence.) The utilization will be continually evaluated and the fence will be relocated or added as needed.
- Permanent fencing (ten-foot high with an additional three-foot kicker) may be constructed with possibility of placement on an eight-foot high berm.
- On very windy days, when all other procedures are not successful in controlling blowing litter, the operator may apply cover material more frequently or immediately to the incoming waste load.
- Buffer zones resulting from required facility setbacks along the site’s perimeter should provide some protection of adjacent properties.
- As a final control measure, personnel will be dispatched, as needed or daily if conditions require, to collect any litter that has escaped the above control measures.

- Portable litter vacuums may be used to collect litter that has accumulated on litter fences. If fences are positioned properly, this can be a very efficient method of collecting litter.
- The main highway leading to the site will be routinely inspected for litter. If the highway has litter associated with the trucks entering the facility, then the litter will be picked up on a routine basis. All necessary safety precautions must be followed.
- Before and after photos of any litter removal effort may be taken in the event anyone questions the level of effort spent on litter collection.
- Site management's cell phone numbers may be provided to community/neighbors.
- The management of litter at the landfill is a daily activity. In most instances the above procedures and techniques should properly manage litter effectively. However, there will be occasions and situations when litter will be distributed by the wind in such a manner that the above procedures will not totally manage the litter and contain the litter on-site. In these situations, the facility operator may not be able to collect all litter within the day the litter problem occurred. However, the facility operator should proceed with collecting the litter off site and complete the retrieval of wind-blown litter at the earliest practicable time.

6.4.9 Impacts on Scavengers/Waste Pickers

Impacts

520. Most of the existing waste pickers are under age children. The waste is brought to the store by local waste pickers who work on small scale. They sell out the waste to the bigger scrap stores in the locality. Amount of income generated from waste collection is linked to the quantity of waste collected. Small waste picker earn amount of only PKR 300-500 daily and they collect recyclable waste upto 5-10 Kg. Small scrap dealer who buy recyclable waste from waste pickers upto 25-30 kg usually earn PKR 6000-7000/day. Medium size scrap dealer with waste collection 70-100 kg usually earn 10,000-15,000 on daily basis. After execution of ISWM project scavenging business will be impacted hence resulting in loss of income of small waste pickers and scrap dealers.

521. Further existing scavenging practices are not formalized and regulated. Facilitation in the form of better streamlined movement of waste within this informal system is lacking and not well integrated within ISWM system. There shall be some form of government formalization, management or oversight in order to better take care of the operation and all the operators involved, regardless of their position or significance in the system's chain.

Mitigation measures

- WSSC Swat will carry out detailed assessment of scavenging business in their respective jursidication to identify waste picker and scrap dealers which will be impacted.
- WSSC Swat will provide resources and tools to efficiently collect and sort out the waste onsite, as these waste pickers are the first one to deal with the waste.
- WSSC Swat will train these waste pickers to optimize their waste collection process.

- WSSC Swat will hire waste pickers at MRF facility that will be established at landfill site.
- WSSC Swat will hire services of scrap dealers for waste collection and transportation to landfill site on need basis.
- WSSC Swat will prepare communication strategy and will run community based operation to integrated SWM operations including waste pickers and scrap dealers.
- PMU KPCIP will preapre guidelines to involve scavengers/waste pickers in IWMS through formalization and regulations of their business. These guidelines will be adopted by WSSC Swat to ecourage involvement of scavengers and waste pickers working at all levels regardless of their position in present system chain.

6.4.10 Improved management of solid waste & health and sanitation

Impacts

522. The landfill development will greatly improve solid waste management system in Mingora city and the project area and improve overall aesthetic value and quality of urban area of Mingora city.

523. Community development programs that may be undertaken, including health and hygiene education, reduction, reuse and recycling of solid waste, skill training of low income people would be of great benefit to local community. The magnitude of the impact shall be high, local, long term and impact is very significant.

Mitigation measures

No measures required.

6.4.11 Improvements in Public Health

Impacts

524. The operation of the proposed landfill will result in solid waste management in integrated way resulting in fixing issues like odor, vector borne diseases from open dumped waste, poor sanitation and ground water contamination in the area.

525. The operation of the proposed landfill will limit risk of vector spread, fire and explosion of dump site gas.

526. It will result in an overall positive impact on the public health by preventing issues such as infectious diseases, disease vector generation, groundwater aquifer contamination etc.

527. Specifically successful operation of Mingora landfill site will limit the child scavenging activity who are directly at risk as they are not using any PPEs.

528. Further, it will provide promising opportunities to people involved in scavenging activity in terms of jobs and other economic incentives to accelerate recycling potential at the facility.

Mitigation measures

No measures required.

6.4.12 Improvements in Aesthetic Aspects

Impacts

529. Open dumping of solid waste create poor aesthetics in the project area. However, landfill site shall be walled and the aesthetic impacts will be far less as compared to open dumping. However, due to the movement of the waste truck on the streets will create a little aesthetic nuisance.

Mitigation measures

- The boundary walls shall be constructed alongside the facility.
- The indigenous plants shall be planted alongside the access road and around the landfill site which will act as buffer zone.
- The waste transfer vehicles shall be covered.
- Reasonable area will be allocated for plantation within and at boundary of facility to improve aesthetic appeal of the area.
- Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity can be started in collaboration with Swat District Development Authority (SDDA) or WSSC Swat can outsource the activity separately.

6.5 Closure and Post Closure Impacts

Impacts

530. Even after closure, landfills required long-term care, including maintenance of the cap system, collection and treatment of leachate, collection and flaring or utilization of landfill gas, and monitoring of groundwater so that the waste remains isolated.

531. Impacts associated with closure and post closure phase of the SWMF include poor aesthetics of the area, runoff issues, leachate/odors issues, uncontrolled gases and long term environmental nuisance. There is need of routine inspection of the facility infrastructure particularly landfill cells and gas/leachate collection system to avoid and monitor any contamination released to environment. The need to manage leachate and gas continues after landfill closure, which should be an integral component of the total landfill management together with restoration and surveillance.

532. As moisture enters the landfill through an ineffectively maintained cover after the landfill has been closed, leachate will also again be generated. If the leachate collection and removal system is no longer functioning to collect and remove from the landfill all the leachate generated, and/or the landfill operator is no longer operating/maintaining the such system, the leachate will accumulate in the landfill, leading to increased potential for leachate to penetrate through the liner and potentially begin to pollute groundwaters.

Mitigation measures

- Appropriate selection of soil type for final cover will be ensured to prevent water infiltration and minimize infiltration of precipitation into the waste and the subsequent generation of leachate; control landfill gas migration; and minimize long term maintenance needs.
- 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.
- Necessary environmental objectives and controls (including technical specifications) will be defined and implemented.
- Necessary surveillance protocols for final capping, lachate and gas monitoring will be established and implemented.
- Future Land use of the site will be defined in consultation with local communities and government agencies.
- It will be ensured that financial resources, and monitoring arrangements are in place for closure and post closure activities.
- PMU KP LGE&RDD 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.

6.6 Cumulative Impacts

533. Based on the scoping exercise of the site and based on discussions with the public sector agencies responsible for development in the project area, no other infrastructure works are planned to be conducted in the landfill project area while these project works shall be conducted. Thus, no cumulative impacts are expected.

6.7 Indirect and Induced Impacts

534. The potential impact of development of the landfill in the project area has been examined, which indicated that the existing and planned infrastructure such as water supply, wastewater collection and treatment, municipal solid waste collection and disposal would be adequate to accommodate any potential population intake as a result of the proposed landfill development. Impacts on the environment from air emissions, traffic and community noise have also been assessed and have found to be acceptable and within the carrying capacities of the environmental media. Thus, negative indirect and induced impacts from the proposed landfill works are not expected.

7 Environmental Management Plan & Institutional Requirements

7.1 Introduction

535. The EIA has identified potential impacts that are likely to arise during development of Mingora SWMF in detail, both negative and positive impacts at each stage of the project. To minimize the effects of adverse impacts the EIA has recommended mitigation measures in the EMP. The proposed mitigation measures have been based on the understanding of the sensitivity and behavior of environmental receptors in the project area, the legislative controls that apply to the project and a review of good industry practices for projects of similar nature. For residual impacts (impacts remaining after applying the recommended mitigation measures) and for impacts in which there can be a level of uncertainty in prediction at the EIA stage, monitoring measures have been recommended to ascertain these impacts during the course of the project activities.

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

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

7.2 Environmental Management Plan (EMP)

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

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

7.3 Objectives of EMP

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

- Defining the roles and responsibilities of the project proponent for the implementation of EMP and identifying areas where these roles and responsibilities can be shared with other parties involved in the execution and monitoring of the project;
- Outlining mitigation measures required for avoiding or minimizing potential negative impacts assessed by environmental study;
- Developing a monitoring mechanism and identifying requisite monitoring parameters to confirm effectiveness of the mitigation measures recommended in the study;
- Defining the requirements for communication, documentation, training, monitoring, management and implementation of the mitigation measures.

7.4 Environmental Management/Monitoring and Reporting

540. During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with the Project Director (PD), Project Management Unit (PMU), and KP LGE&RDD. The PD at the PMU, using the Construction Supervision Consultant (CSC), will supervise the implementation of the proposed mitigation measures and monitor the implementation progress in the field.

541. During the operation phase, the overall responsibility for the implementation and monitoring of the EMP rests with CEO WSSC Swat. For inital two years of LFS operation, relevant contractor will be responsible for running of relevant plant (e.g AD compositing vendor, MRF Vendor, Lechate treatment plant vendor etc.) and also responsible for implementation of EMP. This requirement will be reflected in the bidding document of such Contractors/Suppliers. Furthermore, these Contractors will train designated staff of WSSC Swat with respect to technical matters as well as EMP requirements.

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

7.4.1 Inclusion of EMP in Contract documents

543. In order to make Contractors fully aware and responsible of the implications of the EMP and to ensure compliance, it is recommended that mitigation measures be treated separately in the tender documentation and that payment milestones should be linked to performance, measured by execution of the prescribed mitigation measures. Such a procedure would help ensure adequate management of project impacts is carried out during the construction and operation phases, where a consistent approach will be expected on behalf of the Contractor and its sub-contractors so that data and information collected from monitoring programs is comparable with baseline monitoring data.

544. The Contractor shall be made accountable through contract documents and/or other agreements for fulfilling the environmental safeguard obligations and delivering on the environmental safeguard components of the Project. Contractors shall be prepared to co-operate with the executing agency and supervising consultants and local population for the mitigation of adverse impacts. After the EMP's inclusion in the contract documents, the Contractor will be bound to implement the EMP and will engage appropriately trained environmental and social management staff to ensure the implementation and effectiveness of the mitigation measures.

545. The Contractor is required to bid for executing the EMP, including the recommended mitigation measures and monitoring programs, as part of its Bill of Quantities (BoQ).

7.5 Institutional Arrangements

546. The environmental management plan will require involvement of the following organizations for its implementation during construction and operation phase of project:

7.5.1 Role of PMU, KP LGE&RDD

547. The PMU will:

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

7.5.2 Role of the ADB

548. The ADB will:

- Support the coordination and administration of the project;
- Provide guidance to PMU and WSSC Swat on implementation issues and project design;
- Disclose all safeguards documents, and monitor safeguards implementation;
- Monitor and report project performance;
- Conduct periodic review of the project;

7.5.3 Role of Construction Supervision Consultant (CSC)

549. The CSC will be responsible for the following items:

- Incorporates into the project design the environmental protection and mitigation measures identified in the EMP for the design stage;
- Assists PMU to ensure that all environmental requirements and mitigation measures from the EIA and EMP are incorporated in the bidding and contracts documents.
- Prior to construction, reviews the updated SSEMPs prepared by the contractor.
- Undertakes environmental management capacity building activities for relevant project focal staff.

7.5.4 Role of KP EPA

550. The KP EPA will have the following responsibilities with regards to this SWMF project:

- Provides regulatory compliance works for the project.
- Reviews and approves environmental assessment report of SWMF, submitted by PMU.
- Issues environmental clearance certification for the Project based on their mandate and regulations.
- Undertakes monitoring of the project's environmental performance based on their mandate.

7.5.5 Role of Project Contractor

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

- Implementation of, or adherence to, all provisions of the EIA and EMP;
- Preparation of site specific EMPs (SSEMPs) as required. SSEMPs will be prepared by Contractor’s Environment Specialist, site incharge, HSE staff and project technical team before their mobilization and it will be submitted to Engineer of construction supervision consultant/PMU for review and approval.
- Preparation of site specific EMPs (SSEMPs) as required. Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor has been attached as **Annexure I**.
- Contractor’s environmental performance will rest with the person holding the highest management position within the contractor’s organization. Reporting to their management, the contractor’s site managers will be responsible for the effective implementation of the EMP.
- The Contractor will be required to have qualified Environmental Specialists in their team to ensure all mitigation measures are implemented during the different development phases of the project.

7.5.6 Role of WSSC Swat

552. The WSSC Swat will be responsible for following items:

- Impementation of, or adherence to, all provisions of the EIA and EMP.

- Preparation of site specific EMPs for operations phase.
- WSSC Swat would be responsible to ensure that contractors engaged during operation phase of landfill site are executing activities in compliance to EIA/EMP.
- WSSC Swat will be required to have qualified Environmental Specialist designated for LFS to ensure all mitigation measures are implemented in true letter and spirit.

7.5.7 Role of Third Party Monitor

553. The Third party monitor will be responsible for following items:

- Monitoring and reporting of all provisions of the EIA and EMP.
- Periodic environmental monitoring during opration phase.
- Reporting of environmental non-complaices to project stakeholders including ADB, PMU, WSSC Swat and Supervsion consultants.
- Suggest corrective actions for close out of EMP non compliances.
- Train the contractors and project stakeholder toward EMP implementation.

554. Independenent environmental monitoring consultant will perform 3rd party monitoring of construction of SWMF on quarterly basis. General TORs for third party monitoring are provided as **Annexure J**.

7.6 Monitoring Parameters

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

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

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

558. In general, the construction impacts will be manageable, and no insurmountable impacts are predicted, provided that the EMP is implemented to its full extent as required in the Contract documents. However, experience suggests that some Contractors may not be familiar with this approach or may be reluctant to carry out some measures. For the proposed project, in order that the Contractor is fully aware of the implications of the EMP and to ensure compliance, environmental measures must be costed separately in the tender documentation and listed as BoQ items, and that payment milestones must be linked to environmental performance, vis a vis the carrying out of the EMP.

559. The effective implementation of the EMP will be audited as part of the loan conditions by ADB, and as part of regulatory/NOC compliance by KP EPA. In this regard, the PMU/CSC will guide the design engineers and Contractors on the environmental aspects and necessary EMP documentation. Monitoring during operation phase will be carried out by WSSC Swat with support from PMU.

7.7 Environmental Training

7.7.1 Capacity Building and Training

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

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

7.8 Environmental Staffing and Reporting Requirements

562. EMP implementation would be responsibility of all project stakeholders including PMU, WSSC Swat, Project Construction contractors, O&M contractor and other suppliers' involved in the project. Requirement of environmental staffing will be part of bidding documents and necessary cost will be allocated as BOQ item by the bidder.

563. PMU will maintain environmental safeguard staffing (Environmentalist/Environment Associate) for construction and operation phase of the project to monitor and supervise EMP implementation and performance. Environment expert will also be part of CSC technical time and will produce bi-weekly and monthly environmental compliance reports during construction phase.

564. Environment expert of CSC will be responsible to monitor the implementation of EMP during construction phase by project contractors. Project contractors will also hire sufficient environmental officers to impement the EMP requirements and prepare necessary EMP documentation. Project contractor EMP staff will prepare daily environmental reports and submit to CSC for approval and record.

565. WSSC will hire qualified environmental specialist during operation phase of the project who will be responsible for EMP implementation and reporting by WSSC Swat and its O&M contractors during operation. Monthly environmental compliance report will be prepared by WSSC Swat and circulated to concerned authorities. Furthermore, third party environmental monitoring consultant will be hired on intermittent basis to monitor the EMP implementation and to report environmental non-compliances. Independenent environmental monitoring consultant will perform 3rd party monitoring of construction of SWMF on quarterly basis.

566. Semi-annual environmental monitoring reports (SAEMRs) will be prepared by the Project CSC and submitted to ADB for review, clearance and disclosure on the ADB website as part of the ADB SPS, 2009 guidelines on environmental due diligence for projects being financed by ADB.

Table 7.1: Environmental Management Plan

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
Design/Pre-Construction Phase	1.1	Improper designing of landfill site leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)	▪ Landfill has been designed in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills. ▪ Consideration shall be given to the stability of the sub-grade, the base liner system, the waste mass and the capping system. The sub-grade and the base liner will be sufficiently stable to prevent excessive settlement or slippage. ▪ Bottom and cap lining system for each landfill cell must be designed for the protection of soil, groundwater and surface runoff. ▪ An efficient leachate collection system must be provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum. ▪ The accumulation and migration of gases from landfill facility must be controlled. Landfill gas will be collected through installation of perforated pipes within the cells. ▪ Consideration will be given to the visual appearance of the landfill site during operation and at termination of landfill site and its impact on the surrounding landforms. Necessary plantation will be carried out which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation within and at boundary of facility to improve landscape of the area. ▪ Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. ▪ One groundwater monitoring well will be maintained	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			out of the drills made for geotechnical investigation. However, more wells may be constructed if required once the landfill starts operations. ▪ To incorporate advancement in technology and changes, a periodic review of the design will be carried out, as the lifespan of a disposal site from commencement to completion is long compared to other construction projects.			
	1.2	Improper selection of landfill site due to non-compliance with IFC guidelines for Landfills	▪ Site selection for the proposed landfill site has been conducted in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills. ▪ Factors such as site capacity, accessibility, acceptability, stability, environmental sensitivity, landuse, socio-economic receptors and climate hazards shall be assessed and evaluated at the time of site selection ▪ Proposed selection of landfill site must take into account impacts from leachate, litter, dust, vector and odors on surrounding environment.	EDCM	PMU	BC: during detailed designing of the sub-project
	1.3	Lack of Integration of EIA/EMP requirements into bidding documents	▪ The proposed 'Safeguards unit' that will be developed at the PMU will be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ. ▪ EIA/EMP implementation and monitoring requirements must be part of bidding documents and necessary contractual binding must be agreed by project contractors before award of contract.	PMU	-	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Project contractors shall have qualified and experienced environmental staff to plan, arrange, implement, monitor and report EIA/EMP requirements.			
	1.4	Material Haul routes	The construction vehicles hauling materials along the Mingora city roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the focal agencies will establish a route plan to minimize disruptions which shall be appended to the EMP.	EDCM	PMU	BC: during detailed designing of the sub-project
	1.5	Improper location of worker camps and ancillary facilities	▪ In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc. ▪ The use of proper planning while identifying locations for the labor camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.	EDCM	PMU	BC: during detailed designing of the sub-project
	1.6	Inadequate Contractor's Environmental Safeguards Capacity	▪ PMU KP LGE&RDD shall review the contractor capacity with respect to safeguard management and contracts shall be awarded accordingly. ▪ The Contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures shall be developed and approved by the PMU in collaboration with the focal agencies before the Contractor commences any physical works on	PMU	-	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			ground. ▪ PMU KP LGE&RDD shall ensure the project contractors are selected on merit and necessary funds has been allocated in the contract documents for EMP implementation and monitoring.			
	1.7	Land Acquisition and Resettlement	The PMU KP LGE&RDD shall ensure the following: ▪ Process of compensation against acquired land need to be done on fast track basis and all land owners must be paid before mobilization of construction contractors. ▪ PMU Social safeguard unit shall ensure that project affected people has been paid following appropriate procedures and there are no grievances about land acquisition process. ▪ Accelerating the compensation/resettlement process in collaboration with DC Mingora and WSSC Swat.	PMU		BC: during detailed designing of the sub-project
	1.8	Impacts due to Natural Hazards	▪ Mingora SWMF infrastructure shall be designed keeping in view the seismic zone 3 building considerations. ▪ Retaining wall provided in project design shall be constructed in such way that during extreme precipitation events no flash flooding is entering the site. ▪ Surface water diversion shall be included in the design to protect landfill from urban/flash flooding. ▪ Extreme precipitation events analysis shall be performed for landfill life i.e. 10 years, to predict and manage impacts of flash flooding. ▪ On site waste storage at loading bay shall be kept to minimum during high precipitation events. ▪ Emergency response plan shall be prepared by construction and operation phase contractors and will			

<table>
<tr><th rowspan="2">Project Activities</th><th rowspan="2">Section</th><th rowspan="2">Impact</th><th rowspan="2">Mitigation Measures Recommended</th><th colspan="2">Responsibility</th><th rowspan="2">Timing</th></tr>
<tr><th>Execution</th><th>Monitoring</th></tr>
<tr><td></td><td></td><td></td><td>be submitted to PMU for approval to manage impacts of natural hazards such as earth quakes and floods.</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Construction Phase</td><td>2.1</td><td>Construction of landfill not in accordance with finalized design</td><td>▪ Method statements must be prepared by the Contractor and approved by the Construction Supervision Consultant (CSC) prior to commencement of construction works;
▪ The CSC must closely monitor the construction works being conducted by the Contractor to ensure the finalized design is implemented in full and the landfill design is developed completely in compliance of the approved finalized designs.
▪ Any deviation by the Contractor from following the finalized design must be immediately highlighted and corrective measures must be implemented to ensure full compliance with the finalized design of the landfill.
▪ PMU KP LGERD shall ensure that construction activities are being carried out in compliance to project design following best international practices. It will closely review and monitor the activities of CSC and contractors involved in construction activities.</td><td>Contractor</td><td>CSC, PMU</td><td>DC</td></tr>
<tr><td>2.2</td><td>Degradation of air quality due to construction works</td><td>▪ At the landfill site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions.
▪ All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.
▪ Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions.
▪ Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions.
▪ Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin.</td><td>Contractors</td><td>CSC, PMU</td><td>DC</td></tr>
</table>

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area shall be avoided. ▪ Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors. ▪ Stack height of generators will be at least 3 meters above the ground. ▪ Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area. ▪ A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community. ▪ The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles Shall not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m3) of crushed materials are necessary, they Shall be enclosed with side barriers and also covered when not in use. ▪ Dust emissions due to road travel shall be minimized through good construction practices (such as keeping stock piles down wind and away from communities) and sprinkling water over the access road. ▪ Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects. · ▪ Developing and implementing work practices to minimize release of contaminants into the work			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			environment including: o Direct piping of liquid and gaseous materials o Minimized handling of dry powdered materials; Enclosed operations o Local exhaust ventilation at emission/release points o Vacuum transfer of dry material rather than mechanical or pneumatic conveyance o Indoor secure storage, and sealed containers rather than loose storage ▪ Where ambient air contains several materials that have similar effects on the same body organs (additive effects). **Vehicular & Equipment Emissions** It shall be ensured that the following measures are taken to control emissions from vehicles being used in the construction activity: ▪ Periodically check and conduct maintenance of the construction machinery and haul vehicles. Generators, compressors and vehicles used during construction works will be maintained in a good condition to ensure that emissions are kept to a minimum level. ▪ Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics. ▪ Controlled technology generator and batching plants will be used to avoid excessive emissions. ▪ Burning of wastes at any site will not be allowed. ▪ The stack height of generators will be at least 3 meters above the ground. ▪ Training of the technicians and operators of the construction machinery and drivers of the vehicles.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ All type of machinery and generator must comply with most stringent NEQS/WHO standards. Vehicles, which are not in compliance with NEQS are not allowed to use. ▪ Idling of construction vehicle will be minimized to reduce air pollution. ▪ Periodic emission monitoring of vehicles, generator and batching plants is proposed. ▪ Project activities shall be planned to avoid harsh weather conditions.			
	2.3	Potential accidents and injuries to communities in project area during construction works	▪ 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 in the project area will be briefed on traffic safety, especially women who are the main care providers to children. ▪ Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible. ▪ Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport. ▪ 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	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			plan, which will address health and safety of the people in the project area. ▪ PMU KP LGERD shall 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.			
	2.4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	**General** The Contractor will be required to prepare and implement an effective Worker OHS Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard Worker Health and Safety measures and contractors will be bound to implement these fully. Monitoring will be required to ensure that the OHS plan based on contract specifications is followed. ▪ Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks. ▪ Surfaces (including flooring and work surfaces) in camps, kitchens, dining areas and workshops Shall be solid and easy to clean. Flooring for work camps must be float finished concrete or better. ▪ All drivers engaged by Contractors must hold a valid license for the vehicle they are operating. ▪ Work in confined space shall be executed with available OHS standards. Adequate monitoring and equipment shall be available to detect deficient oxygen levels. ▪ The Contractor shall submit to the Engineer of CSC for approval an emergency evacuation plan and practice the procedure annually. ▪ The Contractor shall submit to the Engineer of CSC for approval a site layout plan, identifying work areas,	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			accommodation, kitchen, dining area, sanitary facilities, location of generators, plant and vehicle parking, transport routes through the camp, pedestrian routes through the camp, evacuation routes, emergency exits, batching plants, storage areas, waste facilities etc. ▪ Fire extinguishers shall be provided throughout camps and work sites. Fire extinguishers Shall be inspected monthly and maintained as necessary. ▪ An adequate and reliable supply of safe drinking water shall be made available at readily accessible and suitable places including at all camps. ▪ The Contractor shall take samples from each supply of drinking water and arrange for analysis of these samples at EPA certified laboratory prior to its use by the Contractor's staff. The results of these tests for each supply must be submitted to the Engineer of CSC and must demonstrate that each water supply meets national and World Health Organisation standards for drinking water. ▪ The Contractor shall provide and maintain adequate hygienic kitchens which are sheltered and separated from the living quarters. Kitchens shall include raised and washable surfaces suitable for food preparation. ▪ The Contractor shall provide and maintain adequate hygienic dining areas for staff. Work places and camps Shall be provided with both natural& artificial light. Artificial lighting Shall be powered by generator in the event of power cuts. ▪ Public sensitization training will be provided to workers to avoid social conflicts between residents and the construction contractor, Occurrence of any such impacts can be avoided by community sensitive project planning and implementation and through effective involvement of local administration.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ All HSE protocols will be implemented in true letter and spirit. ▪ Contractor must appoint an HSE resource to implement, monitor and report the HSE management plan to concerned authorities. ▪ Contractor must ensure the provision of first aid facility at construction site and camps through hiring medics and establishing a dispensary at the campsite. ▪ Reasonable number of first aid kits shall be available on construction sites and within contractor camps. Based on the type of hazard applicable during the proposed works at site, the following mitigation measures as per IFC guidelines for Occupational Health and Safety (OH&S) must be implemented:[25] **<u>Mitigation Measures for Physical Hazards</u>** ***Rotating and Moving Equipment*** ▪ Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. ▪ Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment Shall be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards Shall be designed and installed in conformance with appropriate machine safety standards. ▪ Turning off, disconnecting, isolating, and de-energizing			

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

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			(Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance. ▪ Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms. ***Vibration*** ▪ Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, shall be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values. Exposure levels shall be checked on the basis of daily exposure time and data provided by equipment manufacturers. ***Electrical*** ▪ Marking all energized electrical devices and lines with warning signs; ▪ Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance; ▪ Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools; · ▪ Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI)			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			protected circuits; ▪ Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas; · ▪ Conducting detailed examination and marking of all buried electrical wiring prior to any excavation work. ▪ Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited; · ***Eye Hazards*** ▪ Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full-face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding shall conform to standards published by organizations such as CSA, ANSI and ISO. ***Welding/Hot Work*** ▪ Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. · ▪ Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) shall			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials. ***Industrial Vehicle Driving and Site Traffic*** ▪ Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits. · ▪ Ensuring drivers undergo medical surveillance. · ▪ Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms. · ▪ Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction. · ▪ Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate. ***Ergonomics, Repetitive Motion, Manual Handling*** ▪ Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind. ▪ Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds. ▪ Selecting and designing tools that reduce force requirements and holding times and improve postures.			

<table>
<tr><th rowspan="2">Project Activities</th><th rowspan="2">Section</th><th rowspan="2">Impact</th><th rowspan="2">Mitigation Measures Recommended</th><th colspan="2">Responsibility</th><th rowspan="2">Timing</th></tr>
<tr><th>Execution</th><th>Monitoring</th></tr>
<tr><td></td><td></td><td></td><td>▪ Providing user adjustable workstations.
▪ Incorporating rest and stretch breaks into work processes and conducting job rotation. ·
▪ Implementing quality control and maintenance programs that reduce unnecessary forces and exertions. ·
▪ Taking into consideration additional special conditions such as left-handed persons.
Working at Heights
▪ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area. ·
▪ Proper use of ladders and scaffolds by trained employees. ·
▪ Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines.
▪ Appropriate training in use, serviceability, and integrity of the necessary PPE.
▪ Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.
Fire and Explosions
▪ Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area Shall be:
  ▪ Remote from entry and exit points into camps
  ▪ Away from facility ventilation intakes or vents
  ▪ Have natural or passive floor and ceiling level ventilation and explosion venting</td><td></td><td></td><td></td></tr>
</table>

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Use spark-proof fixtures ▪ Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time. ▪ Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment). · ▪ Providing specific worker training in handling of flammable materials, and in fire prevention or suppression. ***Corrosive, oxidizing, and reactive chemicals*** ▪ Corrosive, oxidizing and reactive chemicals Shall be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills. · ▪ Workers who are required to handle corrosive, oxidizing, or reactive chemicals shall be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc). · ▪ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid shall be ensured at all times. Appropriately equipped first-aid stations shall be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers shall be provided close to all workstations where the recommended first-aid response is immediate flushing with water.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			Mitigations for Biological Hazards ▪ The Contractor shall 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 wok sites. Disease surveillance shall 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 shall be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.			
	2.5	High noise levels from construction activities	▪ Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment. Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers. ▪ Excessive noise emitting equipment will not be allowed to operate and will be replaced. ▪ Blowing of horns will be prohibited on access roads to work sites. ▪ As a rule, the operation of heavy equipment shall be conducted in daylight hours. ▪ Construction equipment, which generates excessive noise, shall be enclosed or fitted with effective silencing apparatus to minimize noise. ▪ Well-maintained haulage trucks will be used with speed controls. ▪ Use of ear plug and ear muffs must be ensured during construction. No employee shall be exposed to a noise	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			level greater than 85 dB (A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear shall 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 shall be investigated and implemented, where feasible. ▪ Periodic medical hearing checks shall be performed on workers exposed to high noise levels. ▪ All the equipment and machinery used during construction phase shall be well maintained and in compliance with NEQS.			
	2.6	Improper handling and/or disposal of hazardous and non-hazardous waste	▪ A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility i.e. designated area with secondary containment. ▪ Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused. ▪ Excavated material from landfill cells will be stored at site and it will be used as daily cover within landfill cells. ▪ All types of combustible and non-combustible waste including plastic or glass bottles and cans will be temporarily stored on site and later sold/handed over to a waste/recycling contractor who will utilize these wastes for recycling purposes. ▪ Waste management training for all site staff to be included in Contractor's training plan.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area shall be equal to 120% of the total volume of fuel stored. ▪ Fuel and hazardous material storage points must be included in camp layout plan to be submitted for approval. Hazardous material storage areas shall include a concrete floor to prevent soil contamination in case of leaks or spills. Fuel tanks will be checked daily for leaks and all such leaks will be plugged immediately. ▪ Designated vehicles/plant wash down and refueling points must be included in camp layout plan to be submitted for approval. ▪ Hazardous waste will be initially stored on site at designated area and then handed over to EPA certified contractor to final disposal. ▪ Record of waste generation and transfer shall be maintained by project contractors. ▪ Spill kits, including sand buckets (or other absorbent material) and shovels must be provided at each designated location. ▪ At the time of restoration, septic tanks will be dismantled and backfilled with at least 1m of soil cover keeping in view landscape of surrounding natural surface. ▪ It will be ensured that after restoration activities, the campsite is clean and that no refuse has been left behind. ▪ Clinical wastes will be temporarily stored onsite separately and will be handed over to approve waste contractor for final disposal. ▪ Training will be provided to personnel for identification, segregation and management of waste.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	2.7	Untreated disposal of effluent from worker camps and batching plant(s) and construction sites	▪ It will be ensured that no untreated effluent is released to the environment. ▪ A closed sewage treatment system including soak pits and septic tank will be constructed to treat the effluent from the construction/labor camps. ▪ Sewage treatment system will be installed at each respective labor camp based on the number of laborers residing at the respective camp. ▪ Wastewater from laundry, kitchen washings and showers will be disposed-off into soak pits or septic tank (where soak pit cannot be constructed) and after treatment it will disposed of in TMA provided drains in the project area. ▪ Soak pits will be built in absorbent soil and shall be located 300 m away from a water well, hand pump or surface water body. Soak pits in non-absorbent soil will not be constructed. ▪ Ensure that the soak pits remain covered all the time and measures are taken to prevent entry of rainwater into them. ▪ Sprinkling of grey water or sewage will not be allowed; in case the septic tank gets filled with sludge, septic tank shall be emptied through vacuum truck and material shall be transferred to treatment facility or approved municipal drain. ▪ Water being released from any batching plant(s) must be treated as per requirements of NEQS prior to release to sewerage system/any other water body. ▪ Sewage at the end of construction period to be disposed of in nearest municipal drains after getting approval from concerned municipal authorities.	Contractor	CSC, PMU	DC
	2.8	Soil Erosion and	Any drainage structures, culverts or pipes crossing the project site may need to be modified or protected and	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
		Sedimentation	the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the construction works.			
	2.9	Soil Contamination	▪ It will be ensured that drip trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil. ▪ Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities. ▪ Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.	Contractor	CSC, PMU	DC
	2.10	Employment Conflicts	▪ The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project area will be informed of the employment policy in place and number of people that can be employed for this project. ▪ It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of the project area. ▪ The PMU will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	2.11	Communicable diseases incl. COVID-19	A communicable diseases prevention program will be prepared for construction workers or residents near the construction sites. **<u>COVID-19 specific measures</u>** ▪ All workers must perform complete sanitization at the site as per SOPs/guidelines issued by WHO. ▪ All workers must wear a mask and gloves as soon as they arrive at site and must keep wearing it at all times while present at the work site/hospital premises. ▪ As soon as workers arrive at work site, their body temperature must be checked and in case any worker is assessed to be running a fever or suffering from a flu or cough, he must be informed to leave immediately and self-isolate for a two week period and not report for work until this two week mandatory period has been completed. ▪ At the work site(s), social distancing measures must be strictly implemented and gathering of workers at any location at the work site(s) must be strictly forbidden. In case of workers not taking this measure seriously, strict penalties must be imposed to ensure implementation. ▪ The work tasks must be divided into shifts, as far as possible, to reduce the workforce present at the work site(s) at any one moment and improve the working speed/efficiency. ▪ All workers will be strictly advised to wash their hands as frequently as practicable and not to touch their face during work. ▪ A supply of safe drinking water will be made available and maintained at the project site(s).	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Chlorinated disinfecting spraying must be conducted at the work site(s) ▪ COVID awareness sign boards must be installed at the hospital premises and at the work site(s). ▪ Contact details of all workers will be kept in a register on site in order to efficiently trace and manage any possible workers that might experience symptoms of COVID-19. ▪ Prohibition of entry for local community/any unauthorized persons at work sites. ▪ Proper hygiene practices in the toilets and washrooms will be implemented with proper and adequate use of soaps and disinfectant spray. ▪ Social distancing must be maintained during the pick-up and dropping off of workers from their residences to and from the work site(s). ▪ GoP and GoKPK guidelines issued for Health & Safety of Building and Construction Workers during COVID-19 outbreak shall be implemented. ▪ Any future issue or revisions in existing COVID-19 guidelines by GOP and GoKPK shall be adopted and implemented.			
	2.12	Vegetation and Wildlife Loss	▪ Consideration has been given to the visual appearance of the landfill site during operation and at the time of closure of the site and its impact on the surrounding land forms. Necessary plantation will be carried out, which will act as buffer zone from surrounding environment. Reasonable area will be allocated for plantation within and at boundary of facility to improve landscape of the area. ▪ Inside the boundary wall, tree plantation will be conducted to create an environmental barrier between	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			the external and internal environment. Indigenous tree plantation will be carried out, which will serve as the buffer zone. For the landfill, to present a clean and aesthetically pleasing view, buffer zone with tree plantation and landscaped berms will be developed. Plantation will commence as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds have been mobilized, plantation activity will be started in collaboration with Swat District Development Authority (SDDA) or WSSC Swat may outsource the activity separately. ▪ Camp/s will be located in existing clearings; as much as possible. ▪ Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project ▪ Vehicles speed will be regulated and monitored to avoid excessive dust emissions. ▪ No hunting or killing of animals will be permitted. ▪ No cutting down of vegetation or using vegetation or trees as firewood will be permitted.			
	2.13	Historical/Archaeological Sites	▪ If evidence of any archaeological remains is found during the construction activities, the excavation work will be stopped immediately and necessary next steps taken to identify the archaeological discovery based on the 'Chance Find' procedures.	Contractor	CSC, PMU	DC
	2.14	Construction of Administration Building and Other Infrastructure	▪ Water will be sprinkled regularly to suppress dust emissions. Off road travelling of vehicles will be prohibited. ▪ Stock piles will be appropriately located and out of wind to avoid dust emissions. Dry dusty materials shall be sprinkled with water and properly covered	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			to avoid dust emissions. ▪ No cement and concrete waste will be left unattended. Construction debris will not be thrown from height to avoid dust emissions. Return unpaved areas to original or improved contours following construction. ▪ Solid waste generated during construction of admin building will be managed through SEMMP. ▪ Set protocols for proper and regular maintenance of construction machinery, vehicles and generators. Generators that will be used will be placed at suitable locations. ▪ Contractor will not be allowed to store bulk quantities of fuel or hazardous material at site. ▪ Any fuel or chemicals stored at site (in small quantities) will be stored at designated site and containers/storage vessels be properly marked for their contents. Storage area will be provided with hard impervious surface and secondary containment. ▪ Equipment and machinery with loose vibratory parts will not be allowed to use. Used equipment and machinery will be in compliance to NEQS. ▪ Waste bins will be provided at appropriate places to mange waste. Daily housekeeping of the construction area will be carried out. ▪ CSC will ensure that proper amounts of insulation in the walls and roof will be used. ▪ Proper weather stripping and caulking will be carried out to ensure energy efficiency. ▪ High quality windows that utilize low-e coatings and gas filling will be installed. ▪ CSC will ensure that energy efficient appliances			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			such as LED lights, energy savers, inverters) are installed in the buildings.			
	2.15	Construction of access road	▪ The road widening will be to a standard that is suitable for movement of high capacity waste carrying vehicles. ▪ WSSC Swat/PMU will maintain close coordination with the residents falling close to road widening works, project information leaflet will be distributed to them and awareness with respect to impacts (noise, dust and vibrations) associated with construction will be provided. If people are notified, their acceptance of the disturbance is usually higher. ▪ WSSC Swat/PMU will arrange community consultation session before commencement of construction works to make public sensitization which will facilitate smooth execution of project activities. ▪ Compaction with heavy vibration rollers should be avoided or minimized in built-up areas. ▪ 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. ▪ Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children. ▪ Traffic diversions will be planned in such way that it does not create traffic congestion during road widening works. Road closure for the works will be	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			avoided. ▪ PMU KPCIP through CSC will ensure that road widening structure shall be as similar as existing part. ▪ Proper drainage system will be provided in order to achieve sustainability. ▪ Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project. ▪ Vehicles speed will be regulated and monitored to avoid excessive dust emissions. ▪ Blowing of horns will be prohibited on access roads to work sites. ▪ Periodic sprinkling on access road at least twice per day during construction phase and restrict vehicle speed to 20 kmph. ▪ Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area. ▪ Traffic is not disrupted by labor camps being set up roadside next to the construction sites. ▪ 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. ▪ PMU KP LGE&RDD 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. ▪ Record of waste generation and transfer shall be maintained by project contractor. ▪ Periodic water sprinkling will be carried out during			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			widening works to suppress dust. ▪ Fuel-efficient and well-maintained equipment and machinery shall be employed to minimize exhaust emissions. ▪ The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use. ▪ Prior to starting of work, the contractor should prepare a method statement for road wideninining works. This should be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns. ▪ Method Statement is very important, particularly for the road widening works. ▪ Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area. ▪ Method Statement should be in a Table format with appended site layout map and cover the following: o Work description o No. of workers (skilled & unskilled) o Details of Plant, equipment & machinery, vehicles o Work duration (total, and activity-wise, for			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			example for preparation of sub grade, sub-base, base and wearing coarse ○ PPE (helmet, gloves, boots, etc.) details for each type of work ○ Details of materials at each site (type & quantity) ○ Risks/hazards associated with the work ○ Construction waste/debris generated (details & quantity) ○ Detail the sequence of work process (step-by-step) including specific details of each work ○ Contractor's supervision & management arrangements for the work ○ Emergency: Designate (i) responsible person on site, and (ii) first aider ○ Typical site layout plan including placement of material, excavated earth, barricading etc. ▪ The following should be included in the site layout plan: ○ Provide barricading/security personnel at the site to prevent entry/trespassing of			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			pedestrian/vehicles into the work zone. ○ Location of temporary stockpiles and provision of bunds ○ Separation of stockpiles areas with workers/vehicle movement paths to avoid disturbing the stockpiled material ○ Wetting of soil to arrest dust generation by sprinkling water ○ Waste/surplus soil utilization and disposal plan – indicate expected duration of temporary stockpiling along the road and identify final surplus soil utilization/disposal site in consultation with CSC/PMU. ▪ PMU KPCIP will ensure the identification of disposal sites for unsuitable excavated material in consultation with WSSC Swat. ▪ CSC will inspect and monitor borrow material areas prior to procurement to ensure that it is being used in sustainable way and no significant disfiguration of landscape is going on at quarry site. ▪ Stock piling of excavated material at places that are congested will be avoided as these piles can create traffic issues and public nuisance. ▪ Already available quarry sites for additional backfill material will be utilized. Development of new quarry site will be discouraged.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Record of borrow materials will be maintained including details of quarry site, agreement and necessary approvals from concerned government authorities.			
	2.16	Sexual Abuse, Exploitation and Harrasement (SEAH)	▪ The contractor's COC shall cover a program to promote awareness of the construction workers on avoiding any gender-based violence; ▪ The contractor's monthly training program will cover topics related to COC such as sexual harassment particularly towards women and children, violence, including sexual and/or gender-based violence; ▪ Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers; ▪ The contractor will make sure that no discrimination is made on the basis of gender while hiring of workers; ▪ The contractor will set the employment relationship on the code of equal opportunity and fair treatment and develop COC for workers to address these issues; ▪ The employment decisions will not be made on the basis of personal characteristics unrelated to inherent job requirements, including race, gender, nationality, religion or belief, disability, age, sexual orientation, or ethnic, social and indigenous origin; ▪ Special measures will be taken to address harassment, intimidation, and/or exploitation, especially in relation to women; ▪ No Sexual Harassment Policy will be established and strictly endorsed in accordance with provincial law; ▪ World Bank Good Practice Note on Addressing GBV will be used as guidance.	Contractor	CSC, PMU	DC
Operation	3.1	Generation of	▪ A leachate holding tank of 500 m3 (sufficient to	O&M	WSSC	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
Phase		Leachate	store 5 days leachate production) will collect the leachate before it enters the treatment plant. Leachate treatment is based on DTRO, which is potable arrangement for treatment of leachate and can be operationalized during monsoon for 24/7 basis. During monsoon season, recirculation of leachate will be increased to avoid operational constraints of leachate collection, storage and treatment system at landfill site. ▪ Operate the landfill in accordance with applicable internationally recognized standards to minimize leachate generation, including the use of low-permeability landfill liners to prevent migration of leachate as well as landfill gas, a leachate drainage and collection system, and landfill cover (daily, intermediate, and final) to minimize infiltration; ▪ Minimize the daily exposed working face and use perimeter drains and landfill cell compaction, slopes and daily cover materials to reduce infiltration of rainfall into the deposited waste; ▪ Leachate collection will be augmented by a leachate recirculation system in the landfill design. ▪ 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. ▪ The final vegetative cover plays an integral part in	Contractor/ WSSC Swat	Swat, PMU	

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			leachate production control. Its basic functions are to limit infiltration by intercepting precipitation directly, thereby improving evaporation from the surface, and to reduce percolation through the cover material by taking up soil moisture and transpiring it back to the atmosphere. Preferred plant species shall be of those that do not have deep roots in order to protect the surface sealing. Further, these species shall require minimal maintenance and human intervention. ▪ Landfill operators must be properly and adequately trained to operate and maintain the installed control system. ▪ A procedure for the rapid repair of leaks in the pipes, pumps and other equipment must be part of landfill operations. ▪ An inventory of spare parts and repair equipment must be continuously in place to ensure immediate remedial action against breakdowns. ▪ Strict quality assurance and construction guidelines during the installation of the HDPE liner shall be strictly implemented. ▪ In worst case, if leachate contamination is detected during ground water monitoring after few years of landfill operation, Ground water modelling to determine possible contamination of leachate will be carried out and necessary design changes will be done. ▪ Detailed ground water quality baseline will be developed during operation phase of the project to trace any ground water contamination from landfill operations.			
	3.2	Possible	▪ Appropriate liner and collection systems in	O&M	WSSC	DO

<table>
<tr><th rowspan="2">Project Activities</th><th rowspan="2">Section</th><th rowspan="2">Impact</th><th rowspan="2">Mitigation Measures Recommended</th><th colspan="2">Responsibility</th><th rowspan="2">Timing</th></tr>
<tr><th>Execution</th><th>Monitoring</th></tr>
<tr><td></td><td></td><td>Contamination of Soil and Groundwater</td><td>compliance with international guidelines/criteria are part of the design and will be installed.
▪ 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.
▪ The leachate system will consist of a leachate collection layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) with pipe network to convey the leachate to treatment facility.
▪ A total of 600 mm clay liner of permeability of 1x10-6 cm/sec will be compacted at the bottom in series of 150mm layers each compacted to 95% of compaction. This layer will be topped by 1.5 mm HDPE geomembrane.
▪ As soon as HDPE is placed, 200 mm silty sand or geotextile will be covered on top of HDPE for the protection of the HDPE on the side slopes.
▪ Above this 300 mm PEA gravel layer will be placed followed by 150 mm compacted (85-90%) sand layer.
▪ Leachate collection pond shall be in opposite direction from nearest surface water body.
▪ A leachate treatment facility with a design capacity of 50 m3 /d will be constructed. Leachate treatment is designed on activated sludge treatment with advance level treatments (Disc Tube Reverse Osmosis-DTRO) for heavy metals and other pollutants potentially present in leachate.
▪ Slope of the landfill site shall be away from nearest surface water body.
▪ Cut-off drains around active landfill site and</td><td>Contractor/ WSSC Swat</td><td>Swat, PMU</td><td></td></tr>
</table>

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			peripheral drains around landfill site shall be provided ▪ Ground water monitoring wells shall be dug keeping in view of the flow of ground water on both upstream and downstream of the disposal site and monitor the ground water quality of the upper strata for any contamination for disposal site every month. ▪ Waste hauling vehicles shall be covered during transport of waste to landfill site ▪ Hauling vehicles shall not be washed at the surface water bodies along the route as the wash water shall drain into the canal and will pollute the surface water source which is used by the animals of the nearby communities and for agriculture purpose. ▪ Domestic sewerage of Mingora facility shall not be discharged untreated in open area and drains, ▪ Waste water generated from vehicle wash area shall be contained and treated before final discharge ▪ In order to augment this system, regular quality control checks on the equipment /accessories will be implemented and incorporated during construction and operations. ▪ Detailed analysis of leachate leackage detection on ground water quality will be carried out and necessary design changes/improvements will be done. ▪			
	3.3	Generation of Landfill Gas	▪ The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate considering that only a small quantity of gas will be produced. Common methods to treat	O&M Contractor/ WSSC Swat	WSSC Swat, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For KPCIP landfills, Open flame flare technology, consisting of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology. ▪ For Mingora flaring is proposed for landfill gas management. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed. ▪ PMU KP LGE&RDD 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 based on the monitoring results necessary design changes will be incoproated to avoid air quality impacts from flaring. ▪ As part of closure plan of existing dumping site, GHG monitoring will be carried out and necessary gas venting system will be done. ▪ Periodic GHG monitoring will be carried out during operation phase of the project and accordingly, necessary design changes will be incorporated, if required.			
	3.4	Generation of objectionable Odor and impact on air quality	Best management practices and good housekeeping measures will be implemented to minimize the release of objectionable odours. Potential odours impacts can be minimized or eliminated by adopting the following measures: ▪ Daily cover will be placed on working surface of waste in order to reduce the risk of fire, wind	O&M Contractor/ WSSC Swat	WSSC Swat, PMU	DO

<table>
<tr><th rowspan="2">Project Activities</th><th rowspan="2">Section</th><th rowspan="2">Impact</th><th rowspan="2">Mitigation Measures Recommended</th><th colspan="2">Responsibility</th><th rowspan="2">Timing</th></tr>
<tr><th>Execution</th><th>Monitoring</th></tr>
<tr><td></td><td></td><td></td><td>littering, odor, vector breeding and dust hazards in the landfill.
▪ Suitable amount of daily cover will be stocked at the landfill site.
▪ Final capping of landfill cells will be carried out in order to limit and control the amount of precipitation that enter the waste and to limit wind and water erosion and burrowing animal activity. This will not only prevent the odor of decaying waste from escaping from the landfill but also protect the site against intrusion of vermin and pests.
The top cover system consists of following arrangements.
▪ Thick top soil layer of 45 cm capable of supporting vegetation in order to protect the landfill surface from wind and water erosion.
▪ Drain Layer of 15 cm at bottom to maximize runoff of precipitation while minimizing infiltration and preventing ponding of water on the landfill.
▪ Compacted soil layer or barrier of 60 cm of low permeability to limit and control the amount of precipitation that enters the waste.
▪ Vent layer of 15 cm thickness comprised of sand and gravel
▪ Appropriate and regular housekeeping (i.e. cleaning) will be done in all areas where solid waste will be processed (i.e. weigh bridge area). This will prevent the reproduction of flies, generation of obnoxious odors, scattering of plastic and papers, etc.
▪ Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, MRFs, material handler and waste</td><td></td><td></td><td></td></tr>
</table>

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			compactor operators) must be ensured. ▪ All the incoming ingredients that are anaerobic will be converted to aerobic state through combining them with a coarse, dry bulking amendment to increase the porosity and allow oxygen penetration. ▪ Air shall be thoroughly dispersed throughout the organic waste. This is done by frequently turning and mixing the wastes. ▪ Oxidizing chemicals like hydrogen peroxide, potassium permanganate, and chlorine will be used by the wastewater treatment industry for odor control. ▪ Organic waste lot which is creating objectionable odor will be attended immediately and introduced in the composing system on priority basis. ▪ Controlled compositing conditions will be maintained throughout the operation. ▪ Mandatory health and medical check-ups for all employees especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health (10 mg/m3 as an 8-hr TWA). This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill; ▪ Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment (RPE);			
	3.5	Attraction of Vermin and disease vector	▪ The most important control measure used to minimize vector problems at landfills is the application of daily cover. Cover shall be present on	O&M Contractor/ WSSC	WSSC Swat, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
		generation	all solid waste at all times, except the tipping face while it is being worked. Daily cover of at least 150mm of compacted soil or similar material or an effective layer of alternate daily cover (ADC) shall be applied on finished portions of the daily cell during operation and at the conclusion of daily operations, and not less frequently than once per day. Alternative daily cover materials such as tarpaulins, foams, granular waste, etc, can be effective as vector control after careful site-specific evaluation. ▪ Intermediate cover of 300mm (minimum) compacted soil shall be used on all areas not at finished levels, but not to be further landfilled for a period of 30 days or more. ▪ Final cover is typically applied as each area is brought to finished level through the operational life of the landfill. ▪ There shall be no uncontrolled or uncovered (stockpiled) waste, including litter, tyres, brush, appliances, construction/demolition waste or even inert industrial waste on the landfill property. The only exception is compactable soil-like inert wastes, such as ash, but even this waste must be graded and compacted to avoid ponding water. ▪ There shall 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 minimize stagnant water, nutrient build-up and plant growth. ▪ Finally, the waste must be compacted and graded at reasonable maximum slopes (see the Working Face Guideline) to minimize voids within the waste that	Swat		

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			can harbour rodents in particular. Rodents and foxes can readily dig into cover soil, but have much more difficulty digging into compacted solid waste. ▪ 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 shall be kept on file so changes that occur over time and in response to control measures can be assessed.			
	3.6	Occupational Health and Safety	▪ OHS management system will be prepared and implemented. ▪ Designation of an Environment, Health and Safety (EHS) officer dedicated to the site; ▪ All employees must be able to reach their work stations safely. All path, walkways, staircases, ladders and platforms must be stable and suitable for the tasks to be undertaken; ▪ Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, workers at MRF, material handler and waste compactor operators) must be ensured. ▪ Mandatory training of all employees, including sub-contractors, on Health and Safety Practices for Landfill and its auxiliary facilities. Tool Box talks are also recommended; ▪ Mandatory health and medical check-ups for all employees especially workers working at MRF as they may be exposed to general airborne dust	O&M Contractor/ WSSC Swat	WSSC Swat, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			above the level where it is considered a substance hazardous to health (10 mg/m3 as an 8-hr TWA). This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill; ▪ Develop a written program (i.e. health information, instruction and training) which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards of working in a landfill and its auxiliary facilities; ▪ Mandatory monitoring of air quality and noise levels in the working stations i.e MRFs, compactors and bailer etc to maintain the same within local standards and whenever possible near ambient levels; ▪ Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment (RPE); ▪ Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment (RPE); ▪ Accidental fires must be addressed immediately. Appropriate operational procedures involving the spreading and smothering of burning waste, rather than the use of water, must be implemented; ▪ Emergency plan (including fire management) must be developed and implemented;			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Availability of first-aid kits and vehicles that can be used to bring any injured employee to the nearest doctor in cases of accidents; ▪ Mandatory reporting of all accidents or incident of near misses of accidents and immediate adoption of corrective measures; and ▪ Management must provide all the necessary financial and manpower resources for the implementation and enforcement of all health and safety programs and activities of the project; ▪ Regular training and orientation on safety practices will be implemented to impart knowledge of safe and efficient working environment. Furthermore, regular health checkups of all employees including contract workers will be conducted. Effective and proper housekeeping is recommended to reduce dust exposures to its direct vicinity. Heat levels must be monitored as well. Spot checks shall be done to ensure that workers' welfare is addressed especially during summer months.			
	3.7	Waste Collection and Hauling Impacts	▪ Capacity of WSSC Swat will be increased though increase in its collection fleet. It will be done through procurement of both solid waste and non-solid waste carrying machinery under this project. ▪ Door to Door collection of waste will be enhanced through media compaigns. Communication programs would be developed to encourage better management of waste. Proper PPEs will be provided to waste handlers. Key performance indicators will be developed to monitor improvements in the system. ▪ All type of waste hauling will be carried out in purpose built vehicles to avoid scattering of waste at hauling routes. Drivers of waste carrying vehicles	O&M Contractor/ WSSC Swat	WSSC Swat, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			will be trained with resepect to environmental sensitization. Drivers are allowed to commute only on designated routes through purpose built vehicles for waste hauling. ▪ Multiple transactions of waste will be avoided through use of main and mobile transfer stations. Improved segregation practices will be introduces once door to door collection desired effieciency achieved. Necessary legal bindings with respect to waste storage by Public will be introduced. ▪ A comprehensive traffic management plan (TMP) must be developed and implemented; ▪ As part of the TMP, it will be ensured that the movement of heavy vehicles related to landfill operations is minimized during the peak traffic hours of the day in order to prevent congestion and accidents as far as possible; ▪ Furthermore, the movement of heavy vehicles within Mingora city related to landfill operations must be restricted to specific routes containing least number of sensitive receptors and low traffic volumes. ▪ Waste hauling through dirt tracks will be strictly prohibited. Waste hauling through mechanically unfit vehicles or noisy vehicles will not be allowed. ▪ Waste transporters will be directed to use designated routes and follow recommended speed limit for waste hauling and such routes will be metaled roads instead of dirt tracks. ▪ A comprehensive traffic management plan (TMP) must be developed and implemented; ▪ As part of the TMP, it will be ensured that the movement of heavy vehicles related to landfill operations is minimized during the peak traffic hours			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			of the day in order to prevent congestion and accidents as far as possible; ▪ Furthermore, the movement of heavy vehicles within Mingora city related to landfill operations must be restricted to specific routes containing least number of sensitive receptors and low traffic volumes.			
	3.8	Wind Blown Litter	The facility operator, as necessary, will implement the following procedures and techniques to control litter: ▪ All trucks must be tarped upon entering and exiting the facility. They shall only untarp and tarp at the active area. This policy will be strictly enforced. Daily waste entering the landfill site will be subject to immediate compaction to minimize the area and debris subject to the impacts of wind. ▪ If possible, on windy days, the daily fill face tipper locations shall be selected for its protection to minimize effects of wind. ▪ Waste that is more susceptible to windblown distribution may, on windy days, be worked immediately into the fill face and covered with a layer of daily cover, as needed, or the waste may be excluded from the site. ▪ Portable skid-mounted litter fences may be provided for deployment downwind as close as practical to the working area, as needed. ▪ Semi-permanent fencing may be provided around the fill area as an additional barrier to the migration of litter off-site when litter has not been contained by the portable litter fences. (Examples of additional barriers include but not limited to, a four-foot minimum temporary construction fence and/or a ten-foot or higher semi-permanent fence.) The utilization will be continually evaluated and the fence will be	O&M Contractor/ WSSC Swat	WSSC Swat, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			relocated or added as needed. ▪ Permanent fencing (ten-foot high with an additional three-foot kicker) may be constructed with possibility of placement on an eight-foot high berm. ▪ On very windy days, when all other procedures are not successful in controlling blowing litter, the operator may apply cover material more frequently or immediately to the incoming waste load. ▪ Buffer zones resulting from required facility setbacks along the site's perimeter shall provide some protection of adjacent properties. ▪ As a final control measure, personnel will be dispatched, as needed or daily if conditions require, to collect any litter that has escaped the above control measures ▪ Portable litter vacuums may be used to collect litter that has accumulated on litter fences. If fences are positioned properly, this can be a very efficient method of collecting litter. ▪ The main highway leading to the site will be routinely inspected for litter. If the highway has litter associated with the trucks entering the facility, then the litter will be picked up on a routine basis. All necessary safety precautions must be followed. ▪ Before and after photos of any litter removal effort may be taken in the event anyone questions the level of effort spent on litter collection. ▪ Site management's cell phone numbers may be provided to community/neighbors. ▪ The management of litter at the landfill is a daily activity. In most instances the above procedures and techniques shall properly manage litter effectively. However, there will be occasions and			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			situations when litter will be distributed by the wind in such a manner that the above procedures will not totally manage the litter and contain the litter on-site. In these situations, the facility operator may not be able to collect all litter within the day the litter problem occurred. However, the facility operator shall proceed with collecting the litter off site and complete the retrieval of wind-blown litter at the earliest practicable time.			
	3.9	Impacts on Scavengers and Waste Pickers	▪ WSSC Swat will carry out detailed assessment of scavenging business in their respective jursidication to identify waste picker and scrap dealers which will be impacted. ▪ WSSC Swat will provide resources and tools to efficiently collect and sort out the waste onsite, as these waste pickers are the first one to deal with the waste. ▪ WSSC Swat will train these waste pickers to optimize their waste collection process. ▪ WSSC Swat will hire waste pickers at MRF facility that will be established at landfill site. ▪ WSSC Swat will hire services of scrap dealers for waste collection and transportation to landfill site on need basis. ▪ WSSC Swat will prepare communication strategy and will run community based operation to integrated SWM operations including waste pickers and scrap dealers. ▪ PMU KPCIP will preapre guidelines to involve scavengers/waste pickers in IWMS through formalization and regulations of their business. These guidelines will be adopted by WSSC Swat to ecourage involvement of scavengers and waste			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			pickers working at all levels regardless of their position in present system chain.			
	3.9	Improvement in Aesthetic Aspects	▪ The boundary walls shall be constructed alongside the facility. ▪ The indigenous plants shall be planted alongside the access road and around the landfill site which will act as buffer zone. ▪ The waste transfer vehicles shall be covered. ▪ Reasonable area will be allocated for plantation within and at boundary of facility to improve aesthetic appeal of the area. ▪ Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity can be started in collaboration with Swat District Development Authority (SDDA) or WSSC Swat can outsource the activity separately.	O&M Contractor/ WSSC Swat	WSSC Swat, PMU	DO
Closure & Post Closure Phase	4.1	Closure and Post Closure Impacts	▪ Appropriate selection of soil type for final cover will be ensured to prevent water infiltration and minimize infiltration of precipitation into the waste and the subsequent generation of leachate; control landfill gas migration; and minimize long term maintenance needs. ▪ 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	WSSC Swat	WSSC Swat	During Closure & Post Closure

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			constituents; ▪ Application of final cover components that are consistent with post closure use and local climatic conditions. ▪ Necessary environmental objectives and controls (including technical specifications) will be defined and implemented. ▪ Necessary surveillance protocols for final capping, lachate and gas monitoring will be established and implemented. ▪ Future Land use of the site will be defined in consultation with local communities and government agencies. ▪ It will be ensured that financial resources, and monitoring arrangements are in place for closure and post closure activities. ▪ PMU KP LGE&RDD 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	

CSC : Construction Supervision Consultant

BC : Before Construction

DC : During Construction

PMU : Project Management Unit

DO During Operation

WSSC Swat Water & Sanitation Services, Swat

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

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Ambient Air Quality	To establish baseline air quality levels	CO,NO_2,SO_2, O_3 & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in the project area both upwind and downwind	Once	CSC
Ambient Noise	To establish baseline noise levels	Ambient noise level near receptors in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour, and then averaged	At three random receptor locations in the project area	Once	CSC
Groundwater Quality in vicinity of landfill site	To establish groundwater quality in project area	Groundwater quality in project area	Water samples for comparison against NEQS parameters	At five locations around the landfill site in the project area	Once	CSC

Table 7.3: Construction Phase Monitoring Requirements

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Noise Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level at different locations in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour at 15 m from receptors, and then averaged	At three random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, CSC
Air Quality Dust emissions from movement of construction vehicles and equipment Exhaust emission from tailpipes of equipments	To determine the effectiveness of dust control program on dust at receptor level	CO, NO_2, SO_2, O_3 & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, CSC
		Visible dust	Visual observation of size of dust clouds, their dispersion and the direction of dispersion	Construction site	Once daily during peak construction period	Contractor's Environmental officer, CSC
Safety precautions by Safety workers	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Construction site	Once Daily	Contractor's Environmental officer, CSC
Soil Contamination	To prevent contamination of soil from oil and toxic chemical spills and leakages	Incidents of oil and toxic chemical spills	Visual inspections	At construction site and at vehicle and machinery refuelling & maintenance areas	Once a month	Contractor's Environmental officer, CSC

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Solid Waste & Effluent disposal Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal will be undertaken at all work sites in project area	Visual inspections	At work sites in project area	Once daily.	Contractor's Environmental officer, CSC

Table 7.4: 'Operation Phase' Environmental Monitoring Plan

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Groundwater Quality in vicinity of landfill site	To assess whether landfill operation is causing any seepage into the groundwater aquifers in project area and contaminating it.	Groundwater quality in project area	Water samples for comparison against NEQS parameters	At five locations around the landfill site in the project area	Quarterly	WSSC Swat
Surface water Quality in vicinity of landfill site (If available within 300 meters down gradient as per IFC standard)	To assess whether landfill operation is causing any seepage into the surface water aquifers in project area and contaminating it.	Surfacewater quality in project area	Water samples for comparison against NEQS parameters	At two locations downstream of landfill site	Bi-annual	WSSC Swat
Ambient Air Quality in vicnity of Landfill site	To assess wheter landfill operation is causing deterioration of ambient air due to flaring	Ambient air quality in project area	Ambient air quality monitroing against NEQS parameters	At three locations around the landfill site in the project area	Quarterly	WSSC Swat

Solid Waste Management Plan	To assess that solid waste generated from SWMF operation is managed as per EIA/EMP requirements	Solid waste inventory is being maintained Only MSW is reaching the SWMF	Solid waste inventory audit	Each component of SWMF	Monthly	WSSC Swat

Table 7.5: Capacity Development and Training Programme

Provided by	Organized by	Contents	No. of training events	Duration	Cost (PKR)
Pre-construction Phase Monitoring Consultants/Organizations offering specialized services in environmental management and monitoring	CSC & PMU	Short seminars and courses on: Environmental Management Plan and Environmental Monitoring Plan	Two seminars for Contractor management staff and project staff	1 day	200,000/Training
Construction Phase Monitoring Consultants/Organizations offering specialized services in environmental management and monitoring	CSC & PMU	Short seminars on Environmental risks associated with construction phase. Development of Environmental Performance Indicators Occupational Health and Safety (OHS) issues	Two seminars for Contractor management staff and project staff dealing in environment and social issues	1 day	200,000/Training
Operation Phase **Landfill Facility Operator authorized representative or 3rd party trainer**	Landfill Facility Operator	Short seminars on Environmental risks associated with operation phase. Development of Environmental Performance Indicators Occupational Health and Safety (OHS) issues	Bi-annual seminars	1-2 Day	600,000/Year
Total			**100,000** **(PKR 1 million)**		

7.9 Environmental Management Costs

567. The **Table 7.6** below provides cost estimates for 'Pre-Construction phase' monitoring while **Tables 7.7** and **7.8** provides cost estimates for 'Construction phase' and 'Operation phase' monitoring of key environmental parameters.

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

Table 7.6: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring[26]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO_2, SO_2, O_3 and PM_{10}	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per reading
Ground Water Quslity	NEQS	5 (Once only at 5 locations)	150,000	5 readings @ PKR 30,000 per sample
Contingencies			16,500	5% of monitoring cost
Total (PKR)			**346,500**	

Table 7.7: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring[27]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO_2, SO_2, O_3 and PM_{10}	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per reading
Contingencies			36,000	5% of monitoring cost
Total (PKR)			**756,000**	

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

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

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

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Surface Water Quality	NEQS	2 (bi-annual basis)	60,000	2 readings @ PKR 30,000 per sample
Groundwater Quality in vicinity of landfill site	NEQS	5 (quarterly basis @ 5 locations)	6000,000	20 readings @ PKR 30,000 per reading
Ambient Air Quality Monitoring	NEQS	3 (Quarterly basis @ 3 locations)	360,000	12 readings @ PKR 30,000 per reading
Contingencies			52,000	5% of monitoring cost
Total (PKR)			**1,071,000**	

Table 7.9: Estimated Costs for EMP Implementation

Item	Sub-Item	Estimated Total Cost (PKR)
Staff, audit and monitoring cost[28]	1 person for 24 months (@ 100,000 per month)	**2,400,000**
Monitoring Activities	Provided separately in Tables 7.7 and 7.8.	-
Mitigation Measures	As prescribed under EMP and EIA.	**40,00,000**
(i) Water sprinkling	To suppress dust emissions	800,000
(ii) Solid waste collection & disposal	From construction sites (based on initial estimates)	700,000
(iii) Plantation around project boundary to control odor levels	To plant vegetation all along the landfill boundary to limit odor emissions	15,00,000
(iv) Chemicals/pesticides to prevent/minimize disease vector generation	Chemicals to be injected into the influent streams in order to minimize/prevent disease vector generation	10,00,000
Contingencies	5% of EMP implementation cost	320,000
Total Estimated Cost (PKR)		**6,720,000**

[28] To cover staff cost of expense of environmental specialist for contractor

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

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

8 Public Consultation and Information Disclosure

569. This section describes the process and outcomes of the consultations carried out with various groups of stakeholders as part of the environmental and social assessment. It includes a brief discussion on the concerns expressed by the stakeholders during the consultation meetings and responses provided in order to address the concerns through necessary mitigation measures.

570. The specific objectives of the consultation were: (i) obtaining local and indigenous knowledge about the environment and people living in the project area; (ii) interaction with the project affected population and other stakeholders for the collection of primary and secondary data on environment and people; and (iii) engaging stakeholders for maximization of the project benefits.

571. The process of public consultation was conducted in the month of May, 2020. Total 3 FGDs was conducted on Solid waste management system Katwaro Maira. Total 31 men and women participated in these 3 FGDs out of 31 participants 13 (42%) are women. Information on positive and negative impacts associated with constructional and operational stage and proper mitigation of adverse impacts were shared at these consultations. Questionnaires for conducting FGDs and Surveys are attached as **Annexure B.** Details persons consulted during FGDs are provided as **Annexure C.**

8.1 Identification of Stakeholders

572. There are three types of stakeholders for the proposed landfill site development as described below.

8.1.1 Primary Stakeholders

573. The primary stakeholders are primarily the Project Affected Persons (PAPs) and general public including women residing in the project area - for example, people living in the project area particularly those affected by the footprint of the Katwaro Maira Landfill site, Mingora. These are the people who are directly exposed to the project's impacts, though in most cases they may not be receiving any direct benefit from the project.

8.1.2 Secondary Stakeholders

574. The secondary stakeholders are typically institutional stakeholders – for instance, related government department/agencies, local government, and organizations that may not be directly affected by the project; however, they may influence the project and its design. In the case of the proposed landfill site development, the secondary stakeholders are as follows:

- Irrigation, Agriculture and EPA Departments
- The ADB (The Financing Agency)
- Forest and Wildlife Departments, Government of KP
- P&D Department, Government of KP
- Representatives of local communities
- Water and Sanitation Services Company, Swat

- Irrigation Department, Government of KP
- Revenue Department, Government of KP
- Public at large

8.1.3 Key stakeholders

575. The stakeholders considered to possess the ability to significantly influence a project, or who are critical to the success of a project are considered key stakeholders. Key stakeholders may be from the primary and/or secondary stakeholder groups. In this context of the proposed landfill site development, these are considered to be local leaders, influential community members and other local representatives including Imams of mosques and teachers of local schools.

8.2 Information Disclosure and Consultation

8.2.1 Scope of Consultations

576. All consultations were carried out in accordance with the 'meaningful consultation' guidelines of ADB's SPS 2009 and their outcome is discussed in the proceeding sections. Consultations were also held with the PMU, Local Government Board and the design consultants.

577. As part of the present environmental and social assessment, detailed consultations with different stakeholders were conducted through focus group discussions (FGDs) with the communities, including women in the project area. Separate meetings were held with the institutional stakeholders in the form of one-to one meetings i.e. with EPA, WSSC Swat, etc. Specially, prepared consultation Performa was used during the data collection. Details of this consultation process are described in the **Table 8.1** below. Photographs of institutional stakeholders are provided in **Figure 8.1.** Photographs of FGDs are provided in **Figure 8.2.**

Table 8.1: List of FGDs Consultation and Concerns

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
1	06/05/20	Labor Colony	18 (Male)	• Odor issue during the summer season • Diseases, such as skin allergies, dengue, typhoid • Land acquisition issue • Site is already used for dumping	• People were briefed regarding waste Management issues. • Waste Management and transportation plan should be properly implemented. Timely compensation to be provided in case of resettlement, as applicable • Provided briefings on the landfill technology which will eliminate disease and odor related issues • Implementation of EMP i.e. spraying of fleas and mosquito killer reagents at site • Communities were briefed that land is already owned by the GoKP
2	06/05/20	Jamila House	6 (Female)	• The local women appreciated the initiative taken for managing the solid waste problem. • These people were only concerned that adequate and efficient transportation of solid waste to the targeted proposed landfill should be followed.	• Waste Management and transportation plan should be properly implemented. Timely compensation to be provided in case of resettlement, as applicable • Educating about the landfill technology to be implemented, which will eliminate disease and odor related issues • Preparation of buffer zone along the boundary limits of the landfill site

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
3	07/05/20	Katwaro Maira	07 (female)	• Odor issue during the summer season • The local demanded for new infrastructure to be provided to their village • Diseases, such as skin allergies, dengue, typhoid.	• Educating about the technologies that go into landfills which will eliminate disease and odor problem. • Preparation of green belt along the boundary limits of the landfill site.

Table 8.2: Consultations with Government Stakeholders

Sr. No.	Date	Department of Consultation	Name/Designation of Person	Comments/Concerns	Consultant Response
1	04-02-20	EPA Head Office Peshawar	Waheed Khan (DD-EIA)	The design and project implementation should be in compliance with the KPEPA 2014 and NEQS. Project proponent should obtain the approval before to start any activity at site.	After the detail design and all mandatory financial arrangement project proponent will make a liaison with EPA for necessary applicable approval.
2	07-08-20	EPA Site Office Swat	Acting Director	Site alternatives analysis should be done prior to drafting its EIA report. The design and project implementation should be in compliance with the KPEPA 2014 and NEQS. Project proponent should obtain the approval before to start any activity at site	Site alternative analysis is in process and will be provided in detail in the EIA report. After the detail design and all mandatory financial arrangement, project proponent will make a liaison with EPA for necessary applicable approval.
3	07-08-20	EPA Site Office Swat	Solid waste manager	Soil quality of the proposed Landfill site should be taken under consideration while	All physical structures and road network assessment is also part of the feasibility and will be

Sr. No.	Date	Department of Consultation	Name/Designation of Person	Comments/Concerns	Consultant Response
				designing sanitary landfill for Swat. Ground water shall not be contaminated at any level due to construction /operational activities. Solid waste shall be dumped in the landfill under the monitoring of WSSC Swat	considered during the detail design and construction/operational activities.
4	19-10-20	P& D Department	Director Sustainable Development Unit (SDU)	He expressed an interest in facilitating the necessary fulfillment of the environmental and social safeguard criteria.	All necessary protocols will be followed as per environmental and social safeguard criteria
5	19-10-20	KP Wildlife Department	District Forest Officer-Wildlife	There is need to conserve the natural environment as best possible. GIS database of project sites' surrounding areas may be prepared as it will help track the natural environmental and any changes to it caused by the projects.	Project design and implementation will be socially and environmentally sustainable. Compliance monitoring arrangements are provided in the EMP.
6	07-08-20	WSSC Swat	Solid waste manager	WSSC is already dumping at the proposed landfill site and sorting out of waste is processed on site. During design of proposed landfill, site geography should must be considered including seasonal drain and soil quality etc.	Site assessment is a mandatory part of EIA report and it will be done in an efficient manner
7	20-10-20	Irrigation Department	SE Headquarter	Solid waste being dumped in canals and streams which is a major concern for the department	Project design and implementation will be socially and environmentally sustainable.

Sr. No.	Date	Department of Consultation	Name/Designation of Person	Comments/Concerns	Consultant Response
				as far as sources of irrigation are concerned. Project will result in sustainable development of the city	
8	04-02-20	PkHA	Deputy Director Env. & Resettelment	The designer should also assess the carrying capacity of road network of the area before selection of the final site	All physical structures and road network assessment is also part of the feasibility and will be considered during the detail design.

Figure 8-1: Consultations with Institutional Stakeholders

Design team meeting with WSSC Swat officials

Consultation with DD-EIA, KP-EPA

PMU officials meeting with CEO WSSC Swat

Consultation with Irrigation Department

Meeting with Director-I PKHA (Pakhtunkhwa Highways Authority)

Meeting with Director SDU (Sustainable Development Unit) P&D Department

Meeting with Acting Director (EPA site office, Swat)

Meeting with Solid waste expert (WSSC Swat)

Meeting with DFO, Wildlife (KP Wildlife Department, Headoffice)

Meeting with Conservator, Forestry (KP Forestry Department, Headoffice)

8.2.2 Social Safeguard Focused Group Discussions

578. Consultation with the affectees was conducted within their settlements to encourage and facilitate their participation. 58% men and 42% women were interviewed. Separate sessions were arranged for the women. During the consultation process, a verbal detailed description of the Project activities was provided to those interviewed.

Figure 8-2: Focus Group Discussions (FGDs) for Mingora SWMF

Consultation with affected persons in Labor Colony

Consultation with affected persons in Katwaro Maira

Consultation with affected persons in Labor Colony

Consultation with affected persons in Katwaro Maira

8.2.3 Findings of the Public Consultations/Focal Group Discussions

579. All the directly affected people were the owners of proposed landfill property so majority of those had observation regarding land settlement process as they stated that the government is exercising land acquisition forcefully and pay less as per market rate. Those people demanded that they should be paid a handsome amount for their acquitted land.

580. All the indirectly affected people included the population living in the vicinity of the project area. Those people complained about the smell issues and spreading of different diseases in the project area due to open dumping of untreated solid waste in the proposed landfill site. Due to variation in direction and flow of wind in summers, the odour problem was observed to be increased and hence causing the spread of fever and skin diseases.

581. Efficient transportation for waste hauling should be ensured.

582. Local demanded for improvement of infrastructure for village Katwaro Maira.

8.2.4 Response from Social Safeguard Team

583. Our team made sure that the affected people were given full surety regarding their demands.

584. The people directly affected from the project were told on spot that they would be given payment of their acquitted land after completion of the entire process and that they would be called to DC office and the cheques would be issued in the name of each land owner of the proposed landfill site to make sure no one misses out on their right.

585. The people indirectly affected from the project were told about the new technological installation in the project area as installation of new engineered landfill would reduce the odour issue and hence reduction in spreading of different diseases.

586. The people were made sure that their demands reach to the higher authorities and that the basic life amenities be provided to them once work on project gets initiated.

8.2.5 Basic data of affected people

587. The basic data of the all directly affected people from the proposed landfill project are provided as **Annexure C** with 18 males and 13 females consulted.

588. As land has been already acquired by WSSC therefore no LARP study is carried out and limited data on affected people was available at the time of EIA preparation.

8.2.6 Consultations with Scavengers and Scrap Dealers

589. This section consists details of the waste scavengers, scrap collectors, dealers, and transporters operating in the city. During the environmental and socioeconomic studies of the project area, these groups were identified as important stakeholders which will be influenced in some form or another. To gather more information on the nature and extent of this influence, a data collection and analysis strategy was devised by the environmental experts, questionnaires drafted and site visits conducted. All these activities are described below.

590. The process of consultation was planned to begin with contacting the workers collecting waste door-to-door every morning, and progressing step by step through scrap collection and sorting facilities of various capacities, possibly including the transporters associated along the way, up till the larger scrap recycling or management facilities.

591. The initial few visits conducted by the environmental team, covering most of the aforementioned groups, yielded some useful data which projects a picture of the current operations within the informal waste management system structure. Details of their operations, income levels and their opinions, particularly concerns, are given in at the end of this section. The summary of the consultation data is provided in the **Table 8.3** below. Photographs of scavenger's consultations are provided in **Figure 8.3.**

592. Based on these consultations, some general conclusions can be derived regarding the prevailing scavenging and informal waste recycling system in operation, as well as its scope of potential involvement in the proposed ISWM system, which are summarized below:

- First of all there is a collective feeling among all stakeholders consulted that some form of government formalization, management or oversight is needed in order to better take care of the operation and all the operators involved, regardless of their position or significance in the system's chain.

- Improvements in physical equipment and facilities made available to the operators will serve to improve their working conditions and income levels.

- The reason that most scavengers and waste-pickers adopt this line of work is due to necessity born out of a lack of employment opportunities of any other kind.

- Those stakeholders in the waste management business doing well financially appear to have been involved in this line of work for a longer period, pointing to the benefits of persistence and experience in this business. In their position, they are no longer limited by work options and do this type of business more by choice and in anticipation of significant profits.

8.3 Consultation Plan for Construction and Operation Phase

593. Consultation plan for construction and operation phase of Mingora SWMF will be prepared in order to take response of project stakeholders and general public about the project. Periodic consultations and community feed back surveys will be carried out to develop positive perception about the project. Intended stakeholders for such consultations will be all stakeholders that are consulted at the time of EIA prepration and KPCIP PRF processing. Record of such consultations will be maintained at PMU/WSSC Swat offices and necessary changes in operational modalities will be introduced in the system in light of the response provided by the consultees.

Table 8.3: Consultations with Scavengers and Scrap Dealers

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
1	16/7/20	Makan Bagh, Mingora	1	**(Scrap dealer)** The scrap business does generate a relatively stable income, although low, as the owner and employees have gotten accustomed to the market. Their reason for adopting this line of work is a lack of other employment opportunities. They hope and expect facilitation in the form of better streamlined movement of waste within this informal system or any future proposed system of waste management, particularly regarding its transportation options.	The new system will carefully consider some level of formalization of the informal network, in order to facilitate improvement in working conditions and creating secure employment.
2	16/7/20	Makan Bagh, Mingora	1	**(Scrap dealer)** Their reason for adopting this line of work is a lack of other employment opportunities. They feel that more formal job opportunities in this sector can and should be provided, along with cleaner and safer working protocols.	Proper consideration will be given to develop measures that do not disrupt the existing profitable and efficiently running operations, as is the risk when government involvement usually takes place.
3	16/7/20	Parn Road, Mingora	1	**(Scrap dealer)** Highly informal income source, necessitated due to lack of education, employment options and government support or supervision of any kind. They urged the government to regulate the solid waste management system and facilitate these scavengers in their system and provide job opportunities for them.	The new system will carefully consider some level of formalization of the informal network, in order to facilitate improvement in working conditions and creating secure employment.
4	16/7/20	Parn Road, Mingora	6	**(Scavengers)** For them, this is a steady source of income generation. Their waste sorting and transporting activity is not as labor intensive since the waste they receive has already undergone some preliminary sorting.	The new system will carefully consider some level of formalization of the informal network, in order to facilitate improvement in working conditions and creating secure employment.

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
				The employee and owner consulted were generally satisfied with their working conditions.	
5	16/7/20	Haji Baba Road, Mingora	1	**(Transporter)** Their operations generate a decent income. They still feel that a lack of regulation and streamlined processes hinders them from operating optimally. Overall they stressed that this industry has great potential for profit which is still mostly untapped. They particularly emphasized the need for improvement in the waste transportation mechanism, which currently still ignores most of the waste on the dumping sites.	Proper consideration will be given to develop measures that do not disrupt the existing profitable and efficiently running operations, as is the risk when government involvement usually takes place.

Table 8.4: Responses from Scavengers based on Survey Questions

Name, Details	Responses
• Fazal Khan 26, small scavenger,	**Amount of waste collected/day:** Waste quantity varies from 10kg to 15kg everyday **Usefulness of that waste:** The waste is sorted out on spot and the recyclable material is sold to small warehouses. **Procedure for collection:** The waste is collected from different dumping grounds. Sorting is done on site and then the useful recyclable material is delivered to small warehouses. **Usual cost and time spent:** It takes the entire day in sorting out the waste. The usual cost depends on quantity of waste brought to the store. **Amount of income generated:** It varies from 300-500 rupees/day **Source of income:** This is their only source of income **End use of waste:** The waste is further sold to bigger waste collecting dealers. **Motivation/reason for this job:** This is the only opportunity they have to earn some bread for themselves and their families. **Working relationship with any government authority:** Private business **Expected improvements in the system:** Mode of transportation for waste picking should be improved
• Akbar Shah 31, small warehouse	**Amount of waste collected:** The amount of waste collected by them is around 15-20kg per day

Name, Details	Responses
	Usefulness of that waste: These small scale waste collectors sort out the waste further and then sell the useful materials to the relatively bigger scrap dealers **Procedure for collection:** The waste is brought into the small warehouse every day by different small scale scavengers. The waste is further sorted out for its usefulness and then sold to bigger waste collectors... **Usual cost and time spent:** Some waste pickers have got themselves different vehicles/carts for transportation of the waste, while others travel by foot to different waste dumps. **Amount of income generated:** The income opportunity for these people is relatively very low as compared to bigger scrap dealers. They earn around 300-500 rupees daily. **Source of income:** This is the only source of income for these people. **End use of waste:** The useful materials are sold to further scrap dealers up in the hierarchy cycle of scrap material dealers. **Motivation/reason for this job:** Lack of business and job opportunities. **Working relationship with any government authority:** These scrap dealers are working on their own. **Expected improvements in the system:** The government should focus on hiring these waste pickers and develop a network of entire waste scavenger's hierarchy.
• Irshad Khan 28, bigger warehouse owner	**Amount of waste collected:** The amount of waste collected daily by their store is around 70-80 kg. **Usefulness of that waste:**

Name, Details	Responses
	The waste is sorted out first by the waste pickers and then used according to its recycling potential. **Procedure for collection:** This owner has hired 2-3 suzuki drivers for transporting the waste from different small scavengers to their warehouse. The waste is sorted out in the warehouse and then sold to other buying warehouses in the locality. **Usual cost and time spent:** It doesn't take much time for the waste collectors to sort out the waste and then arrange it categorically. They sort out the waste accordingly. **Amount of income generated:** Rs 3000-3500 earned daily **Source of income:** Buy/Sell of scrap materials **End use of waste:** The sorted waste is then sold out to bigger scrap companies for their use. **Motivation/reason for this job:** This is one of biggest business opportunities which offers respectable money in return if done in a systematic manner. **Working relationship with any government authority:** This is a private run business. **Expected improvements in the system:** Incentives or subsidies from government departments or authorities to make this activity more attractive.
• Bilal 50, waste picker/transporter	**Amount of waste collected:** Amount of waste generated varies widely every day. But according to a rough estimate, they collect approximately 5-7kg waste every day **Usefulness of that waste:** The waste is sorted out at site and the recyclable material is further sold or transported to scrap dealers

Name, Details	Responses
	Procedure for collection: Usually the waste is picked by the waste picker from different dumping sites. They store it in their bags and take it to different scrap dealers. **Usual cost and time spent:** The time spent on the process depends on the waste brought to the store. But normally it takes 5-6 hours every day to sort out the waste and set them. There are 5 workers working independently with this worker. **Amount of income generated:** The income normally generate from selling the waste is Rs 150-250 rupees. **Source of income:** This is the only source of income of these people. **End use of waste:** The waste is sold to different scrap dealers. **Motivation/reason for this job:** Lack of job opportunities **Working relationship with any government authority:** This is a private run job. **Expected improvements in the system:** The waste collection process should be made systematic and regulated by the government. Priority should be given to waste delivery system as most of the waste is left untouched on the dump sites because of lack of transportation to the targeted scrap stores.
• Khurshid Ali 34, waste transporter	**Amount of waste collected:** The capacity of his vehicle is about 50-100 kgs every trip **Usefulness of that waste:** The waste is transported from different waste bins along roadsides, to different warehouses on Parn road **Procedure for collection:**

Name, Details	Responses
	Usually the waste is bought from along roadsides by the small vehicles and from bigger waste bins by tractors. **Usual cost and time spent:** The cost and time spent while dealing with the waste everyday depends on the number of trips taken to and from the dumping sites. **End use of waste:** The waste after its delivery to different recycling plants in the outskirts of Mingora gets converted into useful raw material or products **Motivation/reason for this job:** Steady income source with a decent profit margin. **Working relationship with any government authority:** Privately employed. **Expected improvements in the system:** Regulation, supervision and support of government.

Figure 8-3: Consultations with Scavengers/Waste Handlers

Consultation with small scale scavengers near Makan Bagh, Mingora

Consultation with small scale scavengers near Parn road, Mingora

Consultation with small scale scavengers near Alhajj Market, Mingora

Consultation with small scale scavengers near Parn road, Mingora

Consultations with small scale scavengers near Makan Bagh, Mingora

Consultations with small scale scavengers near Haji Baba road, Mingora

9 Grievance Redressal Mechanism

9.1 General

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

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

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

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

598. First tier of GRM. The PMU is the first tier of GRM which offers the fastest and most accessible mechanism for resolution of grievances. The PMU staff for environment and social safeguards will be designated as the key officers for grievance redressal. Resolution of complaints will be completed within seven (7) working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, traffic police, etc.). Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number will be assigned for each grievance, including the following elements:

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

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

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

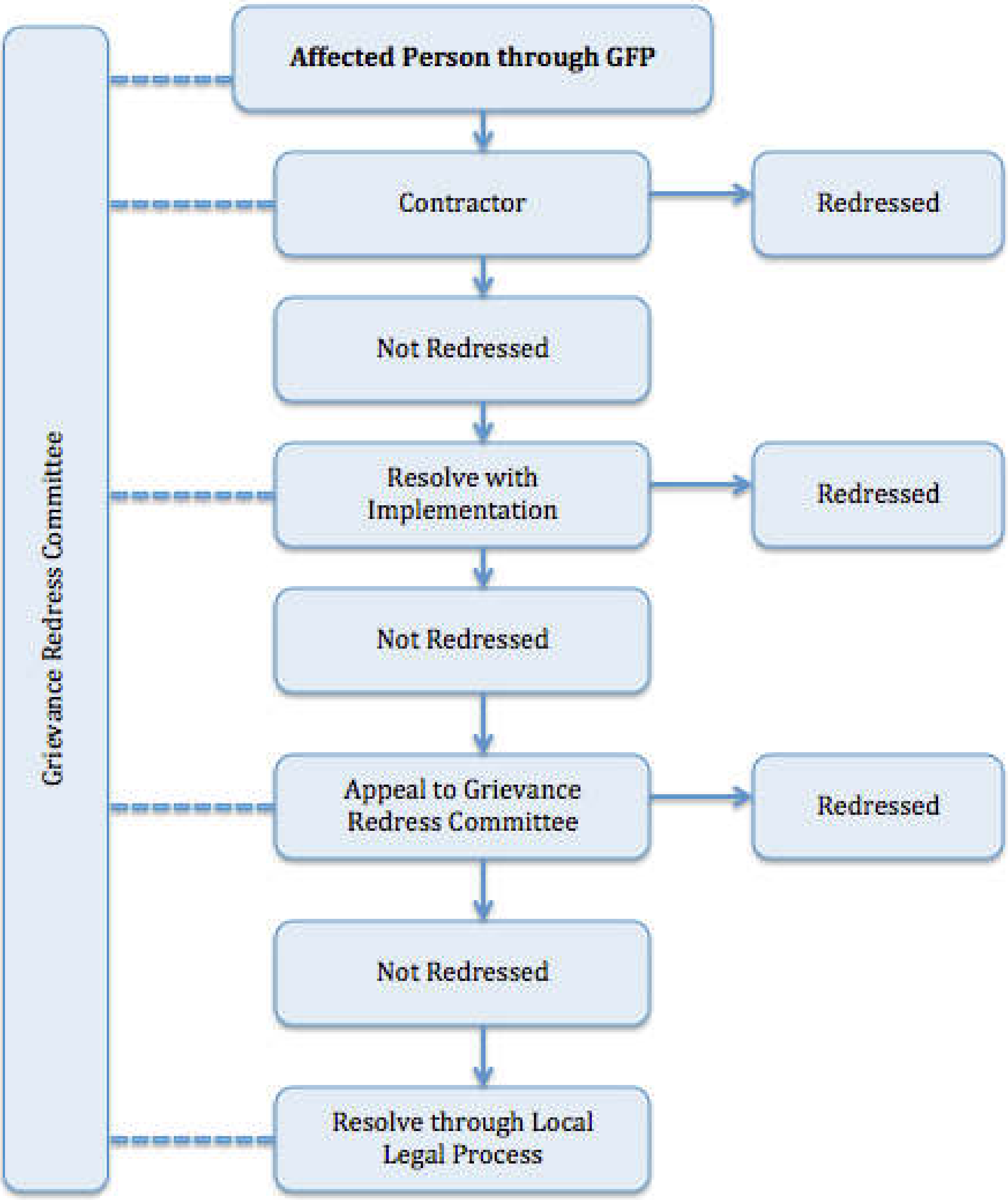
600. The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues and including dust, noise, utilities, power and water supply, waste disposal, traffic interference and public safety as well as social issues and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

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

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

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

Figure 9-1: Grievance Redressal Mechanism



10 Conclusion and Recommendations

604. The development of the proposed SWMF project in Mingora is of high significance considering the urgent need for improving the solid waste management system of Mingora city.

605. Primary and secondary data has been collected and used to assess the environmental impacts of the Project. This EIA report highlights all potential environmental impacts associated with the Project and recommends mitigation measures and monitoring mechanisms. Any environmental impacts associated with the project need to be properly mitigated, through the existing institutional arrangements defined in this report.

606. The majority of the environmental impacts are associated with the operation phase of the project since these will be long term, such as Generation of objectionable Odor and impact on air quality, Attraction of Vermin and disease vector generation, Leachate generation, Possible contamination of Soil and Groundwater, Generation of Landfill Gas etc., to name a few.

607. The implementation of mitigation measures during this period will be the responsibility of the Contractor. Therefore, the required environmental mitigation measures will have to be clearly defined in the bidding and contract documents, and appropriately qualified environmental staff retained by the Consultant to supervise the implementation process. The EMP includes measures to minimize project impacts due to noise and air pollution, waste generation etc.

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

609. This project has been assigned environmental category ‘A’ in accordance with the ADB’s Safeguard Policy Statement (SPS) 2009 and Schedule II as per EPA, IEE and EIA Gazette Notification, 2000. Thus, a comprehensive EIA report has been prepared for the proposed project.

11 References

Kharat, M.G., Kamble, S.J., Raut, R.D. Identification and evaluation of landfill site selection criteria using a hybrid Fuzzy Delphi, Fuzzy AHP and DEMATEL based approach. *Model. Earth Syst. Environ.* **2,** 98 (2016). https://doi.org/10.1007/s40808-016-0171-1

Dutta, R.K, Gayathri V. Landfill planning and design considerations. *Ground Improvement and Ground Control including Waste Containment with Geosynthetics* (2012). https://www.researchgate.net/publication/304148141_Landfill_planning_and_design_considerations

Kumar S, Chiemchaisri C, Muddoo A. Bioreactor landfill technology in municipal solid waste treatment: An overview. *Critical Reviews in Biotechnology 31(1):77-97.* (2011). DOI: 10.3109/07388551.2010.492206

Sher Alam Shinwari. Future of thousands of street children at stake. *DAWN*. April 2015. www.dawn.com/news/1178251

Intikhab Alam, Ayesha Jabeen, Niaz Muhammad, Sara Safdar, Mussawar Shah, Asad Ullah annd Madeha Asghar. Scavenging: The Children Role In Surging The Economic Profile Of Families In Pehawar, Pakistan. *Sarhad Journal of Agriculture*. Vol.27, No.1 Pg153-159. 2011

Sher Alam Shinwari. Street children exposed to serious threats. *DAWN*. April 2017. www.dawn.com/news/1330141

Ahmed, M. and Suphachalasai, S. (2014). Assessing the Cost of Climate Change and Adaptation in South Asia. Manila: ADB

Anjum, B. F. et al. (2005). Climate Change Perspective in Pakistan. Pakistan Journal of Meteorology. 2(2). pp. 11–21

Asian Development Bank (2017b). Climate Change Operational Framework 2017-2030: Enhancing Actions for Low Greenhouse Gas Emissions and Climate-Resilient Development, Retrieved from: https://www.adb.org/sites/default/files/institutional-document/358881/ccof-2017-2030.pdf

Asian Development Bank (2017c). Climate Change Profile of Pakistan. ISBN 978-92-9257-721-6 (Print), 978-92-9257-722-3 (e-ISBN). Publication Stock No. TCS178761. DOI: http://dx.doi.org/10.22617/TCS178761. Retrieved from: https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf

Asian Development Bank (2014). Midterm Review of Strategy 2020: Meeting the Challenges of a Transforming Asia and Pacific

Chaudhry, Q. Z. et al. (2009). Climate Change Indicators of Pakistan. Technical Report. No. 22. Islamabad: Pakistan Meteorological Department.

IPCC (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Rehman, N., Adnan, M. and Ali, S. (2018) 'Assessment of CMIP5 climate models over South Asia and climate change projections over Pakistan under representative concentration pathways', Int. J. Global Warming, Vol. 16, No. 4, pp.381–415.