EIA GUIDELINES

WASTE TREATMENT AND DISPOSAL - SOLID WASTE

Department of Environment
Ministry of Environment and Water, Malaysia

Department of Environment, Malaysia

ISBN 978-983-9795-44-8

Published by:
DEPARTMENT OF ENVIRONMENT
Level 1-4, Podium 2&3
Wisma Sumber Asli
No. 25, Persiaran Perdana, Presint 4
62574 Putrajaya.

Printed by:
OMNITECH PRINT SYSTEMS SDN BHD
102, Jalan SS15/4
47500 Subang Jaya
Selangor Darul Ehsan.
Tel: 03-5880 6633
Email: my.omnitech@gmail.com

ACKNOWLEDGEMENT

The EIA Guidelines for Waste Treatment and Disposal (Solid Waste) has been developed and established under the Eleventh Malaysia Plan (2016-2020) to strengthen and empower the implementation of Environmental Impact Assessment (EIA) procedure in Malaysia in accordance with the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 of the Environmental Quality Act 1974 (Act 127).

DOE had appointed ERE Consulting Group Sdn. Bhd. to prepare this guideline. Special acknowledgement and appreciation for their effort in developing this guideline as well as the DOE Steering Committee for providing guidance and support throughout its development.

This guideline has been developed with involvement and support from various government agencies, industrial players, non-governmental organisations (NGOs) as well as individual experts in solid waste management. Their various contributions, both through representations in the Technical Committee and through information discussions, are much appreciated and graciously acknowledged.

DOE wish to acknowledge the contributions of National Solid Waste Management Department, Ministry of Health Malaysia, PLANMalaysia, Department of Irrigation and Drainage, Public Works Department Malaysia, Department of Mineral and Geoscience Malaysia and other related agencies.

DOE would also like to appreciate the contributions of industries such as Solid Waste and Public Cleansing Management Corporation (SWCorp), BERJAYA Enviroparks Sdn. Bhd., and SWM Environment Sdn. Bhd. for sharing their expertise.

Finally, DOE wish to acknowledge the contributions from all those individuals who have shared their knowledge and experience for the development of this guideline.

PREFACE

In pursuing green growth for sustainability and resilience, holistic waste management was identified as a strategy in the Eleventh Malaysia Plan (2016-2020) by applying 3R approach. 3R approach aims to increase recycling and recovery rates to improve landfill management by reducing the amount of waste disposed and pollution generated. The 3R approach enables the management and use of raw materials more effectively, therefore the consumption of natural resources is minimized.

While the development of solid waste treatment and disposal projects is critical in resolving waste disposal issues, these activities are also associated with environmental and social risks. It is important to maintain environmental sustainability in line with the rapidity of national development. As Malaysia transitions into a developed nation, population growth, economic development, and changes in consumer consumption patterns have resulted in a higher complexity of waste and increasing waste generation per capita. As the government pursues sustainable solutions, new waste management systems and technologies will be adopted.

Solid waste treatment and disposal projects are a prescribed activity under Activity 14(b) Solid Waste of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 where Project Proponents are required to conduct an environmental impact assessment (EIA). The EIA is an important assessment tool to ensure that the development of solid waste treatment and disposal projects are aligned with the requirements of the Department of Environment (DOE) Malaysia, and meets the requirements of other relevant technical agencies and stakeholders.

This guideline aims to provide Project Proponents and Qualified Persons with relevant information for the preparation of a comprehensive EIA report that meets the goals described above. It takes into cognisance the most recent policy framework, legal requirements, and guidelines from all related technical agencies. The guideline outlines data requirements, assessment tools and standards, and describes potential mitigation measures that may be implemented to reduce environmental and social risks. In complying with this guideline, it is anticipated the development of solid waste treatment and disposal projects shall result in positive economic and social benefits while ensuring the sustainability of the environment.

NORLIN BINTI JAAFAR
Director General
Department of Environment

INTRODUCTION

SCOPE OF THE EIA GUIDELINES

1 FIRST SCHEDULE

Activity 14(b)(i)
Construction of composting plant

Activity 14(b)(ii)
Construction of recovery plant or recycling plant

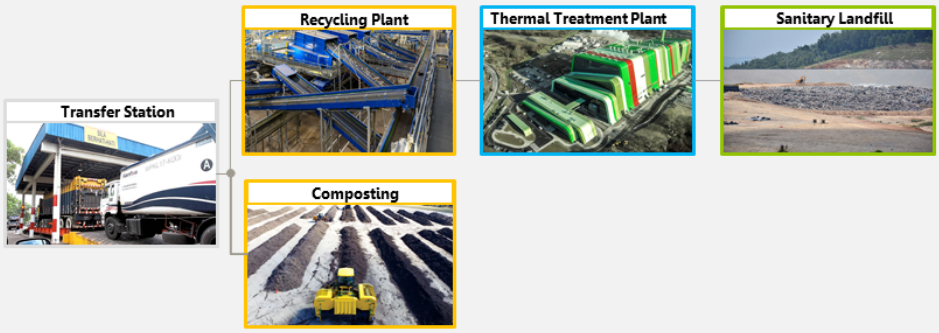
2 SECOND SCHEDULE

Activity 14(b)(i)
Construction of thermal treatment plant

Activity 14(b)(ii)
Construction of sanitary landfill facility

Activity 14(b)(iii)
Construction of transfer station

RELATIONSHIP WITHIN SUB ACTIVITIES 14(b) – SOLID WASTE



EIA REPORT REQUIREMENT

EIA Requirement for Solid Waste Treatment and Disposal Projects

- Department Of Environment (DOE) Malaysia
  - Peninsular Malaysia
  - Sabah
- Natural Resources and Environment Board (NREB)
  - Sarawak

SUMMARY

TERMS & DEFINITIONS

Solid Waste

Defined in Solid Waste and Public Cleansing Management Act 2007 (Act 672) as:

- Any scrap material or unwanted surplus substance or rejected products arising from the application of any process
- Any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled
- Any other material that according to this Act or any other written law is required by the authority to be disposed of but excluding scheduled wastes, sewage or radioactive wastes

Controlled Solid Waste

Any solid waste falling within any of the following categories:

- Commercial solid waste
- Construction solid waste
- Household solid waste
- Industrial solid waste
- Institutional solid waste
- Imported solid waste
- Public solid waste
- Solid waste which may be prescribed from time to time

OVERVIEW OF EIA PROCESS

STEP 1
Provide Project Brief or Basic Information

STEP 2
Identify the Legal Requirements

STEP 3
Check Existing Policies and Guidelines

STEP 4
Conduct Preliminary Stakeholder Engagement

STEP 5
Prepare TOR and ESI Report

STEP 6
Submit TOR and ESI Report

STEP 7
Collect Baseline Data for EIA Report

STEP 8
Prepare EIA Report

STEP 9
Conduct Stakeholder Engagement

STEP 10
Completion of EIA Report

STEP 11
Submit EIA and Public Display

ENVIRONMENTAL PROJECT PLANNING SUMMARY

GOVERNANCE STRUCTURE

Act 672 States

KPKT → JPSPN → SWCorp MALAYSIA

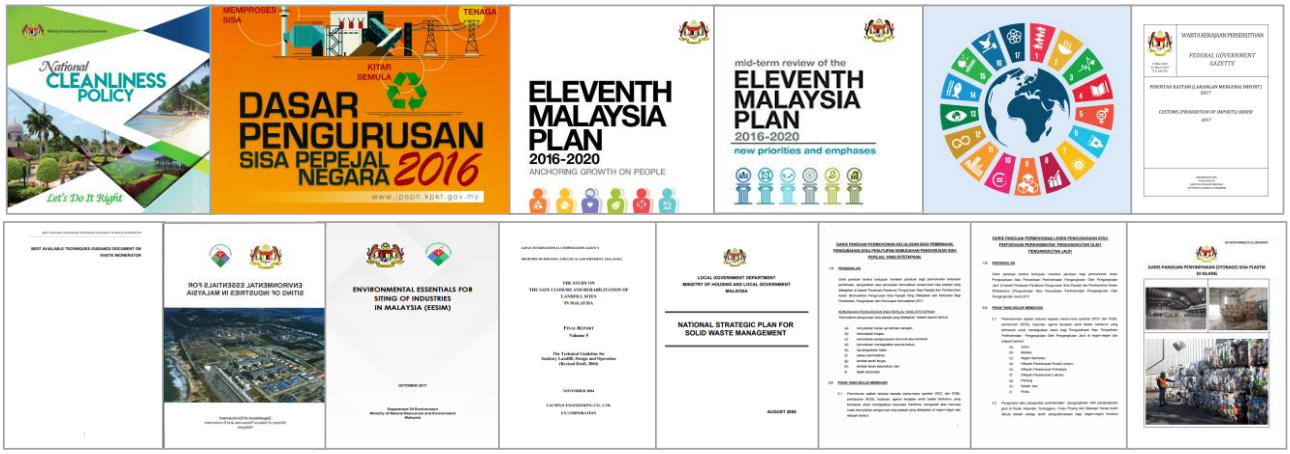
Non Act 672 States

KPKT → KKT → State Government → City / Municipal / District Council

RELEVANT LEGISLATIONS

- Environmental Quality Act 1974
- Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009
- Solid Waste and Public Cleansing Management Act 2007 (Act 672)
- Solid Waste and Public Cleansing Management Corporation Act 2007 (Act 673)
- Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for the Construction, Alteration, and Closure of Facilities) Regulations 2011
- Environmental Quality (Clean Air) Regulations 2014
- Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015
- Solid Waste and Public Cleansing Management (Scheme for Construction Solid Waste) Regulations 2018
- Town and Country Planning Act 1976 (Act 172)
- Local Government Act 1976 (Act 171)

POLICIES AND GUIDELINES



RELEVANT REQUIREMENTS AT VARIOUS PROJECT IMPLEMENTATION STAGE

1 Pre-Planning	2 Planning & Design	3 Pre-Construction	4 Construction	5 Pre-Operation	6 Operation	7 Pre-Abandonment / Closure	8 Abandonment / Closure
• Feasibility • Site & Technology Selection • Land Status • SI Report • Approval for construction and alteration of solid waste management facilities	• EIA, SIA, TIA Studies • ESCP • Geotech Report • Development Order Submission	• Written Permission • EMP Construction • Written Notification	• Environmental Monitoring, Reporting and Audit • Competent Person	• EMP Operation • Stormwater Management Plan • License for Prescribed Solid Waste Management Facilities	• Written Declaration • Environmental Monitoring • Environmental Reporting • Environmental Audit	• Abandonment Plan • Closure Plan • Approval for closure of solid waste management facilities	• Environmental Monitoring • Environmental Reporting

STAKEHOLDER ENGAGEMENT

RELEVANT STAKEHOLDERS

- DOE
- Project Proponent
- Government Agencies
- Approving Authorities
- Affected Groups
- Interested Groups

ENGAGEMENT METHODS

- Interview
- Questionnaire
- Townhall Meeting
- Forums or Workshops
- Focus Group Discussion

DOCUMENTATION & REPORTING

- Details of the programme
- Attendance list of participants
- Copies of survey forms
- Brief summary of findings from event
- Video or voice recordings

TERMS OF REFERENCE SUMMARY

ENVIRONMENTAL SCOPING

- Gather and analyse information
- Identify significant environmental issues
- Prioritise significant issues for EIA
- Determine approach, methodology and tools for assessment
- Identify potential P2M2s
- Submit TOR and ESI for DOE assessment and endorsement

SITE SUITABILITY ASSESSMENT

Considerations in project alternatives and options:

- Project siting
- Process technology options
- P2M2s technology options
- Project component and design
- Social aspect

STUDY BOUNDARY

- **Zone of study (ZOS):** generally 5-km radial zone from project boundary
- **Zone of impact (ZOI):** vary depending on the size of project, extent shall be determined by the Qualified Person

BASELINE DATA REVIEW

- **Physical:** land use, topography and terrain, geology and hydrogeology
- **Environmental:** surface water quality, groundwater quality, marine water quality
- **Biological:** terrestrial and aquatic flora, terrestrial and aquatic fauna
- **Socio-economic:** demography, public health, development needs and potential
- **Infrastructure and utilities:** Physical communications, points of access and transportation routes

DETERMINATION OF KEY PROJECT ACTIVITIES

Based on four main common activities:

- Pre-construction phase
- Construction phase
- Operation phase
- Abandonment phase

IDENTIFICATION OF SIGNIFICANT IMPACTS AND PRIORITY SETTING

- Key issues are determined based on their importance
- Criteria for determining significance of environmental impacts: magnitude, permanence, reversibility, cumulative effects

RELATED KEY ISSUES

- Air quality & odour
- Noise & vibration
- Soil erosion & sedimentation
- Water quality
- Groundwater quality
- Quantitative risk
- Health impact
- Waste management
- Socio-economic
- Traffic
- Visual and aesthetic

ESTABLISHMENT OF STUDY REQUIREMENT

- Address identified impacts of the project activities
- Type of study is dependent on the scale and extent of Project Site
- Qualified Person shall provide methodologies, assessment, and expected outputs

SELECTION OF MITIGATION MEASURES

- To be identified based on **Best Available Techniques Economically Achievable (BATs), Best Management Practices (BMPs)** and other options for **P2M2s**
- To be described qualitatively and further detailed in EIA study

STUDY TEAM

- **EIA Study**: Appointment of **Qualified Person** as stipulated in Section 34A(2) of the Environmental Quality Act 1974
- **Pollution Control System Design:** Qualified Consultant must be **Professional Engineer** registered under Section 10(2) of the Registration of Engineers Act 1967 (Revised 2015)
- **Preparation of LD-P2M2:** Recognised consultant with certification from DOE on **Certified Professional in Erosion and Sediment Control (CPESC)**

PREPARATION OF TOR/ESI

To follow format detailed under the Guidance Document for Preparing TOR according to EGIM

BASELINE DATA SUMMARY

BASELINE DATA COLLECTION

Purpose

To provide an overview of the existing environment to determine the suitable approach and methodology for the impact assessment

Primary Source

Field studies i.e. site survey, aerial photos, SI report, sampling and monitoring activities etc.

Secondary Source

Desktop studies i.e. topography map, satellite imagery, local authority, peer comments and other references

BASELINE MONITORING AND ANALYSIS

Samples collected must be analysed by a SAMM accredited laboratory
Laboratory report or COA shall be included in the EIA as appendix

Air Quality

Parameters and criteria as referred in Malaysia Ambient Air Quality Standards (MAAQS) 2013

Odour

Parameters may include perceived odour (DT) and odour concentration (OU/m^3)

Noise

Parameters and criteria as referred in the Guidelines for Environmental Noise Limits and Control, Third Edition 2019

Vibration

Parameters and criteria as referred in the Planning Guidelines for Vibration Limits and Control in the Environment Second Edition 2007

Surface Water Quality

Parameters and criteria as referred in the National Water Quality Standards (NWQS)

Marine Water Quality

Parameters and criteria as referred in the Malaysian Marine Water Quality Standards (MMWQS)

Groundwater Quality

Parameters and criteria as referred in Malaysia Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water)

Note:
Parameters for baseline monitoring shall be dependent on the project needs as described in the TOR and ESI

GOOD PRACTICES FOR SAMPLING

Water Quality

- ✓ Sites must be easily and safely accessed under all weather conditions
- ✓ Sampling depth is measured from the water surface to the middle of the sampler
- ✓ A bottle that is to be used for transport or storage of the sample should be rinsed three times with portions of the sample before being filled. This does not apply, however, if the storage/transport bottle already contains a preservative chemical
- ✓ A small air space should be left in the sample bottle to allow the sample to be mixed before analysis

Air Quality

- ✓ Identify location of potential on-site emission sources, as identified from the review of site background information or from preliminary on-site inspections
- ✓ Sampling station location should be representative of the area selected
- ✓ Identify potential off-site emission sources located upwind of the sampling location(s). Study local wind patterns to determine the location of off-site sources.
- ✓ As a general rule, the distance away from the obstruction should be 10 times the height of the obstruction

Noise & Vibration

- ✓ The sound level meter may be hand held for spot readings, but for extended monitoring shall be mounted onto a tripod A noise reading should always be taken at least 1.2–1.5 metre above the ground)
- ✓ Measurement location shall be at least 3.5 m away from walls, buildings or other sound reflecting structures
- ✓ Measurements cannot normally be made if the wind speed exceeds 5 m/s at the microphone position.
- ✓ Relevant standards for noise measurement include ISO 1996-1:2016, BS 5228-1:2009

Groundwater Quality

- ✓ Always sample from the anticipated cleanest, i.e., least contaminated location, to the most contaminated location
- ✓ Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately
- ✓ Purged water should be monitored for pH, specific conductance and turbidity and volume recorded
- ✓ All samples requiring preservation must be preserved as soon as practically possible, ideally immediately at the time of sample collection

EVALUATION OF IMPACTS SUMMARY

SOIL EROSION & SEDIMENTATION

Typical Input
- Rainfall erosivity factor
- Soil erodibility factor
- Slope length and degree factor
- Land-cover management factor
- Conservation practice factor
- Runoff volume
- Peak discharge

Impact Assessment
- RUSLE, MUSLE
- Manual calculation or aid of software

Output
- Annual soil erosion rate
- Sediment yield
- Potential soil erosion risk map
- Impact significance evaluation

WATER QUALITY

Typical Input
- Flowrate of water bodies and flowrate of pollutant
- Pollutant Water Quality Data
- River water quality
- Marine water quality

Impact Assessment
- Mathematical models
- Simple mass balance models

Evaluation Criteria
- Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009
- Environmental Quality (Industrial Effluent) Regulations 2009
- NWQS/MMWQS

Output
- Graph of concentration of pollutants over spatial for normal scenario and worst case scenario

GROUNDWATER QUALITY

Typical Input
- Topography
- Pollutant Water Quality Data
- Groundwater Level
- Rainfall data
- Hydraulic conductivity
- Geology
- Pumping rate
- Well yield

Impact Assessment
- Mathematical models

Output
- Graph of concentration of pollutants over spatial for normal scenario and worst scenario

Evaluation Criteria
- Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water)

AIR QUALITY & ODOUR

Typical Input
- Source data
- Meteorological data
- Terrain data
- Building data
- Sensitive receptors

Impact Assessment
- Air Dispersion Modelling Software

Output
- MAIC
- GLC
- Dispersion contours
- Impact significance evaluation

Evaluation Criteria
- Environmental Quality (Clean Air) Regulations 2014
- MAAQS 2013
- AAQC 2003
- IAQM 2018

NOISE

Typical Input
- Sound power level, sound pressure level
- Source classification and mobile sources
- Existing background noise and existing noise sources
- Type of noise
- Propagation factors
- Directionality
- Ground effect
- Location and height of source
- Total attenuation from factors

Impact Assessment
- Calculation of increased noise level for worse case scenario

Output
- Absolute numerical noise limit
- Change in noise levels relative to an existing baseline level

Evaluation Criteria
- Guidelines for Environmental Noise Limits and Control 3rd Edition 2019

WASTE

Typical Input
- Incoming waste information
- Source of waste
- Waste generation rate
- Number of workers

Impact Assessment
- Estimation of total amount of waste

Output
- Weight of estimated waste generated
- Volume of estimated waste
- Impact significance evaluation

QUANTITATIVE RISK

Typical Input
- Hazardous substance data
- Equipment specifications
- Possible accident scenario
- Failure frequency data
- Meteorological data

Impact Assessment
- Consequence modelling software for normal case and worst-case

Output
- Individual risk
- Societal risk
- Individual risk contours
- F-N Curve
- Impact significance evaluation

Evaluation Criteria (Individual Risk)
- Industry: 1 x 10^{-5} fatalities/person/year
- Public: 1 x 10^{-6} fatalities/person/year

HEALTH

Typical Input
- Community health data
- Local health statistics
- Air quality assessment result
- Water quality assessment result
- Groundwater quality assessment result

Impact Assessment
- HRA using qualitative and quantitative risk assessments

Output
- Health risk calculation at certain level of exposure
- Impact significance evaluation

Evaluation Criteria (Public Health)
- Non-carcinogenic: Hazard quotient (HQ) < 1
- Carcinogenic risk: Generally acceptable risk (10^{-4} to 10^{-6})

SOCIO-ECONOMIC

Typical Input
- Details of demographics
- Local economic profile
- Feedback from stakeholders engagement

Impact Assessment
- Social impact matrix

Output
- Risk matrix with socio economic concerns and the magnitude of impact

Evaluation Criteria
- Manual for SIA for Project Development 2nd Edition 2018

VIBRATION

Typical Input
- Reference PPV from reliable publication
- Distance from equipment / activities to receiver
- Attenuation rate of the ground

Impact Assessment
- Equation for prediction of vibration level

Output
- Prediction of PPV
- Damage risk in structural damage
- Level of human annoyance

Evaluation Criteria
- The Planning Guidelines for Vibration Limits and Control in the Environment 2nd Edition 2007

MITIGATION MEASURES SUMMARY

PURPOSE

- Avoid negative impacts by selecting alternatives to implement preventive measures
- Adopt relevant mitigation measures and BMPs to minimize impacts when an impact cannot be avoided
- Enhance and amplify the beneficial impacts
- Ensure residual impacts are kept within acceptable levels

PRINCIPLES OF ADOPTION OF P2M2

Need and extent of P2M2s shall correspond to the significance of the predicted impact

Priority shall be given to control at source rather than to rectifying impacts

Proposed P2M2 should be **project-specific** and designed for site conditions

Adequate explanation on the design and function of P2M2s should be include in EIA

Project Proponent is encouraged to use **new technology** provided it is proven effective

P2M2s require regular **inspection, maintenance and rehabilitation**

Effectiveness of P2M2s shall be documented through **monitoring programme**

Qualified Person should propose **BMPs** based on the findings of the EIA

APPROACHES TOWARDS P2M2 ADOPTION

Key P2M2s that are applicable include:

- Air Pollution Control
- Water Pollution Control
- Noise and Vibration Control
- Erosion and Sediment Control
- Scheduled Waste Management

Other mitigation measures:

- Safety and Health
- Traffic

LAND-DISTURBING POLLUTION PREVENTION AND MITIGATION MEASURES (LD-P2M2)

Project Activity and Implementation

- Phasing plan
- Project implementation schedule
- Description of construction activities
- Construction schedule
- Construction method statements

Information and Analysis on Project Development

- Selected weather and rainfall data
- Site runoff velocity and flow rates
- Description of site soil and geological characteristics
- Description of adjacent affected areas by land disturbance
- List of waterways
- List of P2M2s proposed
- Access roads and project components outside boundary
- Earthworks cut and fill volume
- Availability of rocks materials
- Biomass ,solid and hazardous waste management
- Spill prevention and control plan
- Soil loss prediction
- Calculation for sediment traps/basins and runoff flows

Map of Site Plan with Existing Conditions

- Topographic survey map
- Geological terrain map
- Erosion risk map
- Landuse map
- Site development plan map

ENVIRONMENTAL MANAGEMENT PLAN SUMMARY

EMP FRAMEWORK

- Monitoring of water quality of receiving water body by Accredited Lab
- Monitoring of TSS and Turbidity at inlets and outlets of sediment structures
- Monitoring of leachate discharge
- In-situ monitoring of TSS and Turbidity after rain event
- Monitoring of air, noise and vibration qualities depending on receptor sensitivity
- Planning, construction and maintenance of LD-P2M2 on site
- P2M2 notification and implementation
- Identification of need of competent persons to undertake specific task on site
- Description and implementation details of EMT
- Any other green initiatives undertaken
- Clear documentation on any transfer of ownership or proponent of approved EIA
- Allocation and reporting of sufficient resources to undertake project activities
- Temporary / permanent abandonment / project closure plan details for all phases
- Implementation of 5S concept in good housekeeping practices

AUDIT PROGRAMME

Pre-Audit

- ✓ Preparation of pre-audit checklist and information request to the auditee
- ✓ Submission of notification of audit to DOE and auditee

On-Site Audit

- ✓ Briefing to auditee by Lead Auditor
- ✓ Include documentation review, site inspection, interviews with relevant personnel
- ✓ Auditee briefed at Closing Meeting
- ✓ On-site Audit Summary submitted to state DOE

Post Audit

- ✓ Lead Auditor shall submit an Audit Report to DOE within 14 calendar days after site audit
- ✓ Auditee shall develop a Corrective Action Plan for any non-compliances which shall be submitted to DOE within 21 calendar days after site audit

SELF-REGULATION

7 ENVIRONMENTAL MAINSTREAMING TOOLS

- Environmental Policy
- Environmental Facility
- Environmental Budget
- Environmental Monitoring Committee
- Environmental Competency
- Environmental Reporting and Communication
- Environmental Transparency

ABANDONMENT PLAN

- ✓ Project abandonment can occur during the construction stage or operation stage of the Project due to unforeseen circumstances.
- ✓ The Project Proponent must submit a project abandonment plan to the DOE prior to the abandonment of the Project
- ✓ In essence, the project abandonment plan shall address the environmental issues arise from the decommissioning including demolition and dismantling activities

EMERGENCY RESPONSE PLAN

- ✓ Clear, written policies that designate a chain of command, listing names and job titles of the people (or departments) who are responsible for making decisions, monitoring response actions and recovering back to normal operations; Indicate arrangements that should be put in place with the local emergency authorities before facility start up

REPORTING AND REVIEW SUMMARY

EIA REPORT

Data Deliverables

- All relevant data collected during the EIA Study shall be make available
- Sampling results, modelling databases, baseline data, metadata

Conclusion to the EIA Report

- When concluding the EIA Report, the Qualified Person should provide fair and unbiased conclusion of the EIA study based on the expert opinion of the impact assessment for the purpose of informed decision-making.

EIA REPORT SUBMISSION AND REVIEW PROCESS

Components	First Schedule Activities	Second Schedule Activities
Submission of Report	• DOE State	• DOE HQ
TOR/ESI Report Submission	• Three (3) hardcopies and one (1) softcopy in PDF format via email • Distribution of softcopy (CD) to agencies/AI/NGO for comments	• Three (3) hardcopies and one (1) softcopy in PDF format via email • Distribution of softcopy (CD) to agencies/AI/NGO for comments
EIA Report Submission	• Three (3) hardcopies and one (1) softcopy (CD) to DOE State • One (1) softcopy (CD) to DOE HQ • Distribution of softcopy (CD) to agencies/AI/NGO for comments	• Three (3) hardcopies and one (1) softcopy (CD) to DOE HQ • One (1) hardcopy to DOE State • Distribution of softcopy (CD) to agencies/AI/NGO for comments
Review Timeline	• Twenty-five (25) working days (5 weeks)	• Sixty (60) working days (12 weeks)
Public Participation in EIA Study	• Required	• Required
Public Display of EIA Report	• Not required	• Required
Advertisement of EIA Report	• Not required	• Online advertisement in two (2) major newspapers for three (3) consecutive days

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF ABBREVIATIONS

3R	Reduce, reuse, recycle
ALARP	As Low as Reasonably Practicable
APCS	Air Pollution Control System
ASR	Air Sensitive Receptors
BACT	Best Available Control Technology
BAT	Best Available Technology
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
C&D	Construction and Demolition
CePBFO	Certified Environmental Professional in Bag Filters Operation
CePLTPO	Certified Environmental Professionals in The Leachate Treatment Plant Operation
CePSO	Certified Environmental Professional in Scrubber Operation
CePSTPO	Certified Environmental Professional in Sewage Treatment Plant Operation

CePSWaM	Certified Environmental Professional in Scheduled Waste Management
CESSWI	Certified Erosion, Sediment and Storm Water Inspector
CISEC	Certified Inspection of Sediment and Erosion Control
CM	Compliance Monitoring
COA	Certificate of Analysis
COA	Conditions of Approval (EIA)
COD	Chemical Oxygen Demand
CPESC	Certified Professional in Erosion and Sediment Control
DID	Department of Drainage and Irrigation (JPS)
DO	Dissolved Oxygen
DOE	Department of Environment
DOSH	Department of Safety and Health
DOSM	Department of Statistics Malaysia
EB	Environmental Budgeting
EC	Environmental Competency
EESIM	Environmental Essentials for Siting Of Industries In Malaysia
EF	Environmental Facility
EGIM	Environmental Impact Assessment Guideline (2016)
EIA	Environmental Impact Assessment
EMC	Environmental Monitoring Committee
EMP	Environmental Management Plan
EMR	Environmental Monitoring reports
EMT	Environmental Mainstreaming Tools
EMTs	Environmental Management Teams
EP	Environmental Policy
EPMC	Environmental Performance Monitoring Committee
EQA	Environmental Quality Act
ERC	Environmental Reporting and Communication
ERCMC	Environmental Regulatory Compliance Monitoring Committee
ESCP	Erosion and Sedimentation Control Plan
ESI	Environmental Scoping Information
ET	Environmental Transparency
GAs	Government Agencies
GLC	Ground Level Concentration
GPS	Global Positioning Systems
HIA	Health Impact Assessment
HQ	Hazard Quotient
HQ	Headquarter
HRA	Health Risk Assessment
IM	Impact Monitoring
IWK	Indah Water Konsortium

JAKOA	Jabatan Kemajuan Orang Asli (Department of Orang Asli Development)
JKR	Public Works Department (JKR)
JKT	Jabatan Kerajaan Tempatan
JMG	Department of Mineral and Geoscience (JMG)
JPBD	Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia (Federal Department of Town and Country Planning (PLANMalaysia))
JPSPN	Jabatan Pengurusan Sisa Pepejal Negara (National Solid Waste Management Department)
JUPEM	Jabatan Ukur dan Pemetaan Malaysia
KM	Kebenaran Merancang
KPKT	Kementerian Perumahan dan Kerajaan Tempatan (Ministry of Housing and Local Government)
LCR	Lifetime Cancer Risk
LUAS	Lembaga Urus Air Selangor
MAIC	Maximum Average Incremental Values
MiTI	Ministry of International Trade and Industry
MoH	Ministry of Health
MPFN	Majlis Perancangan Fizikal Negara
MUSLE	Modified Universal Soil Loss Equation
NGO	Non-Governmental Organisations
NH3-N	Ammoniacal Nitrogen
NTU	Nephelometric Turbidity Units
P2M2	Pollution Prevention and Mitigation Measures
P2M2s	Pollution Prevention and Mitigation Measures
PERHILITAN	Jabatan Perlindungan Hidupan Liar dan Taman Negara
PM	Performance Monitoring
PTG	Pejabat Tanah dan Galian
PWD	Public Works Department (JKR)
QRA	Quantitative Risk Assessment
RUSLE	Revised Universal Soil Loss Equation
SAMM	Skim Akreditasi Makmal Malaysia
SDG	Sustainable Development Goals
SI	Soil Investigation
SIA	Social Impact Assessment
SIRIM	Standard and Industrial Research Institute of Malaysia
SLM	Sound Level Meter
SPA	State Planning Authority
SR	Self-Regulation
SSA	Site Suitability Assessment
STP	Sewage Treatment Plant

SWPCM	Solid Waste and Public Cleansing Management
TELOS	Technical, Economic, Legal, Operational and Scheduling
TIA	Traffic Impact Assessment
TNB	Tenaga Nasional Berhad
TOR	Terms of Reference
TSS	Total Suspended Solids
UN	United Nations
WAC	Waste Acceptance Criteria (WAC)
WGR	Waste Generation Rates
WRF	Weather Research and Forecasting
ZOI	Zone of Impact
ZOS	Zone of Study

LIST OF FIGURES

LIST OF TABLES

EIA GUIDELINES

Waste Treatment and Disposal - Solid Waste

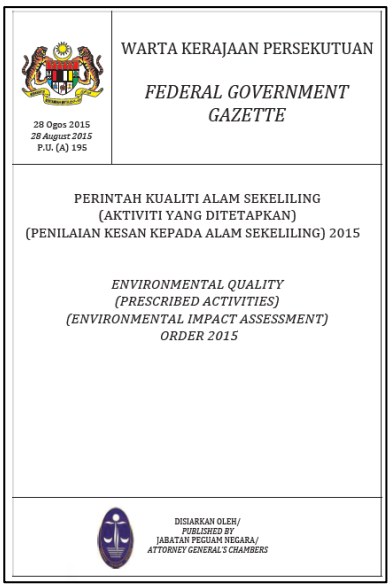
1 INTRODUCTION

Chapter 1

INTRODUCTION

1.1 INTRODUCTION

The '**Environmental Impact Assessment (EIA) Guideline for Waste Treatment and Disposal Project – Solid Waste'** (hereinafter referred to as the 'Guideline') has been issued in alignment with the latest amendments to the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015, of the Environmental Quality Act 1974 (Act 127).


WARTA KERAJAAN PERSEKUTUAN

FEDERAL GOVERNMENT GAZETTE

28 Ogos 2015
28 August 2015
P.U. (A) 195

PERINTAH KUALITI ALAM SEKELILING
(AKTIVITI YANG DITETAPKAN)
(PENILAIAN KESAN KEPADA ALAM SEKELILING) 2015

ENVIRONMENTAL QUALITY
(PRESCRIBED ACTIVITIES)
(ENVIRONMENTAL IMPACT ASSESSMENT)
ORDER 2015

DISIARKAN OLEH/
PUBLISHED BY
JABATAN PEGUAM NEGARA/
ATTORNEY GENERAL'S CHAMBERS

The Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 was gazetted on 28 August 2015 with a list of Prescribed Activities specified in the First Schedule and Second Schedule. 21 prescribed activities are specified in the First Schedule and 17 prescribed activities are specified in the Second Schedule.

The Guideline, encompasses prescribed activities under Activity 14(b) – Waste Treatment and Disposal (Solid Waste) where the preparation and submission on an EIA report is required as stipulated in Section 34A of the Environmental Quality Act (EQA) 1974.

The Department of Environment (DOE) has rationalised the EIA process to make it more reflective of the scope, functions and visions of the Department in line with its Environment Strategic Plan, with a focus on Environmental Mainstreaming Tools (EMT) to achieve Self-Regulation (SR).

The Guideline shall be read together with the Environmental Impact Assessment Guideline in Malaysia (EGIM) published by DOE. Compliance with the requirements set out in this Guidelines and EGIM will fulfil the obligations of the Project Proponent as stated under Section 34A (2C) of the EQA 1974.

1.2 GUIDELINES OBJECTIVES

01 OBJECTIVE

CLEAR AND CONCISE

Provide clear and concise guidance on EIA project planning and preparation to the stakeholders, Project Proponents, Qualified Persons, Government Agencies, Enforcement Officers and other EIA-related practitioners.

02 OBJECTIVE

INTEGRATION OF THE EIA

Facilitate integration of the EIA into the overall project planning and development cycle in order to ensure compliance with and adherence to the legal environmental requirements and the framework on environmental sustainability.

03 OBJECTIVE

STEP-BY-STEP GUIDANCE

Provide a detailed step-by-step guidance with explanation of the various Environmental Impact Assessment (EIA) procedures and submissions, comprising:
i) Environmental Scoping Information (ESI) and Terms of Reference (TOR).
ii) EIA Reporting.

04 OBJECTIVE

SCOPE OF THE EIA

Clearly define the scope of the EIA with a focus on the significant environmental issues relevant to the DOE's functional areas (i.e. water, air and wastes), whilst also taking into consideration the environmental requirements by other authorities or agencies, to facilitate overall decision making and project approval.

05 OBJECTIVE

CLEAR FRAMEWORK

Provide a clear framework for the DOE to assess and approve the EIA report.

1.3 SCOPE OF THE EIA GUIDELINES

The scope of the Guideline covers 5 prescribed activities under Activity 14(b) of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015. **Figure 1-1** illustrates the possible relationships within these prescribed activities.

First Schedule

i. Construction of composting plant

ii. Construction of recovery plant or recycling plant

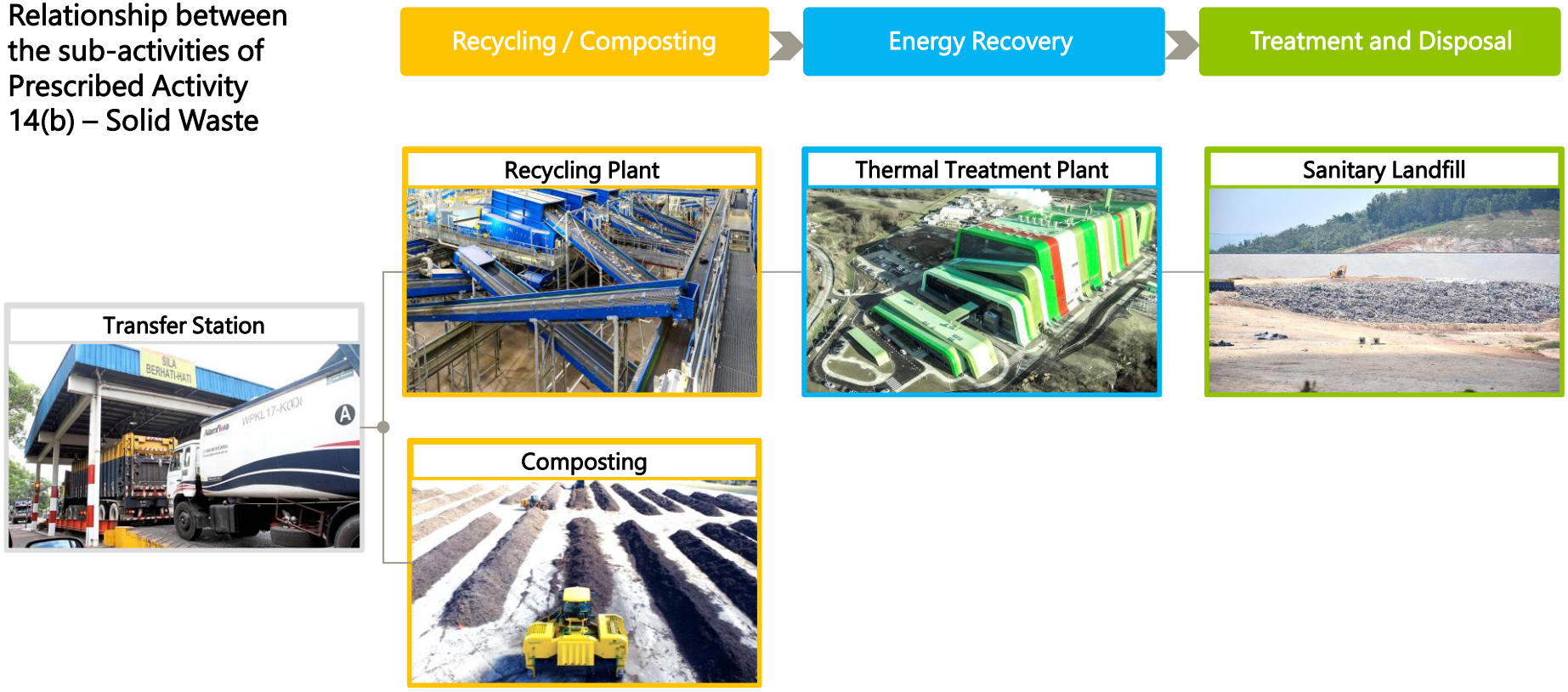
Second Schedule

i. Construction of thermal treatment plant

ii. Construction of sanitary landfill facility

iii. Construction of transfer station

Relationship between the sub-activities of Prescribed Activity 14(b) – Solid Waste



1.4 TERMS AND DEFINITIONS

1.4.1 Introduction

The proposed terms and definitions that will be adopted in this Guideline has been based on an interpretation of relevant documents published by DOE and other related government agencies, registered bodies and institutions, primarily. Some of the terms are based on the Solid Waste and Public Cleansing Management Act 2007 (Act 672) and Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for The Construction, Alteration and Closure of Facilities) Regulations 2011. The terms and definitions that related to Solid Waste Treatment and Disposal Projects are described as follow:

1.4.2 Solid Waste

The reference to 'waste' or 'solid waste' is made in the various legislations described earlier and these are described further in the following.

Solid Waste and Public Cleansing Management Act 2007 (Act 672)

The SWPCM Act defines solid waste as:

a) Any scrap material or other unwanted surplus substance or rejected products arising from the application of any process;
b) Any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled; or
c) Any other material that according to this Act or any other written law is required by the authority to be disposed of,

but does not include scheduled wastes as prescribed under the Environmental Quality Act 1974 [Act 127], sewage as defined in the Water Services Industry Act 2006 [Act 655] or radioactive waste as defined in the Atomic Energy Licensing Act 1984 [Act 304];

Solid waste is further refined according to the following category of wastes such as follow:

Public solid waste
any solid waste generated by public places, which are under the supervision or control of any local authority

Imported solid waste
any solid waste generated in other countries and imported to Malaysia for processing or disposal

Household solid waste
any solid waste generated by a household, and of a kind that is ordinarily generated or produced by any premises when occupied as a dwelling house, and includes garden waste

Institutional solid waste
any solid waste generated by— a. any premises approved under any written law or by the State Authority for use wholly or mainly for religious worship or for charitable purposes; b. any premises occupied by any Federal or State Government department, any local authority or any statutory body; c. any educational premises; d. any healthcare facilities including hospitals, clinics and health centres; or e. any premises used as public zoos, public museums, public libraries and orphanages

Special solid waste
any kind of controlled solid waste as may be prescribed which — a. is or may be dangerous to public health; or b. is difficult to treat, keep or dispose of, that special provisions are required to deal with it;

Commercial solid waste
any solid waste generated from any commercial activity

Construction solid waste
any solid waste generated from any construction or demolition activity, including improvement, preparatory, repair or alteration works

Industrial solid waste
any solid waste generated from any industrial activity

Controlled solid waste
any solid waste falling within any of the following categories: a. commercial solid waste; b. construction solid waste; c. household solid waste; d. industrial solid waste: e. institutional solid waste; f. imported solid waste; g. public solid waste; or h. solid waste which may be prescribed from time to time

Recyclable solid waste
controlled solid waste which is suitable for recycling as may be prescribed

1.4.3 Relevant Terms

FIRST SCHEDULE
Activity 14(b)(i) Construction of Composting Plant

Composting Plant

[1] **Communal or commercial composting facility** means a facility where microbial decomposition of organic controlled solid waste is carried out under controlled aerobic conditions to convert organic materials into a humus-like product for use as soil conditioner or fertilizer and may include vermicomposting, turned windrows, aerated static piles or aerated in-vessel systems which serves two or more premises, and in the case of commercial composting facility, which produces compost for sale.

- [2] controlled solid waste refers to any solid waste falling within any of the following categories:
  a. commercial solid waste;
  b. construction solid waste;
  c. household solid waste;
  d. industrial solid waste:
  e. institutional solid waste;
  f. imported solid waste;
  g. public solid waste; or
  h. solid waste which may be prescribed from time to time

- Examples of [3] controlled aerobic conditions refers to the factors affecting the aerobic composting which are as follow:

Factors	Description
Temperature	Suitable temperatures vary from ambient (c. 25°C) up to 58-60°C, depending upon the micro-organism.
Aeration	Air can be supplied to the void spaces by means of turning, natural convection, or by some form of forced air system, depending upon the composting technology chosen.
Moisture Control	The optimum moisture for composting will very much depend upon the water holding capacity of the composting mixture.
pH value	The starting pH of a composting mixture will depend upon the nature and proportions of the components of the feedstock, and will vary throughout the composting process.
Nutrients	The ratio of carbon to nitrogen in the initial feedstock has a major effect upon the composting process.

Source:

[1] Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for The Construction, Alteration and Closure of Facilities) Regulations 2011
[2] Solid Waste and Public Cleansing Management Act 2007 [Act 672]
[3] Misra, R. V., Roy, R. N., & Hiraoka, H. (2003). On-Farm Composting Methods. Rome: Food and Agriculture Organization of the United Nations.

FIRST SCHEDULE
Activity 14(b)(ii) - Construction of Recovery Plant/ Recycling Plant

Recycling

- [1] To collect and separate solid waste for the purpose of producing products [1] Solid Waste and Public Cleansing Management Act 2007 (Act 672).
- [2] Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations

Recovery

- [3] The process of obtaining materials or energy resources from solid waste
- [4] Any waste management operation that diverts a waste material from the waste stream and which results in a certain product with a potential economic or ecological benefit

Source:

[1] Solid Waste and Public Cleansing Management Act 2007 (Act 672)
[2] Waste Framework Directive 2008/98/EC, Article 3 (Definitions), No. 17
[3] Code of Federal Regulations (CFR). (2020, June 1). Title 40 Protection of Environment Chapter 1(I) §246.101 Definitions of Recovery
[4] Manual on the Basic Set of Environment Statistics of the FDES 2013, 2018

SECOND SCHEDULE
Activity 14(b)(i) - Construction of Thermal Treatment Plant

Thermal treatment plant

[1] A fixed or mobile plant where controlled solid waste is treated under controlled conditions by mass burn incineration, gasification, plasma technology, pyrolysis or other means of treatment under controlled temperature or atmospheric pressure

The definition of incineration shall adopt the meaning of incinerator as follow:

- [2] Incinerator refers to any device, apparatus, equipment or structure used for destroying, reducing or salvaging or waste heat recovery by fire or by burning any material or substance including refuse, rubbish, garbage, agricultural waste, trade waste, debris or scrap or a facility for cremating animal remains

- [3] Example of range of controlled temperature:

Means of treatment	Range of temperature
Air gasification	800°C to 1,100°C
Oxygen gasification	1,000°C to 1,400°C
Pyrolysis	700°C to 1,000°C
Plasma	Up to 2,000°C

Source:

[1] Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for The Construction, Alteration and Closure of Facilities) Regulations 2011
[2] Environmental Quality (Clean Air) Regulations 2014
[3] National Strategic Plan for Solid Waste Management, 2005

SECOND SCHEDULE Activity 14(b)(ii) - Construction of Sanitary Landfill Facility
Sanitary Landfill [1] A disposal site where controlled solid waste is deposited into or on any land or water and where principles of engineered design is used to confine the controlled solid waste within the facility for ensuring its proper treatment and handling to avoid any nuisance or hazard to public health, safety and the environment
SECOND SCHEDULE **Activity 14(b)(iii) - Construction of Transfer Station**
Transfer Station [2] A facility where controlled solid waste is unloaded from waste collection vehicles, and reloaded to large capacity long haul vehicles, barges or rail haulage for ground or waterway shipment to treatment and disposal facilities

Source:

[1],[2] Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for The Construction, Alteration and Closure of Facilities) Regulations 2011

1.5 SCOPE OF PRESCRIBED ACTIVITIES

The scope of the prescribed activities under Activity 14(b) of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 are as tabulated in **Table 1-1** and **Table 1-2**.

Table 1-1 Scope of Activity 14(b) Solid Waste Treatment and Disposal in the First Schedule of EIA Order 2015

First Schedule Activity 14(b)(i) Construction of Composting Plant
Scope of Activity: • Construction and operation of composting plant • Plants receiving solid waste more than 5 tonnes / day • Facility where microbial decomposition of organic solid waste is carried out under controlled aerobic conditions to convert organic materials into a humus-like product for use as soil conditioner or fertilizer. • Facility that has the basic composting process to produce compost as follow: Waste → Pre-composting stage → Thermo-phillic stage → Mesophilic stage → Maturation stage → Compost • Examples of the common composting technologies are: - Windrow composting - Aerated static pile - In-vessel composting

First Schedule

Activity 14(b)(i) Construction of Composting Plant

- Examples of organic solid waste include:
  **Note: This list is not complete but does cover the most common types of waste*
  - Food waste
  - Palm oil biomass such as empty fruit bunch (EFB), decanter cake, palm oil mill effluent (POME)
  - Biosolids (treated sewage solid sludge with minimum 25% dry solid content)
  - Green waste such as lawn clippings, flowers, leaves and twigs, grass, tree trimmings, small branches

Exclusion:

- Community-scale, decentralized, home or backyard scale operation which serve primarily residential neighbourhoods or individual because the amount of waste to be processed is usually small, hence less environmental impact
- Operation of food waste digester that turn food wastes into compost
- Anaerobic digester is not included because the composting is defined as aerobic process (with the presence of oxygen).

Activity 14(b)(ii) - Construction of Recovery Plant/ Recycling Plant

Scope of Activity:

- Construction and operation of recovery plant / recycling plant of all sizes
- Recycling or recovery process that involve washing and/or heat processing methods such as extrusion, moulding, melting
- Waste for recycling activity are concentrated to 6 types of waste as follow:
  - Plastic
  - Tyre
  - Ferrous metals (scrap iron)
  - Non-ferrous metals (aluminium, copper, lead, tin, zinc)
  - Paper
  - Glass

- Specific scope of activity for plastic recycling plant as follow:

Plastic Recycling Plant

Plastic recycling plant which has washing component and/or heating component in the process. Example of heat processing methods includes extrusion, injection moulding, blow moulding and rotational moulding.

- Exclusion of activities:
  - Plastic recycling plant that carry out the process of compacting and baling scrap plastic without washing activity and compressed into a bale using hydraulic machine.
  - Plastic recycling plant that carry out crushing of scrap plastics to flake without washing activity.

Table 1-1 Scope of Activity 14(b) Solid Waste Treatment and Disposal in the First Schedule of EIA Order 2015 (cont'd)

First Schedule

Activity 14(b)(ii) - Construction of Recovery Plant/ Recycling Plant

Scope of Activity:

- Specific scope of activity for tyre recycling plant as follow:

Tyre Recycling Plant
Tyre recycling plant that has pyrolysis process, thermal degradation of scrap tyres either in the absence or lack of oxygen and operating at temperature less than 800°C. The primary products are carbon black, fuel oil and steel wire.

  - Exclusion of activities:
    - Tyre recycling plant which involves re-threading or re-moulding of scrap tyres
    - Tyre recycling plant which involves the physical and mechanical processes of producing recycled raw materials. The mechanical processes involve shredding, grinding, milling, separation and fractionation to produce rubber granulate, textile and metal.

- Specific scope of activity for scrap metal recycling plant as follow:

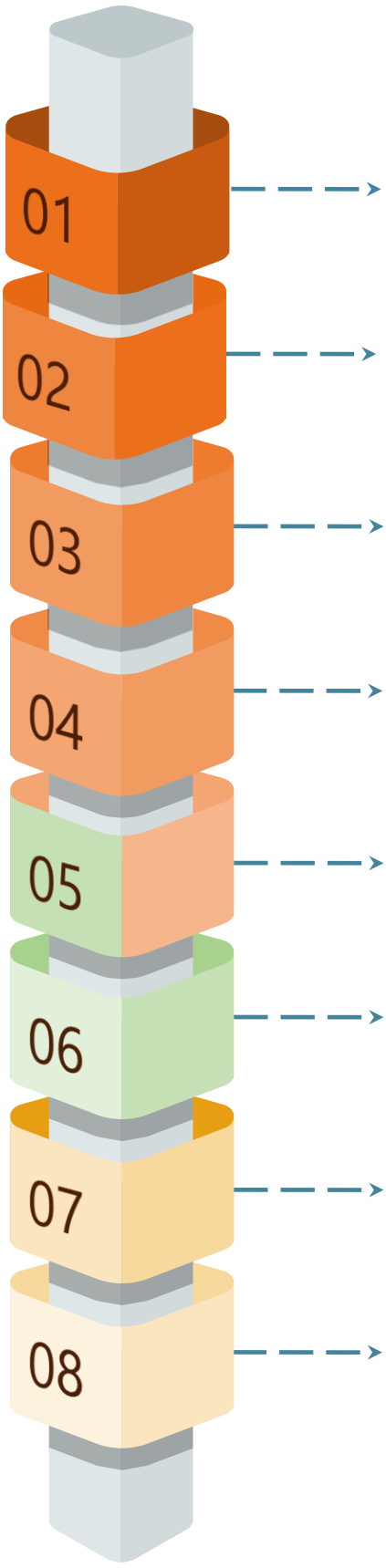
Scrap Metal Recycling Plant
Applicable to premises carrying out scrap metal recycling activities (metal scrap) involving industrial effluent emissions and / or air emissions only. The processes involved in recycling scrap metal activities are as follows: - • Compressing (compacting or throwing) in which scrap metal is compressed using a hydraulic machine; • Crushing or granulating of scraps of metal to a small size called flakes or granules; • Washing and drying; • Isolation between metal flakes / granules and other residues (residue) such as the use of vibration separation or screening machines or sink / float tank techniques. This process usually generates industrial effluent; and / or • Smelting to obtain metal ingots. • Only activities that involve the process of washing, separation and / or smelting above involve the release of industrial effluent and / or air emission.

  - Exclusion of activities:
    - Accordingly, for premises that carry out recycling activities of scrap metal but does not involve the release of pollutants into the environment such as carrying out the process of (i) compacting or (ii) crushing only, it is not subject to the preparation of the EIA Study.

Table 1-2 Scope of Activity 14(b) Solid Waste Treatment and Disposal in the Second Schedule of EIA Order 2015

Second Schedule
Activity 14(b)(i) Construction of Thermal Treatment Plant
Scope of Activity: • All sizes of thermal treatment plant or waste to energy (WTE) plant. • Any stationary or mobile equipment or apparatus (including modular) dedicated to destruction of solid waste into solid, liquid and/or gaseous components. • Plant that is operating to treat waste under controlled conditions by mass burn incineration, gasification, plasma technology, pyrolysis or other means of treatment under controlled temperature or atmospheric pressure.
Activity 14(b)(ii) - Construction of Sanitary Landfill
Scope of Activity: • All sizes and all types of sanitary landfill where the waste is buried either underground or in large piles and lined to undergo process of decomposition and stabilisation. • An existing dumpsite which is planning to upgrade to a sanitary landfill. **Exclusion:** • An inert landfill is not included under this scope of activity. • Inert landfill means a disposal site receiving solid waste that does not physically or chemically react or biodegrade and will not decompose within the landfill, for example construction and demolition solid waste.
Activity 14(b)(iii) - Construction of Transfer Station
Scope of Activity: • Any transfer station with any sizes and types.

1.6 STRUCTURE OF THE EIA GUIDELINES



INTRODUCTION
Provides the general overview of the guidelines including the scope and definition of activities covered as well as the environmental assessment process.

ENVIRONMENTAL PROJECT PLANNING
Provides the bird's-eye-view on all the relevant legal requirements and policies involve throughout the entire lifecycle of the Activity 14(b) projects.

TERMS OF REFERENCE (TOR)
Provides guidance for the preparation of TOR/ESI form the screening and scoping exercises. Impacts to be addressed and how to assess the impacts in the EIA study are outlined in this chapter.

BASELINE DATA
Provides guidance for the baseline data collection and analysis for the EIA study. This chapter not only focuses on the primary data collection but also the secondary data collection.

EVALUATION OF IMPACTS
Provides guidance for the evaluation of impacts which covers the typical input, appropriate methods and tools, intended output and the evaluation criteria for impact assessment.

MITIGATION MEASURES
Provides guidance on the selection of suitable mitigation measures to minimise the environmental impacts as well as residual impacts identified in the EIA Study.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)
Provides guidance on the formulation of the Environmental Management Plan (EMP) with the incorporation of Guided Self-Regulation (GSR) element.

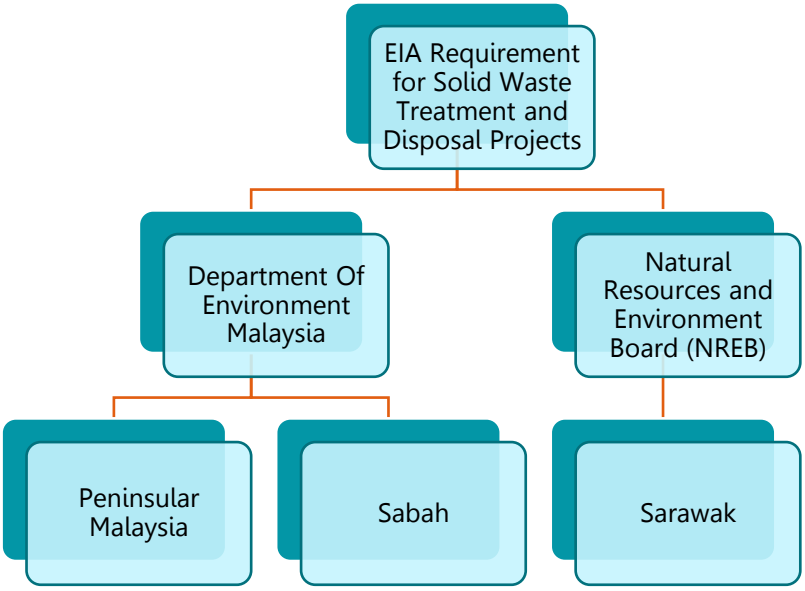
REPORTING AND REVIEW
Provides guidance on the preparation of the EIA report including the submission and approval process in line with the EIA Guidelines in Malaysia 2016 published by DOE.

1.7 EIA REPORT REQUIREMENT

1.7.1 Peninsular Malaysia and Sabah

An EIA report is required under Section 34A of the Environmental Quality Act 1974. It is clear that any new development under Activity 14(b) of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 in Peninsular Malaysia and Sabah fall under Activity 14(b) of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 shall submit a report to the Director General of the DOE for approval. However, Activity 14(b) of EIA Order 2015 does not apply in the state of Sarawak.

Figure 1-2 EIA Requirement for Solid Waste Treatment and Disposal Projects



1.8 OVERVIEW OF THE EIA PROCESS

An EIA is a study to identify, predict, evaluate and communicate both the adverse and beneficial impacts of a proposed project on the environment. It also specifies any pollution prevention and mitigation measures (P2M2s) that are required to minimise significant environmental impacts throughout the project cycle.

Table 1-3 below shows the step-by-step guide of the EIA process. Relevant chapters to be referred in the guidelines are given in the reference column.

Table 1-3 Step-by-Step Guide for the Environmental Impact Assessment Process

	Step	Description	Reference
STEP 1	Provide Project Brief or Basic Information	• The Project Proponent must provide the basic information to enable the Qualified Person to understand the scope of the project and carry out the screening process. • The requirement for the EIA study will be determined and if required, the project will be classified under the First Schedule or Second Schedule.	• Chapter 1
STEP 2	Identify the Legal Requirements	• The Qualified Person shall identify all legal requirements relevant to the project based on the information provided by the Project Proponent.	• Chapter 2
STEP 3	Check Existing Policies and Guidelines	• The Project Proponent is required to clear all policy and administrative matters related to the project before submitting the EIA report to the DOE.	• Chapter 2
STEP 4	Conduct Preliminary Stakeholder Engagement	• The Project Proponent and the Qualified Person should engage with the DOE and the relevant GAs to determine the requirements to be included in the TOR report. • The Qualified Person can also engage with other relevant stakeholders to obtain site information and data for the scoping.	• Chapter 2
STEP 5	Prepare TOR and ESI Report	• ESI and TOR must be prepared before the preparation of the EIA report. • The Qualified Person shall obtain secondary data to assist in the Environmental Scoping. • At this point in time, qualitative data is sufficient for scoping of significant impacts for the TOR. • Relevant information required for the TOR includes: ✓ Site Suitability Assessment (SSA). ✓ Determination of the study boundary. ✓ Overview of baseline data. ✓ Identification of key project activities. ✓ Identification of significant impacts and priority setting. • Selection of mitigation measures.	• Chapter 3

	Step	Description	Reference
STEP 6	Submit TOR and ESI Report	• The Qualified Person shall review all data obtained during scoping to prepare the TOR report based on DOE requirements in the EGIM.	• Chapter 3
STEP 7	Collect Baseline Data for EIA Report	• Baseline data collection shall be carried out after the TOR endorsement to obtain detailed information of the existing environment on the project site and its surroundings.	• Chapter 4
STEP 8	Prepare EIA Report	• The major studies and components of the EIA report shall cover the following: ✓ Identify and predict significant environmental issues and impacts. ✓ Assess and evaluate the significant environmental issues and impacts. ✓ Identify suitable P2M2s. ✓ Provide the Environmental Management Plan (EMP) framework. ✓ Conclude the EIA study findings. • Process description shall cover the following (refer to **Appendix A** for more detail): ✓ Project Location ✓ Project Components ✓ Type of Solid Waste ✓ Waste Acceptance Criteria (WAC) ✓ Process Technology ✓ Detailed Design for Pollution Control System ✓ Mass Balance Calculation ✓ Project Activities ✓ Infrastructure, Utilities and Amenities Requirement ✓ Project Implementation Schedule	• Chapter 5,6 & 7
STEP 9	Conduct Stakeholder Engagement	• The Project Proponent and Qualified Person are recommended to engage with the relevant stakeholders particularly to those affected by the project. • The engagement aims to seek their thoughts and feedback. • Key points for the engagement are as follows: ✓ Project background. ✓ Potential environmental issues. ✓ Proposed P2M2s. • All findings from the engagement shall be incorporated and addressed in the EIA report when necessary.	• Chapter 2

	Step	Description	Reference
STEP 10	Completion of EIA Report	• The results of assessments and studies required by other GAs have to be incorporated into the EIA report but not necessary to append the individual reports. • The EIA report shall be prepared according to the EGIM.	• Chapter 8
STEP 11	Submit EIA and Public Display	• The EIA report shall be submitted to DOE State or DOE HQ for review. • The Qualified Person shall note the differences in requirements for a First Schedule and Second Schedule EIA and follow the required procedures. • Second Schedule EIA requires a public display of the EIA report. • The public can provide their comments and feedback within the review period to DOE HQ during the public display.	• Chapter 8

EIA GUIDELINES

Waste Treatment and Disposal - Solid Waste

2

ENVIRONMENTAL PROJECT PLANNING

CHAPTER 2

ENVIRONMENTAL PROJECT PLANNING

2.1 INTRODUCTION

EIA is an integral part of the overall integrated project planning, which can provide benefits and value to any project. It is a tool to evaluate the potential impacts arising from a proposed project based on the psychochemical, ecological and human components of the environment.

It identifies the key areas of environmental concerns for consideration during the project planning stage and provides a means to decide on the types of mitigation measures to avert or minimise the adverse impacts at an early stage. A summary of the EIA process is shown in EGIM.

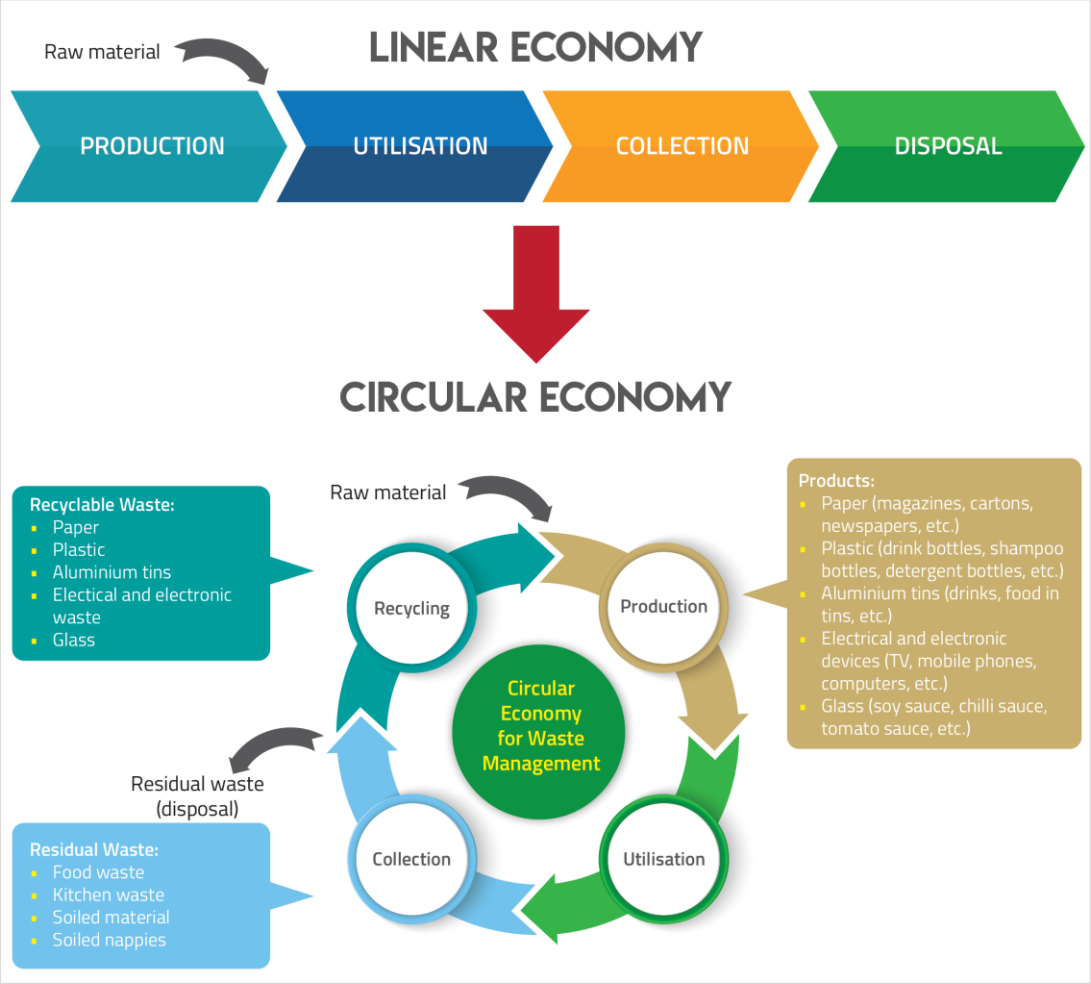
2.2 WASTE MANAGEMENT CONCEPT

Malaysia had adopted the cradle-to-grave method previously. This method begins from the extraction of the raw materials, the manufacturing process, followed by the use of products and finally the disposal of the products. Priority is given to the disposal rather than resource recovery. It has given rise to the environmental problems such as illegal dumping.

In the linear economy, raw natural resources are taken, transformed into products and get disposed of. On the opposite, a circular economy model aims to close the gap between the production and the natural ecosystems' cycles – on which humans ultimately depend upon.

Moving towards a circular economy is critical from both supply security and environmental perspectives and provides the basis for a sustainable and competitive economy. Establishing a circular economy with improved waste and materials management further helps addressing the issue of microplastics in the environment and marine litter. Recovering materials from waste streams for recycling or reuse, using products longer and increasing the use intensity of goods through sharing economy approaches like car-sharing are some of the areas in which circular business models are operating. **Figure 2-1** shows the comparison of a linear economy and a circular economy.

Figure 2-1 Comparison of A Linear Economy and A Circular Economy



Source: National Cleanliness Policy, 2019

A circular economy seeks to:

- maximise the value of the materials that circulate within the economy;
- minimise material consumption, paying particular attention to virgin materials, waste streams that raise specific concerns (such as plastics, food, electric and electronic goods);
- prevent waste from being generated and reduce hazardous components in waste and products.

Figure 2-2 Hierarchy of Solid Waste Management

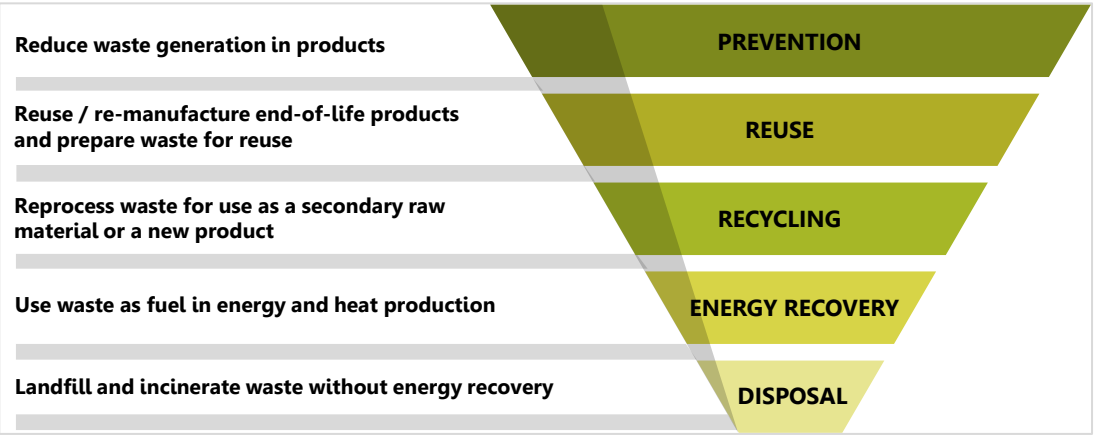
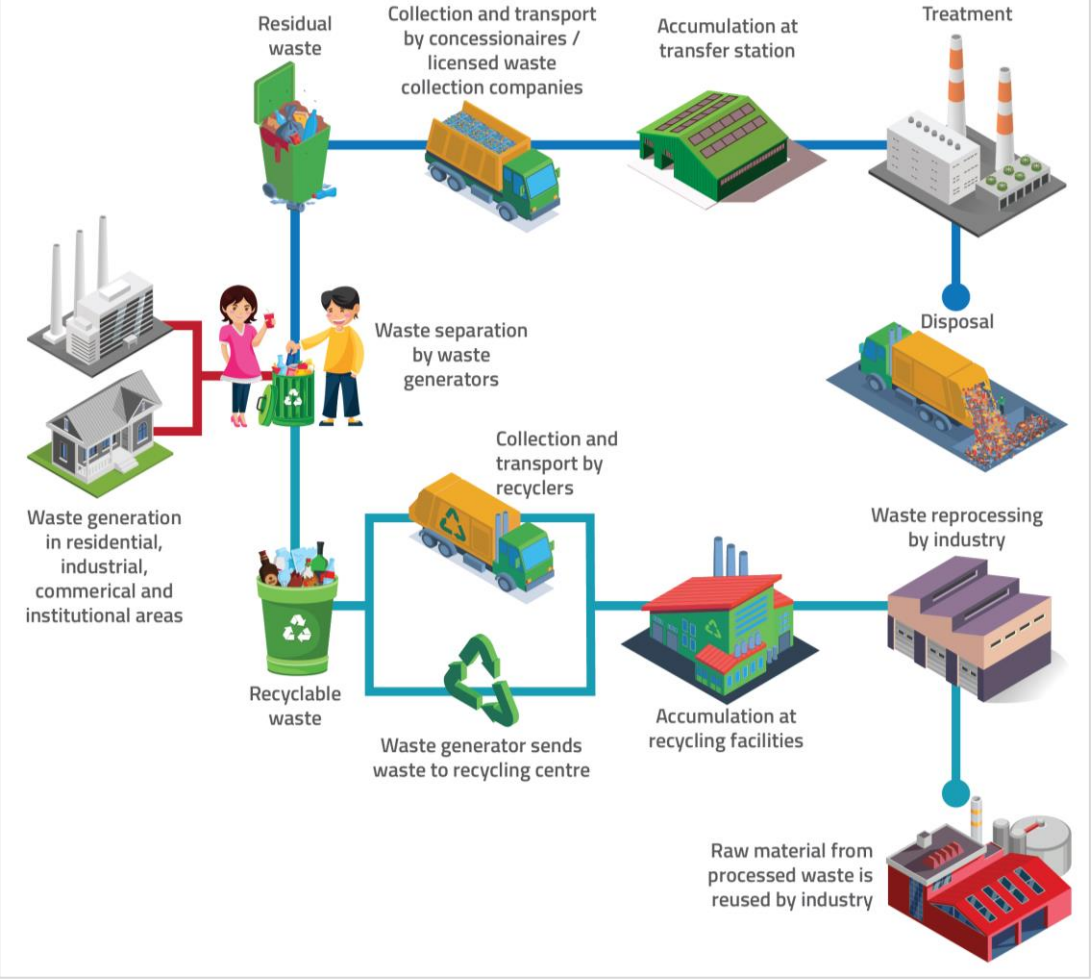


Figure 2-3 Flow Chart of Solid Waste Management



Source: National Cleanliness Policy, 2019

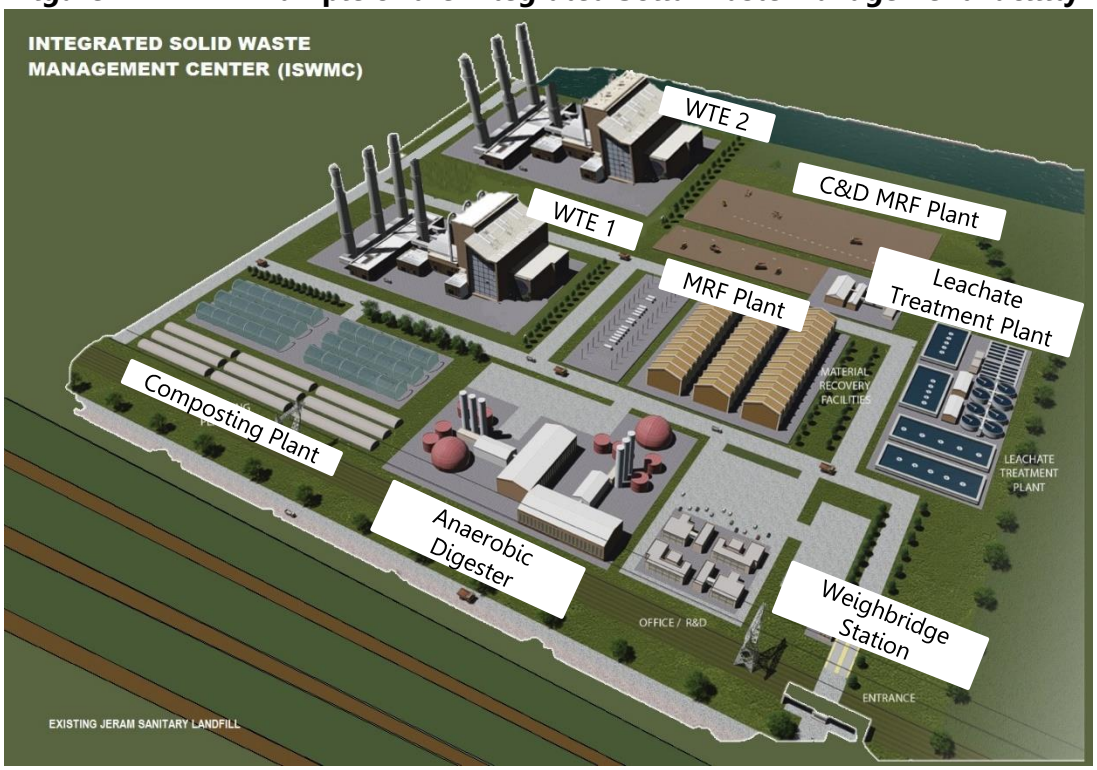
Figure 2-4 shows the example of the Integrated Solid Waste Management Facility. Main components of this facility are as follows:

- Composting Plant;
- Material Recovery Facility;

- Construction and Demolition (C&D) Material Recovery Facility Plant;
- Waste to Energy Thermal Treatment Plant;
- Recycling Plant for Production of Alternative Raw Material and Fuel;
- Sanitary Landfill;
- Physical and Chemical Treatment Plant;
- Effluent Treatment Plant;
- Leachate Treatment Plant.

It is important to note that the authorities, product producers, generators and solid waste treatment and disposal facilities to play a critical role in ensuring that solid wastes are prevented, minimized, collected and treated properly in accordance to the waste hierarchy or ''cradle-to-cradle'' concept. Converting to this concept will protect the natural resources and reduce the solid waste generation in Malaysia.

Figure 2-4 Example of the Integrated Solid Waste Management Facility



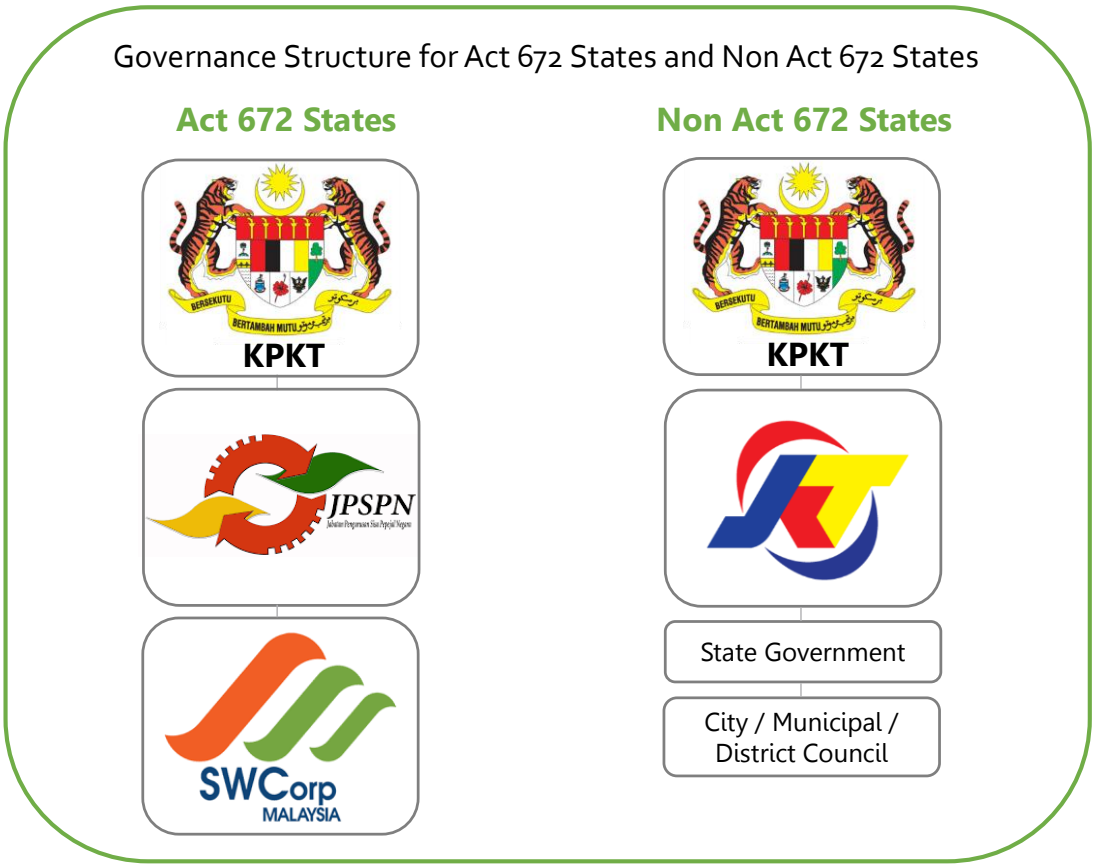
2.3 GOVERNANCE STRUCTURE OF SOLID WASTE MANAGEMENT

Peninsular Malaysia and Federal Territories

The governance structure of solid waste management is governed by multi stakeholders at federal level and state level. The Solid Waste and Public Cleansing Management Act 2007 (Act 672) was introduced in the year 2007 and this act applies to Peninsular Malaysia and the territories of Putrajaya and Labuan that come into force on 1st September 2011. This act regulates the management of solid waste and public cleansing for the purpose of maintaining proper sanitation in Peninsular Malaysia and Federal Territories. States that has adopted this Act are Kuala Lumpur, Putrajaya, Johor, Melaka, Negeri Sembilan, Pahang, Kedah and Perlis. Under this Act, the jurisdiction pertaining to solid waste management and public cleansing falls within Federal Government.

For States that do not adopt Act 672, all matters on solid waste management falls under jurisdiction of the State Government and the respective city / municipal or district council. The solid waste management in the States are governed by the Local Government Act 1976.

Figure 2-5 Governance Structure for Act 672 States and Non-Act 672 States



2.4 RELEVANT LEGISLATIONS

The EQA 1974 (Act 127) and the Solid Waste and Public Cleansing Management Act 2007 (Act 672) are the two main legal instruments that governing the solid waste management in Malaysia. There are also other key legislations governing the solid waste activities as tabulated in **Table 2-1**.

Table 2-1 Key Legislations Governing the Solid Waste Activities

No	Legislations	Details
1	Environmental Quality Act 1974	EQA provides for indirect control and regulation environmental pollution due to landfill and related solid waste management activities.
2	Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009	This regulation entails the requirement to control pollution during operation of landfill and transfer station. The regulation also spells out the requirement to notify for new source of leachate discharge or release.
3	Environmental Quality (Clean Air) Regulations 2014	The air pollutant emission from incineration process and emission of hazardous levels of gaseous substances from landfill operation is stated in this regulation.
4	Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015	Lists the activities under solid waste which is subjected to conduct environmental impact assessment.
5	Environmental Quality (Industrial Effluent) Regulations 2009	The management and discharge standard of wastewater is stated in this regulation.
6	Solid Waste and Public Cleansing Management Act 2007 [Act 672]	This act regulates the management of solid waste and public cleansing for the purpose of maintaining proper sanitation in Peninsular Malaysia and federal territories. States that adopt this Act are Kuala Lumpur, Putrajaya, Johor, Melaka, Negeri Sembilan, Pahang, Kedah.
7	Solid Waste and Public Cleansing Management Corporation Act 2007 [Act 673]	This act is for the Establishment of the Solid Waste and Public Cleansing Management Corporation with powers to administer and enforce the solid waste and public cleansing management laws and related matters.
8	Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for the Construction, Alteration and Closure of Facilities) Regulations 2011	The regulation has specifically entails **types of prescribed solid waste management facilities** and the application process for approval to construct, alter or close the prescribed solid waste management facilities.

No	Legislations	Details
9	Solid Waste and Public Cleansing Management (Scheme for Construction Solid Waste) Regulations 2018	Outlines about contractors and other persons who generate and/or hold construction solid waste are under a duty to appoint a licensee to provide collection services for such waste according to scheme areas specified under the scheme. The licensing requirements for any person that intend to provide collection services is also prescribed in this regulation.
10	Town and Country Planning Act 1976 [Act 172]	Any development for solid waste management facility must obtain planning permission approval.
11	Local Government Act 1976 [Act 171]	This Act administers the power of local authority to make, amend or revoke by-laws to keep public places clean and free from liquid waste. It also governs the local authority to prohibit, remove, abate and prevent the occurrence of nuisances.

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant legislations required for the environmental assessment and compliance.

2.5 POLICIES AND GUIDELINES COMPLIANCE

Policies for solid waste management has been established by National Solid Waste Management Department to be in line with the target and goals set in the current Malaysia Plan. They have formulated several policies to regulate and ensure the solid waste management is carried out properly while protecting the nation's interest on the environmental.

It is the responsibility of the Project Proponent and Qualified Person to determine and refer to the latest policies and guidelines. It is also important to note that the policies are not rigid but rather dynamic and keep changing from time to time. Relevant department shall always be consulted to get the latest updates in policies. Factors such as the technological advancement, supply and demand, etc. can affect the policies that have been formulated. Therefore, it is important to engage with the DOE and relevant agencies during the planning stage on the policy matters. Some of the policies that are deemed stable are described below.

2.5.1 National Cleanliness Policy 2019

On February 21, 2019, the Minister of Housing and Local Government announced the establishment of a National Cleanliness Policy. The policy is an initiative of the Government to make Malaysia a clean country and to create a society that promotes cleanliness to ensure the well-being and environmental sustainability. Hygiene is one of the most important aspects of achieving an advanced state. The philosophy behind this policy is as follow:

Creating a clean, sustainable and prosperous country through the cultivation of personal hygiene practices, families, communities and communities in an effort to preserve environment

The objectives of this policy are as follow:

i. Increase awareness and cultivate good hygiene practices in the community
ii. Improve environmental cleanliness and environmental sustainability
iii. Encouraging waste initiative as a source of waste to money towards circular economy
iv. Empower governance and enforcement to be more efficient, effective and integrated

The implementation of the National Cleanliness Policy focuses on five (5) clusters. A total of 14 strategies and 91 action plans have been developed to meet the objectives set out in the National Cleanliness Policy. The clusters are as follow:

Under the cluster of circular economy, national economic development must be in tandem with environmental sustainability to be in line with the national aspiration to make Malaysia a clean country. The transformation from a linear economy to a circular economy based on the principles of reduce, reuse and recycle must be extended to all industrial sectors with a view to minimising solid waste generation at source and maximising the use of resources, thereby reducing carbon dioxide emissions into the environment. The adaptation of a circular economy in the industrial sector can encourage a green economy, i.e. reuse to reduce waste that is generated. Four (4) strategies are outlined under this cluster:

2.5.2 National Solid Waste Management Policy 2016

The National Solid Waste Management Policy 2016 is amendment to the National Solid Waste Management Policy 2006 formulated by Ministry of Local Government and Housing. Improvements to the National Solid Waste Management Policy 2016 are guided by the achievements in the previous National Solid Waste Management Policy 2006, the Strategic Plan for National Solid Waste Management 2005 and the Solid Waste Management Study in Malaysia (2006). Improvement to this policy also includes initiatives on solid waste management presented in the Eleventh Malaysia Plan (2016-2020) as well as the initiatives presented in the Solid Waste Management Laboratory Report 2015.

The aim of this policy is:

i. To create a comprehensive, integrated, cost effective, sustainable and accepted by the public that prioritise environmental preservation, affordable technology selection and guarantees public health
ii. To implement solid waste management based on waste management hierarchy that prioritizes waste minimisation through 3R (reduce, reuse, recycle), intermediate treatment and final disposal

In order to meet these aims, the objectives, cores, strategies and action plan to be taken by relevant parties has been outlined in the policy.

2.5.3 Eleventh Malaysia Plan (2016-2020)

Managing waste holistically has been identified as one of the strategies under the focus key areas in adopting the sustainable consumption and production concept. This focus key area aims in pursuing green growth for sustainability and resilience. All seven types of waste – solid, agricultural, construction, radioactive, mining, sewage, and scheduled waste will be managed in a holistic manner based on a life cycle approach. This approach aims to increase recycling and recovery rate of waste and improve management of landfills to reduce the amount of waste and pollution rather than merely disposing the waste. In order to achieve this, the approach have been described in the Eleventh Malaysia Plan as follow:

i. Increasing coordination on waste management

There is a gap in waste management because it is currently implemented independently by relevant agencies such as the DOE, SPAN and SWCorp as per their respective jurisdiction. Establishment of a waste management platform that meets regularly to coordinate matters on sustainable and holistic waste management will be able to provide tasks in a more integrated and coordinated manner.

ii. Encouraging reuse, reduce and recycle

The Government has set a goal of 22% household recycling rate by 2020. Investments in 3R awareness and education programmes therefore need to

continue to shape better consumption and waste disposal behaviour to enable better management of wastes.

iii. Increasing investment in waste as a resource

Investing in waste recycling and recovery will divert it away from landfills. By using waste as a resource, it gives economic value as wastes becomes a valuable resource, either converted to energy (e.g. biomass and food waste for power generation) or used as an input for other products.

2.5.4 Mid-Term Review of the Eleventh Malaysia Plan 2016-2020

Under the fifth policy pillar which is Enhancing Environmental Sustainability Through Green Growth, strengthening waste management is one of the strategies to intensify climate change mitigation in effort to combat climate change and reducing disaster risk. The components to strengthen waste management are as follow:

Figure 2-6 Strengthening Waste Management Components in the Mid-Term Review of the Eleventh Malaysia Plan 2016-2020

2.5.5 Plastic Waste Importation

Importation of plastic waste must obtain import license (AP) from the Department of National Solid Waste Management (JPSPN). Plastic waste has been placed under the tariff code of HS 3915 in Part I under the Second Schedule of The Customs (Prohibition on Import) (Amendment) Order 2015. This is in accordance to The Customs (Prohibition on Import) (Amendment) Order 2015 where all imports to Malaysia are prohibited except that has Import License (AP).

2.5.6 Sustainable Development Goals

Sustainable Development Goals (SDG) were adopted by all UN Member States in 2015 which consists 17 goals. Good waste management will help to achieve the SDG related to solid waste towards sustainable development. The relevant SDGs related to solid waste management is shown below.

2.6 GUIDELINES AND GUIDANCE DOCUMENT

The EIA report shall refer to the relevant guidelines and guidance documents issued by DOE and other Government Agencies (GAs) on environment-related system and management. Besides that, other documents and notices issued from time to time, related to the EIA process and procedures shall be referred too. It is the responsibility of the Project Proponent and Qualified Person to determine and refer to the latest policies and guidelines. **Table 2-2** provided the list of relevant guidelines or guidance documents which some have been mentioned above.

Table 2-2 List of Relevant Guidelines or Guidance Document

No.	Guidelines/Guidance Documents	Source
1	Best Available Techniques Guidance Document on Waste Incinerator published by the DOE.	DOE Malaysia
2	Guidelines for Siting and Zoning of Industry and Residential Areas, Second Revised Edition, October 2012.	
3	Environmental Essentials for Siting of Industries in Malaysia, October 2017.	
4	The Technical Guideline for Sanitary Landfill, Design and Operation, 2004	JPSPN Malaysia
5	National Strategic Plan for Solid Waste Management 2005	
6	Garis Panduan Permohonan Kelulusan Bagi Pembinaan, Pengubahan atau Penutupan Kemudahan Pengurusan Sisa Pepejal Yang Ditetapkan	
7	Garis Panduan Permohonan Lesen Pengusahaan Atau Penyediaan Perkhidmatan Pengangkutan Oleh Pengangkutan Jauh	JPSPN Malaysia
8	Garis Panduan Penyimpanan (Storage) Sisa Plastik di Kilang	

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant information required for environmental assessment and compliance.

2.7 INTEGRATION OF ENVIRONMENTAL COMPLIANCE INTO PROJECT PLANNING

It is important for the Project Proponent to be aware of all the legal requirements on the environment and other associated requirements that could be one of the pre-requisites for the EIA approval. Environmental compliance is not all about fulfilling the requirements from the DOE and other Government Agencies (GAs) for the EIA study but needs to be seen at a bigger perspective throughout the entire cycle of the project.

A typical project cycle involves many phases and requires inputs from various technical specialists and consultants for submissions and applications to the various approving authorities as shown in **Figure 2-7** and **Table 2-3**.

The benefits of knowing or taking into consideration these requirements at the early development of the project are:

- Avoid any legal implications by the relevant authorities.
- Allow the Project Proponent to allocate sufficient budget to safeguard the environment (not only focusing on the EIA study).

Figure 2-7 Summary of Relevant Requirements at Various Project Implementation Stage

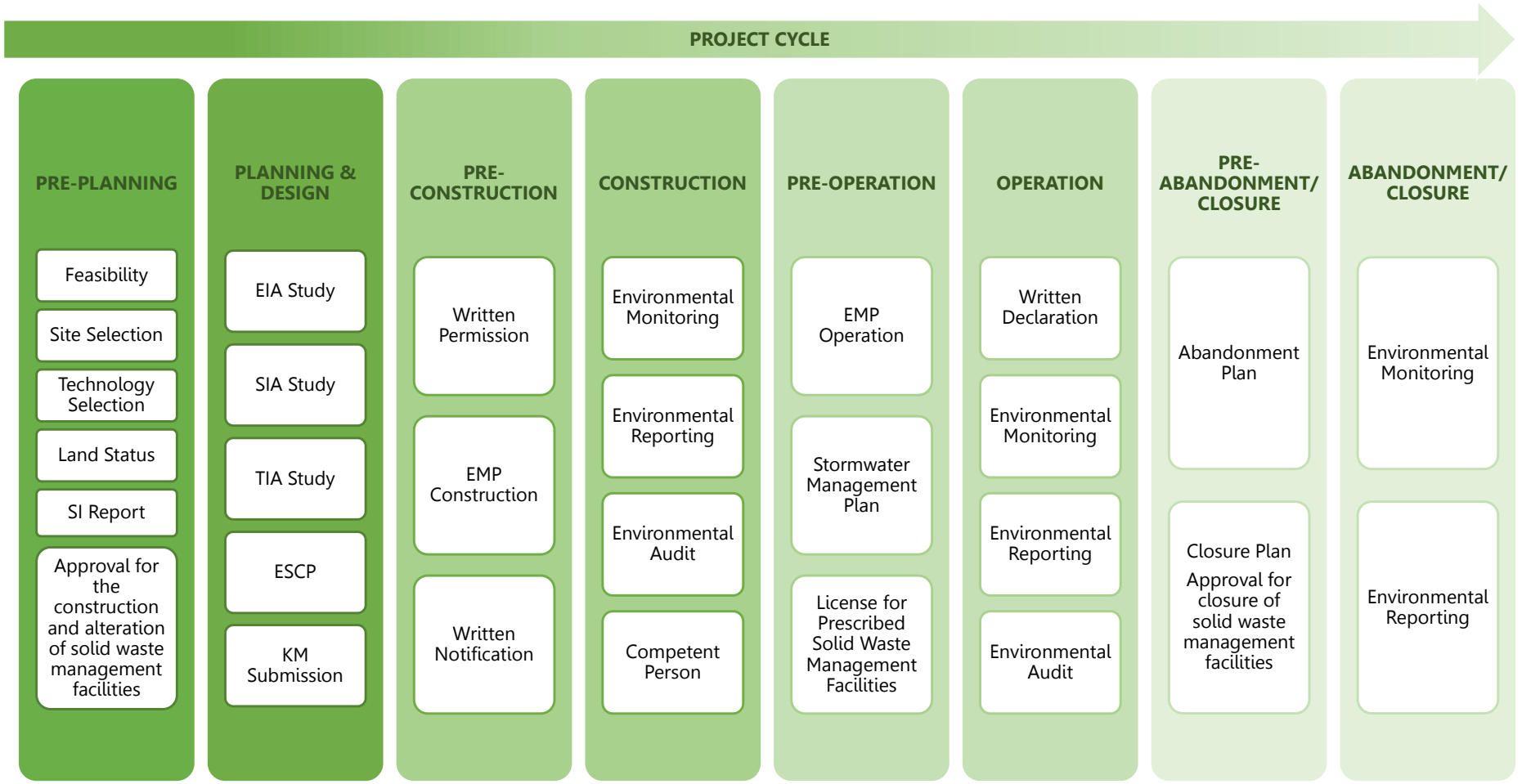


Table 2-3 List of Relevant Requirements at Various Project Implementation Stage

PRE-PLANNING		
Requirement	**Detail**	**Legal Provision**
Feasibility Study	• Assessment on TELOS – Technical, Economic, Legal, Operational and Scheduling	-
Site Selection	• Site suitability assessment	-
Technology Selection	• Create a technology shortlist	-
Soil Investigation (SI)	• Nature and characteristics of sub-soil below the ground level	• Geological Survey Act 1974 (Act 129)
Land Status	• Compatibility of the land	• National Land Code 1965 (Act 56)
PLANNING & DESIGN		
Department of Environment (DOE)		
Environmental Impact Assessment (EIA)	• TOR and ESI • Statement of need • Project options • Project description • Existing environment • Evaluation of impacts • Mitigation measures • Environmental Management Plan (EMP)	• Environmental Quality Act (EQA) 1974 • Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 • Environmental Quality (Industrial Effluent) Regulations 2009 • Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009 • Environmental Quality (Sewage) Regulations 2009 • Environmental Quality (Clean Air) Regulations 2014
PLANMalaysia		
Social Impact Assessment (SIA) –	• Screening • Scoping • Baseline study • Impact projection • Mitigation • Social Impact Assessment (SIA) – Not applicable in Sabah & Sarawak	• Town and Country Planning Act 1976 (Act 172)

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

PLANNING & DESIGN		
Requirement	**Detail**	**Legal Provision**
Department of Irrigation and Drainage (DID)		
Erosion and Sedimentation Control Plan (ESCP)	• Annual soil erosion rate. • Sediment yield. • Proposed erosion and sedimentation control measures. • Inspection and maintenance.	• Street, Drainage and Building Act 1974 [Act 133]
Department of Environment (DOE) / Ministry of Health (MOH)		
Health Impact Assessment (HIA) (note: to be incorporated into the EIA report	• Screening • Scoping • Description of existing public health status • Health risk assessment (HRA)	• Environmental Quality Act (EQA) 1974
Department of Mineral and Geoscience (JMG)		
Geological Assessment Report (note: to be incorporated into the EIA report)	• Subsurface geological profile: drilling/geophysical survey. • Permeability test results. • Construction materials – clay liner, clay blanket & filter sand. • Detailed groundwater regime. • Expected leachate movement and mitigative measures. • Potential groundwater, soil and rock pollution and mitigative measures. • Proposed groundwater monitoring network. • Flood prone area.	• Geological Survey Act 1974 (Act 129) • Geological Survey (Notification of Development of Wells and Excavations) Regulations 2013

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

PLANNING & DESIGN		
Requirement	**Detail**	**Legal Provision**
Public Works Department (PWD)		
Traffic Impact Assessment (TIA)	• Road & junction characteristics. • Traffic count survey. • Existing traffic condition evaluation. • Traffic forecast. • Impact assessment. • Mitigation measures.	• Road Transport Act 1987 (Act 333) • Town and Country Planning Act 1976 [Act 172]
Local Authority (LA)		
Development Order (Kebenaran Merancang)	• Approvals of various submissions to the technical agencies: ✓ EIA report – DOE. ✓ ESCP report – DID. ✓ TIA report – PWD. ✓ Geotechnical report – JMG (if required) ✓ SIA report – PLANMalaysia. ✓ TNB. ✓ IWK. ✓ BOMBA. ✓ DOSH. ✓ PTG. ✓ Various departments under Local Authority. ✓ Others.	• Town and Country Planning Act 1976 [Act 172]

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

PRE-CONSTRUCTION		
Requirement	**Detail**	**Legal Provision**
Jabatan Pengurusan Sisa Pepejal Negara (JPSPN)		
Approval for the construction and alteration of solid waste management facilities	Relevant plans and specifications	• Solid Waste and Public Cleansing Management Act (Act 672)
Department of Environment (DOE)		
Environmental Management Plan (EMP) for Construction	• Company's environmental policy. • Organisational structure. • Training requirements. • Environmental requirements. • Environmental Mainstreaming Tools (EMT).	• Environmental Quality Act (EQA) 1974
Written Notification	• <u>Air pollution control system:</u> ✓ Form AS/PUB/N-BAGFILTER - Written Notification on Air Emission Sources (Air Pollution Control System (Bag Filter)). ✓ Form AS/PUB/N-CHIMNEY - Written Notification on Installation of Exhaust/ Vent. ✓ Form AS/PUB/N-ESP - Written Notification on Air Emission Sources (Air Pollution Control System (Electrostatic Precipitator)). ✓ Form AS/PUB/N-APB - Written Notification on Air Emission Sources (Fuel Burning Equipment). ✓ Form AS/PUB/N-INS - Written Notification on Air Emission Sources (Incinerator).	• Environmental Quality (Clean Air) Regulations 2014 • Environmental Quality (Industrial Effluent) Regulations 2009

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

PRE-CONSTRUCTION		
Requirement	**Detail**	**Legal Provision**
Department of Environment (DOE)		
Written Notification	• <u>Air pollution control system:</u> ✓ Form AS/PUB/N-SCRUBBER - Written Notification on Air Emission Sources (Air Pollution Control System (Scrubber). ✓ Form AS/PUB/N-CYCLONE - Written Notification on Air Emission Sources (Air Pollution Control System (Centrifugal Dust Collector)). ✓ Form AS/PUB/N-JANA - Written Notification on Air Emission Sources (Generator). • <u>Water pollution control system:</u> ✓ Second Schedule – Notification for New or Altered Sources of Discharge of Industrial Effluent or Mixed Effluent ✓ First Schedule – Notification of New Sources of Leachate Discharge	• Environmental Quality (Clean Air) Regulations 2014 • Environmental Quality (Industrial Effluent) Regulations 2009
CONSTRUCTION		
Requirement	**Detail**	**Legal Provision**
Department of Environment (DOE)		
Environmental Monitoring	• Performance, compliance and impact monitoring such as: ✓ Ambient air monitoring. ✓ Noise monitoring. ✓ Silt trap discharge sampling. ✓ Surface water sampling.	• Environmental Quality Act (EQA) 1974
Environmental Reporting	• Form EIA 1-18 – EIA Project Information Status. • Form EIA 2-18 – EIA Approval Conditions Compliance Report.	• Environmental Quality Act (EQA) 1974

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

CONSTRUCTION		
Requirement	**Detail**	**Legal Provision**
Department of Environment (DOE)		
Environmental Audit	• Audit Site Administrative Details. • Regulatory Compliance Summary. • Audit Findings. • Recommendations.	• Environmental Quality Act (EQA) 1974
Competent Person / Certified by DOE	• Certified Erosion, Sediment and Storm Water Inspector (CESSWI). • Certified Inspection of Sediment and Erosion Control (CISEC)	• Environmental Quality Act (EQA) 1974 • Environmental Quality (air Quality) Regulations 2014
Department of Environment (DOE)		
Environmental Management Plan (EMP) for Operation	• Company's environmental policy. • Organisational structure. • Training requirements. • Environmental requirements. • Environmental Mainstreaming Tools (EMT).	• Environmental Quality Act (EQA) 1974
PRE-OPERATION		
SW Corp		
License for Prescribed Solid Waste Management Facilities	• Form JPSPN/2013/SUBPERATURAN4(1)6(1) • Details and financial capability of applicant • Information of prescribed solid waste management facility • Waste management technologies and processes used • Construction or alteration of prescribed solid waste management facility • Impact of construction	• Solid Waste and Public Cleansing Management (Prescribed Solid Waste Management Facilities and Approval for the Construction, Alteration and Closure of Facilities) Regulations 2011 • Solid Waste and Public Cleansing Management (Licensing) (Management or Operation of Prescribed Solid Waste Management Facilities) Regulations 2011

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

PRE-OPERATION		
Requirement	**Detail**	**Legal Provision**
Department of Irrigation and Drainage (DID)		
Drainage and Stormwater Management	• Project Location and Site Descriptions. • Proposed Project Development. • Site Identifications. • Hydrological Data Analysis. • Development of Stormwater Management Master Plan. • Drainage and Conveyance System Plans. • Wet/Dry Pond Plans. • Onsite Detention (OSD) Plans. • Gross Pollutant Traps (GPTs) Plans. • Filtration Plans and/or infiltration plans	• Street, Drainage and Building Act 1974 (Act 133)
OPERATION		
Department of Environment (DOE)		
Environmental Monitoring	• Performance, compliance and impact monitoring such as: ✓ Stack monitoring. ✓ Ambient air monitoring. ✓ Noise monitoring ✓ Leachate discharge monitoring. ✓ Industrial effluent. ✓ Surface water sampling. ✓ Groundwater sampling.	• Environmental Quality Act (EQA) 1974 • Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

OPERATION		
Requirement	**Detail**	**Legal Provision**
Department of Environment (DOE)		
Environmental Reporting	• Form EIA 2-18 – EIA Approval Conditions Compliance Report.	• Environmental Quality Act (EQA) 1974
Environmental Audit	• Audit Site Administrative Details. • Regulatory Compliance Summary. • Audit Findings. • Recommendations.	• Environmental Quality Act (EQA) 1974
Competent Person	• Certified Environmental Professional in Scheduled Waste Management (CePSWaM). • Certified Environmental Professional in Bag Filters Operation (CePBFO). • Certified Environmental Professional in Scrubber Operation (CePSO). • Certified Environmental Professionals in The Leachate Treatment Plant Operation (CePLTPO).	• Environmental Quality Act (EQA) 1974 • Environmental Quality (Clean Air) Regulations 2014 • Environmental Quality (Industrial Effluent) Regulations 2009 • Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009
Written Declaration	• Form AS/PUB/DECLARE – Written Declaration on Design and Construction of Air Pollution Control System. • Third Schedule - Written Declaration on Design and Construction of Industrial Effluent Treatment System.	• Environmental Quality (Clean Air) Regulations 2014 • Environmental Quality (Industrial Effluent) Regulations 2009
Emission Declaration	• Form AS/PUB/EMISSION - Emission Declaration of Air Emission Sources Under Regulations 18 of the Environmental Quality (Clean Air) Regulation, 2014.	• Environmental Quality (Clean Air) Regulations 2014

Table 2-3 List of Relevant Requirements at Various Project Implementation Stage (cont'd)

PRE-ABANDONMENT / CLOSURE		
Requirement	**Detail**	**Legal Provision**
Department of Environment (DOE)		
Abandonment/Closure Plan	• Overall decommissioning and abandonment/closure strategy.	• Environmental Quality Act (EQA) 1974
ABANDONMENT / CLOSURE		
Department of Environment (DOE)		
Environmental Monitoring	• Stack monitoring. • Surface water sampling. • Groundwater sampling.	• Environmental Quality Act (EQA) 1974
Environmental Reporting	• Report on the post abandonment/closure.	• Environmental Quality Act (EQA) 1974
Department of National Solid Waste Management (JPSPN)		
Approval for Closure of Solid Waste Management Facility	• Proposed closure plan • Information in accordance to Second Schedule of Solid Waste and Public Cleansing Management Act (Act 672)	• Solid Waste and Public Cleansing Management Act (Act 672)

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant requirements required for environmental assessment and compliance.

2.8 STAKEHOLDER ENGAGEMENT

2.8.1 Identification of Stakeholder

The EIA process has provided adequate mechanisms to enable the stakeholders to provide relevant inputs as well as contribute their views and comments for the decision-making process by the relevant approving authority. All the relevant inputs from the stakeholders will be addressed in the TOR and EIA reports.

There will be at least 2 stages of stakeholder engagements throughout the EIA process as follows:

- **Stage 1** – Preliminary engagement before to the preparation of TOR.
- **Stage 2** – Engagement during the preparation of EIA.

Generally, the stakeholders can be grouped into six groups **Figure 2-6**. Each group plays important and specific roles and shoulder different responsibilities in the EIA process. Satisfying the requirements of each of these groups, so far as is practical, is a key to a successful EIA.

[Note: Public engagement (public display and public comment) is mandatory for the Second Schedule EIA as stipulated in the sub regulation 3(3) of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) order 2015. However, voluntary public engagement is highly encouraged for the First Schedule EIA.]

Figure 2-6 Relevant Stakeholders to be Engaged in the EIA Process

2.8.2 Roles and Responsibilities

Table 2-4 below provides the list of possible stakeholders to be considered for stakeholder engagement process related to solid waste projects. Please note that the list provided below is an indicative, but non-exhaustive where the relevant stakeholders may vary depends on the project nature. The Qualified Person may identify any relevant stakeholders to be engaged for the project.

Table 2-4 Roles and Responsibilities of Possible Stakeholders in the EIA Study

Stakeholder	Roles and Responsibilities
Department of Environment (DOE)	• Administration of the EIA process under EQA 1974. • Responsible for the issuance of the COA for the EIA. • Post EIA approvals, monitoring and enforcement.
Project Proponent	• Plan, develop and/or manage the project. • Responsible for obtaining all necessary approvals for the project. • Involved in the management of the project at all stages of development.
Government Agencies: • Department of Mineral and Geoscience (JMG). • Land offices • Department of Public Works (PWD). • Department of Drainage and Irrigation (DID). • Federal Department of Town and Country Planning (PLANMalaysia). • Ministry of Health (MoH). • State Water Authority	• Provide relevant inputs in respective areas and expertise. • Review the impacts of the project to their respective area of interest. • Ensure the impacts to within the acceptable levels. • List of pertinent requirements that need to be addressed is shown in **Table 2-3**.
Approving Authority: • Department of National Solid Waste Management (JPSPN) • Federal agency. • State agency. • Local authority.	• Ensure the impacts to be within the acceptable levels. • Give approval to the project after due consideration.
Affected Groups: • Local community. • Business owner. • Land owner.	• Give relevant inputs for protection of local interest. • Give feedback to the impact findings.
Interest Groups: • NGO's related to environment. • Experts. • Environmental practitioners.	• Provide inputs based on their technical knowledge and expertise.

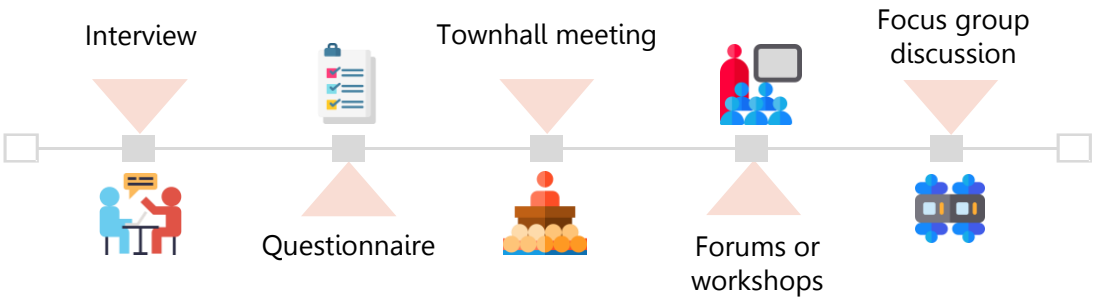
Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to identify the relevant stakeholders to engage for the project.

2.8.3 Method of Engagement

Several engagement methods can be used to engage with stakeholders as shown in **Figure 2-7**. Each method has its advantages and disadvantages. It is up to the Qualified Person to determine which method is suitable and effective in getting the

inputs from the stakeholders. For example, a one-to-one interview may give more inputs than a workshop but it consumes more time. Detailed explanation for the methods that can be used for public engagement can be referred in the Manual for Social Impact Assessment for Project Development Second Edition 2018 published by PLANMalaysia.

Figure 2-7 Stakehoder Engagement Methods



2.8.4 Documentation and Reporting

The public participation process shall be properly documented and reported in the EIA report. The report shall contain the following:

- Details of the programme (dates, venue, itinerary).
- Attendance list of participants.
- Copies of survey forms (if required).
- A brief summary of findings from the event, e.g. reports, minutes of the meeting, list of questions and responses, photographs of the event.
- Video or voice recordings (optional and only as reference).

The report shall form part of the appendix in the EIA report, and the issues brought up by the stakeholders and responses from the Project Proponent, shall be clearly stated and discussed in the EIA report.

This page has been intentionally left blank.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

3

TERMS OF REFERENCE (TOR)

CHAPTER 3

TERMS OF REFERENCE

3.1 INTRODUCTION

The Terms of Reference (TOR) is the first major milestone in the overall Environmental Impact Assessment (EIA) process. Typically, the TOR will:

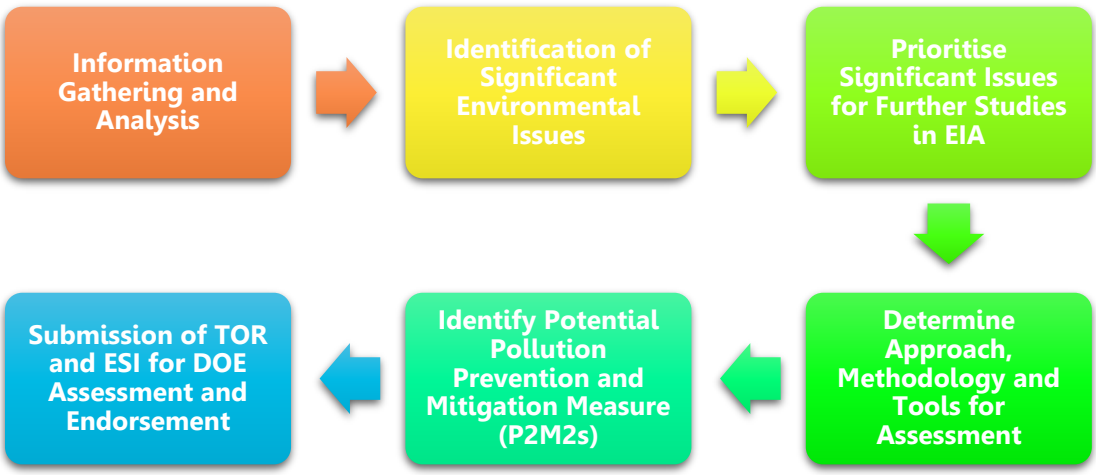
- Define the types of information to be presented in the EIA Report.
- Specify the assessments or studies to be performed.
- Identify the EIA team member to conduct the assessments or studies.
- State the study timeline.
- Outline the methodologies to be used in the evaluation of impacts.

3.2 ENVIRONMENTAL SCOPING

Scoping is very important to determine the key concerns and to set the scope of the EIA study. This helps the decision makers to receive information in a focus and clear manner, unhindered by voluminous reports containing irrelevant data assessment. **Figure 3-1** shows the general flow path for environmental scoping. There are several objectives of the scoping as follows:

- Sets the limits, boundaries and focus of the EIA Study.
- Defines the key environmental concerns which need to be addressed in detail.
- Determines the required baseline data.
- Sets the level of assessment and evaluation criteria.

Figure 3-1 Flow Path for Environmental Scoping



3.3 SITE SUITABILITY ASSESSMENT

A site suitability assessment (SSA) shall be undertaken to determine acceptability of the site in view of environmental consideration by the DOE. Alternatives and options shall be considered for the proposed site, concept, layout, design and methodologies.

Generally, these options are evaluated during the feasibility study whereby certain criteria are used for the areas identified such as site characteristics and project requirement. These criteria are assessed and ranked based on the priority where it helps in deciding the best option available. The outcome from the feasibility study will form the basis in the scoping exercise.

Practical pollution prevention and mitigation measures (P2M2s) and best management practices (BMPs) related to the development of waste treatment and disposal facilities will be incorporated in the final option as part of scoping exercise. Details of the SSA and its related comments shall be reported in the EIA report. **Table 3-1** shows the examples of considerations in project alternatives and options while site selection criteria for solid waste activities are appended in **Appendix B**.

Buffer requirement is one of the criteria in the site selection process. Two guidance documents published by the DOE can be used for guidance namely Guidelines for Siting and Zoning of Industry and Residential Areas (SZIRA 2012) and Environmental Essentials for Siting of Industries in Malaysia (EESIM 2017). The Local Authority will have the final decision on the buffer requirement which essentially depends on the findings of the impact evaluation in the EIA study and advice from the DOE.

A 'No Project' option shall also be assessed and its implications discussed comparatively with the 'With Project' option.

Table 3-1 Considerations in Project Alternatives and Options

No	Options	Considerations
1	Project siting	• Adherence to national, state and local policies and plans such as National Strategic Plan for Solid Waste Management in Malaysia by Department of National Solid Waste Management (JPSPN) • Site constraints to the project and vice versa • Location and proximity to sensitive receptors • Buffer/setback availability and requirements • Any alternative sites proposed for the project
2	Process technology options	• Availability of technology to minimise impacts • Best available technology (BAT) options (**Appendix J**). • Benchmarking with alternative technology • Green technology adoption • Cleaner production concept adoption • Refer to **Appendix C** for examples of technologies
3	Pollution prevention and mitigation measures (P2M2s) technology options	• Availability of technology to minimise impacts • Best available control technology (BACT) options (**Appendix J**). • Benchmarking with alternative technology • Green technology adoption • Zero waste or near zero emissions options
4	Project component and design	• Layout consideration • Choice of construction methods
5	Social	• Need for land acquisition or relocation • Location of workers' camp • Location within or close to sensitive land & historical sites, cemeteries, places of worship • Location within or close to populated areas, parks and scenic areas

Note: The list is not exhaustive and additional criteria / information may be required by relevant agencies. It is the responsibility of the Project Proponent and Qualified Person to engage with relevant agencies on case-by-case basis.

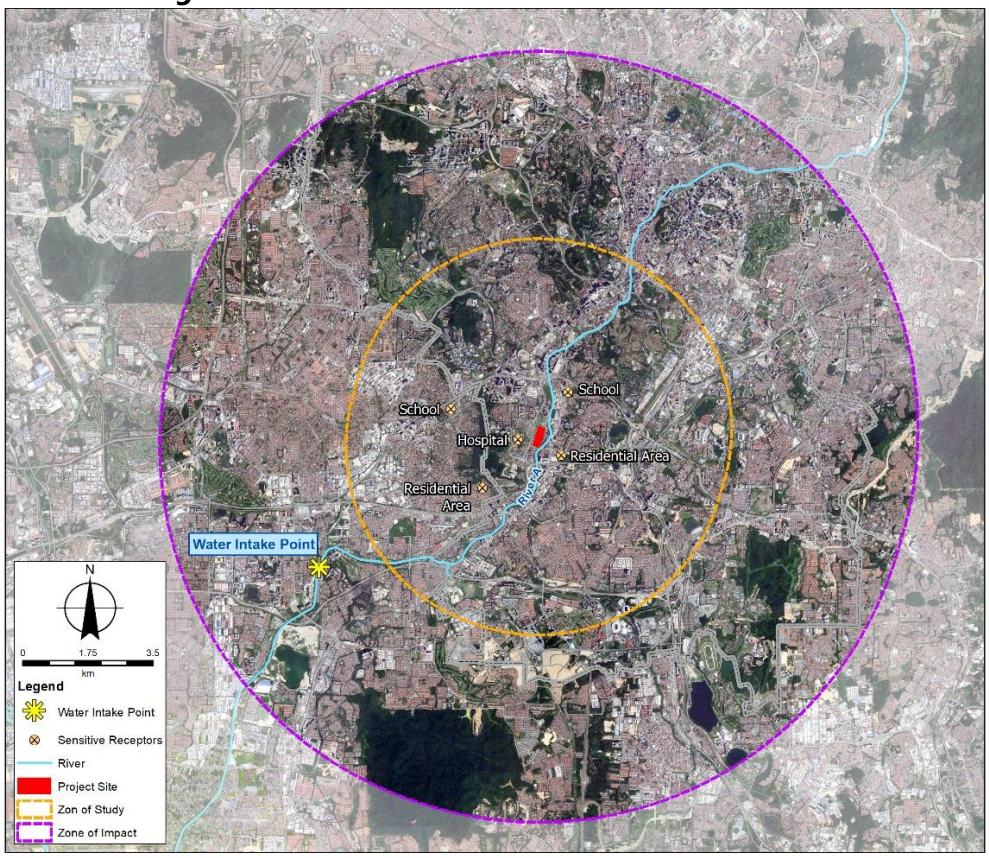
3.4 STUDY BOUNDARY

The study boundaries for each of the significant environmental elements shall be identified in the scoping exercise. These boundaries draw the limit of the study so that only necessary information is gathered and the impact assessment covers thoroughly the critical group of sensitive receptors. There are two types of boundaries as follows:

1) **Zone of Study (ZOS)** – The study area generally encompassing a 5-km radial zone from the project boundary. Qualified Person would need to define the limits of the spatial boundary for each environmental element depending on the location of the sensitive receptors.

2) **Zone of Impact (ZOI)** - The spatial area of the potential impacts could extend beyond the ZOS. The ZOI may vary depending on the size of the project. The extent of the ZOI shall be determined by the Qualified Person based on the nature and extent of significant impacts for example if there is a water intake point located outside of the ZOS but still within the impact range of the effluent discharge from the project, it should be considered as ZOI.

Figure 3-2 Illustration of ZOS and ZOI



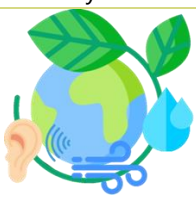
3.5 BASELINE DATA REVIEW

A reliable database is a vital element in undertaking an EIA study. The accuracy of predictions of impacts depends on the understanding cause-effect relationship and the status and changes to the physical, chemical, biological and human characteristics of the environment.

The scoping exercise defines the components of required data and the extent of baseline data collection. Construction of a comprehensive database with regards to the significant issues is important to ensure that the true understanding of the characteristics of the environment could be well established.

If certain environmental aspects have been identified as not significant in the scoping exercise, then that aspect could be omitted from the EIA study and therefore no baseline information need to be gathered. For instance, if vibration impact is not significant, then no baseline for vibration is needed for the EIA study. **Table 3-2** shows an indicative list of required baselines for all the solid waste prescribed activities.

Table 3-2 List of Required Baselines for Solid Waste Activities

No	Key Areas	Required Information	
1	 Physical	• Land use • Topography and terrain • Geology and hydrogeology	• Hydrology and river system • Climate and meteorology • Traffic
2	 Environmental	• Surface water quality • Groundwater quality • Marine water quality	• Air quality including odour • Noise and vibration • Soil quality
3	 Biological	• Terrestrial and aquatic flora • Terrestrial and aquatic fauna	• Environmental sensitive areas
4	 Socio-economic	• Demography • Public health • Development needs and potential	• Infrastructure facilities • Economic activities
5	 Infrastructure and utilities	• Physical communications • Points of access and transportation routes	• Essential infrastructure • Public amenities

Note: The list is not exhaustive and additional baseline information/ sampling may be required by relevant agencies. It is the responsibility of the Project Proponent and the Qualified Person to engage with relevant agencies on a case-by-case basis.

3.6 DETERMINATION OF KEY PROJECT ACTIVITIES

There are four main common activities involve throughout the entire lifecycle of the development of waste treatment and disposal facilities namely:

- Pre-construction phase;
- Construction phase;
- Operation phase; and
- Abandonment phase.

Generally, key project activities during pre-construction, construction and abandonment phases are quite common in nature. A big chunk of the activities during these phases revolve around civil and structural aspect particularly earthworks activities.

On the other hand, activities during the operation phase are different for each of the prescribed activity. These activities shall be determined by the Qualified Person together with the Project Proponent's team to make sure focus is given to address the key project activities. A general list of key project activities for the development of solid waste treatment and disposal facilities is appended in **Appendix D**.

3.7 IDENTIFICATION OF SIGNIFICANT IMPACTS AND PRIORITY SETTING

3.7.1 Priority Setting

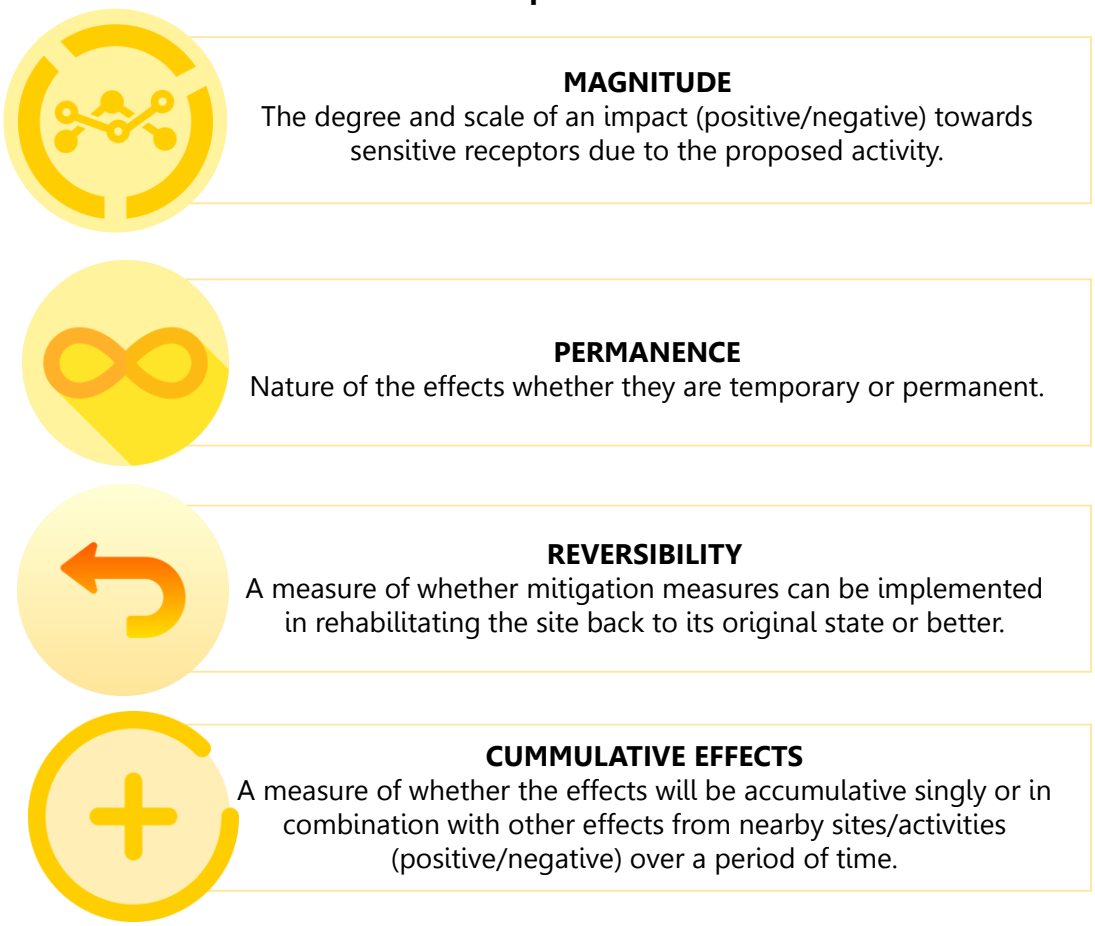
Following the identification of key project activities, a short list of key environmental issues is drawn up. This involves:

- **Categorization and grouping** of the effects under particular environmental components such as air, water quality, etc.
- **Priority setting:** Key issues or concerns are determined based on their importance, either by decision makers or the uncertainty in their significance of environmental impact that may results. Issues that can be excluded from further assessment are identified and reasons for their exclusion are documented in the EIA. Further issues, considered beyond the scope of the EIA, that need resolution are listed.

There are several criteria that need to be considered in setting the priority of the significant impact to be studied in the EIA (**Figure 3-3**). By considering all these criteria, the Qualified Person can use the Environmental Scoping Matrix (ESM) as one of the methods to produce a priority list or the likely significance of environmental impacts to be studied in the EIA (**Appendix E**). The impact significance will be further evaluated based on the impact assessment results in the EIA stage.

Figure 3-3 provides the indicative list of the potential environmental impacts to be evaluated in the EIA Study with the possible risk ranks. The list is not exhaustive and depends on the judgement of the Qualified Person as well as requirements from the respective Government Agencies.

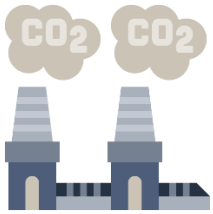
Figure 3-3 Criteria for Determining Significance of Environmental Impacts



3.8 KEY ISSUES RELATED TO SOLID WASTE TREATMENT AND DISPOSAL PROJECTS

Key issues related to the solid waste treatment and disposal projects that should be highlighted in the EIA report are tabulated in **Table 3-3**. The key issues identified below have taken into consideration the way forward in the solid waste treatment and disposal projects, whereby an integrated solid waste management facility is anticipated.

Table 3-3 Key Issues Related to Solid Waste Treatment and Disposal Projects

Key Issues	Potential Impacts
 Air quality & odour	• Fugitive dust emission from the site clearing and earthworks and movement of heavy vehicles during construction activities • Odour from the improper storage, improper landfilling operation, poor bunker design and equipment malfunction • Degradation of air quality due to emissions from solid waste treatment and disposal projects such as vehicular emissions and combustion process of thermal treatment plant: - Dust, PM_{10} and $PM_{2.5}$; - Methane, - Volatile organic compounds (VOCs); - Sulphur Dioxide (SO_2) and Nitrogen Oxide (NOx); - Hydrogen sulphide (H_2S) and Hydrogen Chloride (HCl); - Heavy Metals, and - Dioxin and Furan.
 Noise & vibration	• Noise and vibration generated by the vehicles transporting the solid waste to the treatment and disposal facility for further treatment or final disposal • Noise and vibration from machineries and equipment during construction • Noise and vibration generated from the plant equipment during operation
 Soil erosion & sedimentation	Risk of soil erosion during earthworks and site clearing that will increase the sediment loading in the receiving waterbodies
 Water quality	Generation of wastewater from the project activities such as: • Leachate generation from the sanitary landfill, on-site waste storage or waste sorting activities and bunker in thermal treatment plant • Plant washing and cleaning activity
 Groundwater quality	Accidental spillage/unintended release of: • Leachate from the sanitary landfill if the liners are punctured • Scheduled waste from storage and process areas
 Quantitative risk	Accidental fire, toxic dispersion and explosion due to: • Unintended releases of hazardous substances from waste storage, tank farm and process areas • Incompatible scheduled waste storage • On-site diesel storage area • Scavengers activities • Self-ignition by sun on exposed waste

Key Issues	Potential Impacts
 Health impact	Health risks to the local residents, workers and scavengers from prolonged: • Inhalation of air emissions release into the atmosphere; • Ingestion of effluent/leachate discharge into the river or groundwater • Explosion risk-burning incompatible waste • Effect of dioxin and furan
 Waste management	Generation of waste from the following process: • Fly ash and bottom ash generated from the operation of thermal treatment plant • Residues from on-site waste recovery (If any) • Sludges from the operation of Industrial Effluent Treatment System (IETS) and Leachate Treatment System (LTS)
 Socio-economic	Change in socio-economic environment caused by daily operation of solid waste treatment and disposal activities (positive/negative)
 Traffic	• Spillage of solid waste onto public road may create traffic impedance and inconvenience to the road users • Increase in traffic in the road network system • Spillage of liquid waste (waste juice) from waste truck
 Visual and aesthetic	Change in the existing view with the presence of new solid waste treatment and disposal projects

Note: The key issues listed above may differ according to the project activities and inputs. The Qualified Person shall further scrutinise the key issues and potential impacts that will be generated from the specific prescribed activity. Refer to **Chapter 5.2** for further guidance.

3.9 ESTABLISHMENT OF STUDY REQUIREMENT

Several individual studies are required to address the identified impacts of the project activities. The type of study is dependent on the scale and extent of the Project Site by considering the adjacent land uses and sensitive receptors. The Qualified Person shall provide the methodologies, assessment or modelling tools, and expected outputs for each study.

Table 3-4 shows the general studies required for the solid waste treatment and disposal projects. Consultation between the Qualified Person and related Government Agencies is important to ensure all the requirements by Government Agencies are covered in the EIA report.

Table 3-4 List of Applicable Studies to be Considered in the EIA Report

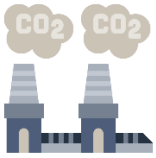
Type of Study	Government Agencies	Prescribed Activity				
		First Schedule		Second Schedule		
		Construction of Composting Plant	Construction of Recovery Plant or Recycling Plant	Construction of Thermal Treatment Plant	Construction of Sanitary Landfill	Construction of Transfer Station
Air Quality Assessment	DOE	✓	✓	✓	✓	✓
Water Quality Assessment	DOE/DID	✓	✓	✓	✓	✓
Waste Management	DOE	✓	✓	✓	✓	✓
Noise and/or Vibration Assessment	DOE	✓	✓	✓	✓	✓
Hydrogeological Assessment	DOE/JMG	✓		✓	✓	✓
Geological Assessment	DOE/JMG	✓		✓	✓	✓
Quantitative Risk Assessment (QRA)	DOE/DOSH			✓	✓	✓
Health Impact Assessment (HIA)	DOE/MOH	(if required)		✓	✓	✓
Socio Economic Study	DOE	(if required)		✓	✓	✓
Social Impact Assessment (SIA)	PLAN Malaysia			✓ (*)	✓ (*)	
Soil erosion and sedimentation assessment including LD-P2M2	DOE/DID	✓		✓	✓	✓
Erosion Soil Control Plan (ESCP)	DID	✓		✓	✓	✓
Traffic Impact Assessment (TIA)	PWD	✓		✓	✓	✓
Geotechnical Survey	JMG / PWD	(if required)		✓	✓	✓
Soil Investigations (SI)	JMG / PWD	✓		✓	✓	✓
Ecological Study (terrestrial and aquatic flora and fauna)	PERHILITAN / FDPM / DOF	(if required)				

Note:
The list is not exhaustive and additional studies may be required by relevant agencies. It is the responsibility of the Project Proponent and the Qualified Person to engage with relevant agencies on a case-by-case basis.
(*) Refer to the Manual for Social Impact Assessment for Project Development Second Edition (2018)

3.10 SELECTION OF MITIGATION MEASURES

After the significant impacts have been determined, possible mitigation measures shall be identified based on the Best Available Techniques Economically Achievable (BATs), Best Management Practices (BMPs) from similar projects and other options for pollution prevention and mitigation measures (P2M2s) to address these identified impacts. Possible mitigation measures for pre-construction, construction, operation and abandonment phases shall be described qualitatively in this section and to be further detailed in the EIA study. **Table 3-5** shows the example of brief descriptions of possible mitigation measures to be implemented.

Table 3-5 Brief Descriptions for Mitigation Measures

Environmental Impacts	Descriptions of Mitigation Measures
 Land acquisition	Engage the affected communities with regards to land acquisition and relocation at the early stage to minimize adverse impacts and ensure adequate support and fair compensation, to be further detailed in the Social Impact Assessment.
 Water quality	Treatment of sediment, sewage and wastewater as well as control of water pollution including those which may arise from accidental discharge and spillage.
 Soil erosion & sedimentation	Implement land disturbing pollution prevention and mitigation measures (LD-P2M2) to minimize soil erosion and sedimentation to the identified watercourses.
 Air quality and odour	Control of point and fugitive sources air emissions and odour.
 Noise & vibration	Control noise level and vibration levels to acceptable limits during construction and operational phases to minimize nuisance to the communities.
 Health risk	Protection of social well-being and health of surrounding population within the impact zone.

Environmental Impacts	Descriptions of Mitigation Measures
 Solid wastes and scheduled wastes	Implement best management practices to handle the biomass, construction, solid and scheduled wastes.
 Fire & explosion risk	Safety and risk planning and management to minimise risks of fire and explosion as a result of accidental events.
 Ecology	Minimise disturbance to the ecology by implementing by formulating and implementing the wildlife management plan, etc.
 Traffic	Minimize traffic congestion during the construction and operation phases by formulating and implementing traffic management plans.

3.11 STUDY TEAM

The Project Proponent is required to appoint a Qualified Person to conduct an EIA for any prescribed activities (i.e. solid waste treatment and disposal) as stipulated in Section 34A (2) of the Environmental Quality Act 1974. A Qualified Person is an individual who is registered with the DOE (i.e. Environmental Consultant or Subject Specialist). **Figure 3-4** shows the proposed study team to be considered for the preparation of the EIA report for the solid waste and treatment activities. The EIA Team Leader shall identify his or her team members according to the potential environmental issues that may arise.

3.11.1 Requirement for Engaging Qualified Consultants to Prepare Detailed Design of Pollution Control System at the EIA Stage

The DOE has announced a new requirement that the EIA Team Leader shall include a Qualified Consultant under the EIA study team to prepare the detailed design for the pollution control system. The pollution control systems in this notice referred to:

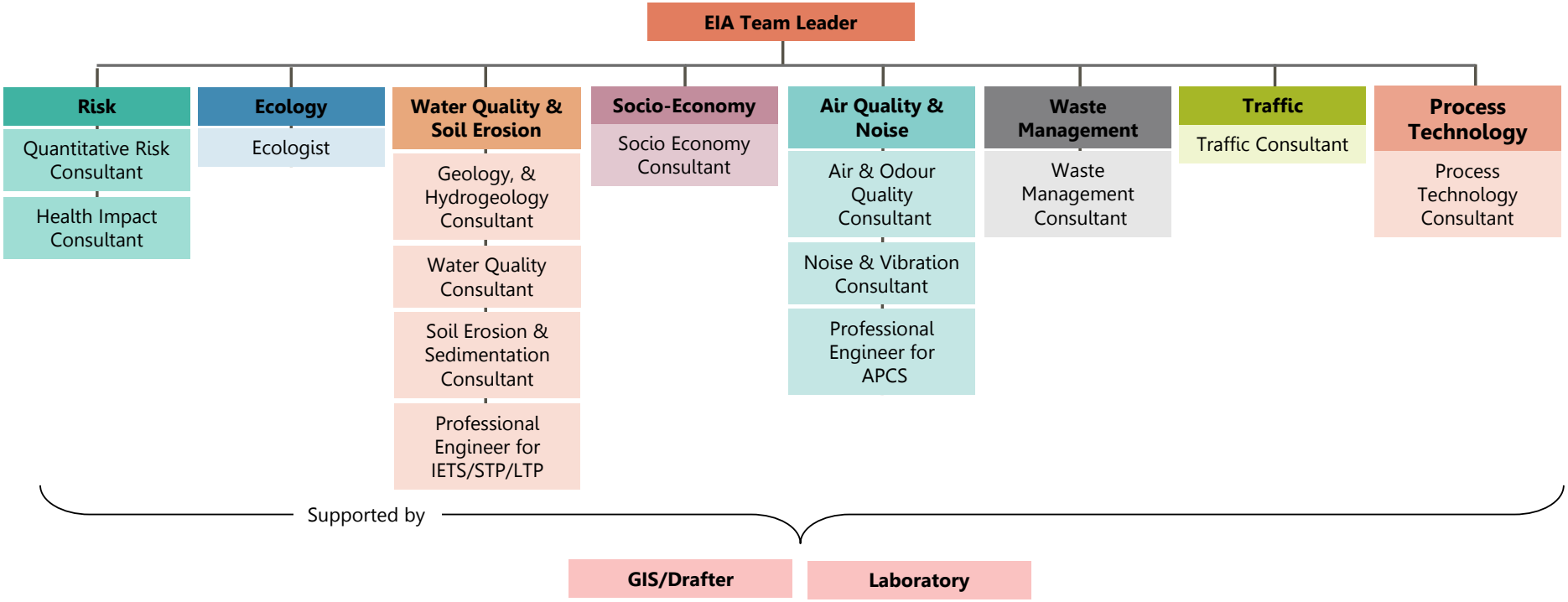
- Industrial Effluent Treatment System (IETS);
- Air Pollution Control System (APCS);
- Leachate Treatment Plant (LTP); and
- Sewage Treatment Plant (STP).

The Qualified Consultant must be a professional engineer who is registered under Section 10(2) of the Registration of Engineers Act 1967 (Revised 2015).

3.11.2 Requirement for Engaging Competent Professionals to Prepare Land Disturbing Pollution Prevention and Mitigation Measures

Another requirement from the DOE is the engagement of a Competent Professional to prepare the LD-P2M2 whenever there are land disturbing or site preparation activities. This requirement is specified in the Appendix 4 - Guidance Document for the Preparation of the Document on Land-Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) EGIM. The Qualified Professional must be a registered consultant and holds a Certified Professional in Erosion and Sediment Control (CPESC) certification recognised by the DOE.

Figure 3-4 Proposed EIA Study Team for Construction of Sanitary Landfill



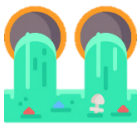
Notes:

1. A geology and hydrogeology consultant is a person registered under the Board of Geologist in accordance to the Geologist Act 2008 (Act 689).
2. A Professional Engineer is a person registered under Section 10(2) of the Registration of Engineers Act 1967 (Revised 2015).
3. Appointed laboratory conducting environmental monitoring and analysis of environmental samples shall be accredited with Skim Akreditasi Makmal Malaysia (SAMM).
4. IETS means Industrial Effluent Treatment System.
5. STP means Sewage Treatment Plant.
6. LTP means Leachate Treatment Plant.
7. APCS means Air Pollution Control System.
8. List of the EIA Study team is not exhaustive. The EIA Team Leader shall identify his or her team members according to the potential environmental issues that may arise.

3.12 PREPARATION OF TOR/ESI

Results from the screening and scoping exercises are translated into the Environmental Scoping Information (ESI) and subsequently into the Terms of reference (TOR). The ESI identifies the issues to be addressed in detail, whereas the TOR sets the objectives, defines the scope, and establishes the strategy and schedule for the EIA process to address these issues. If any new information which was not highlighted in the scoping report or at the time of TOR comes to the attention of the DOE, new components and parameters can be added to the EIA Study. **Table 3-6** shows the typical contents of a TOR document which is following the format detailed under the Guidance Document for Preparing TOR under Appendix 8 of the EGIM.

Table 3-6 Contents of a Typical TOR for EIA Report

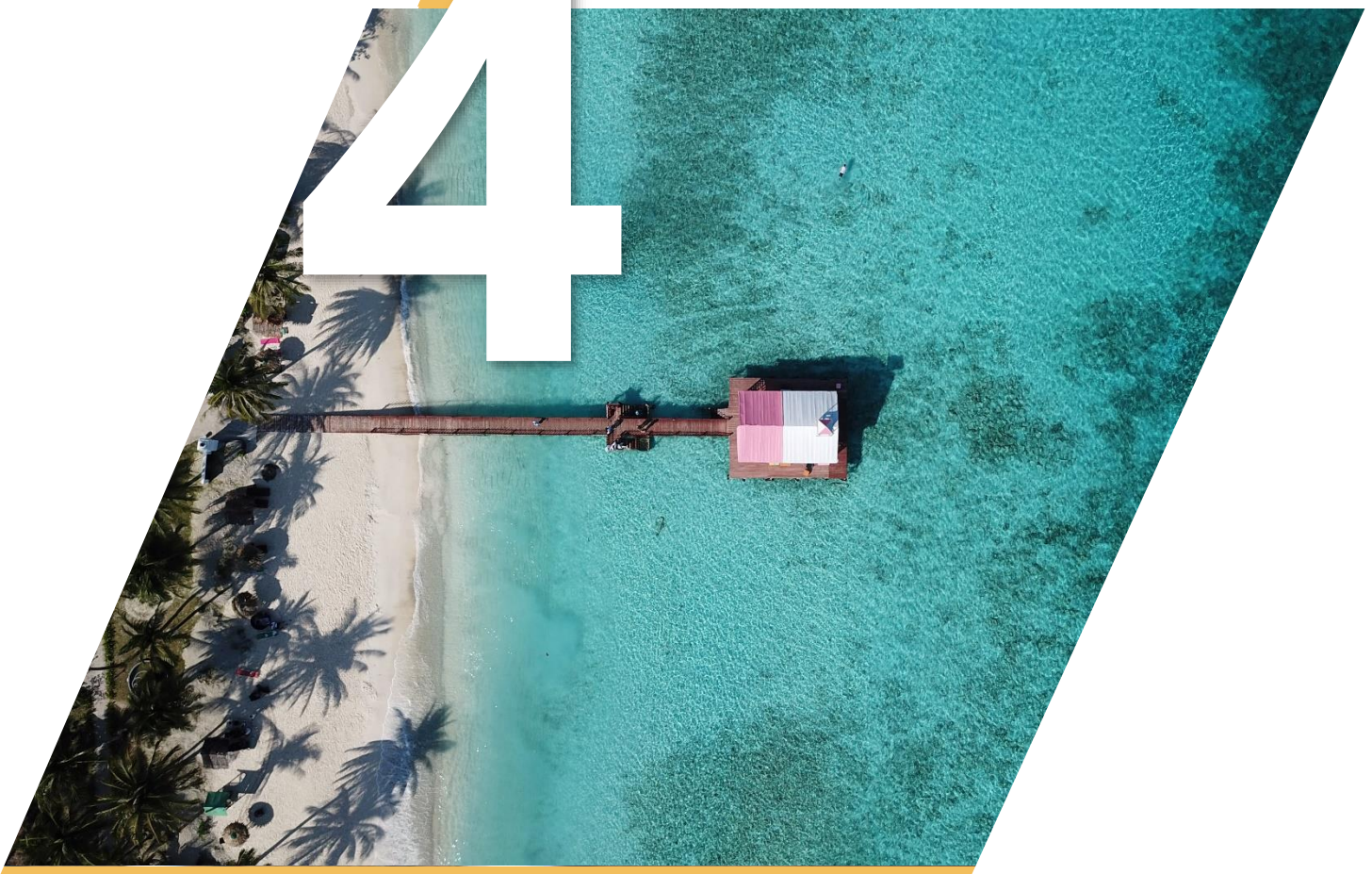
Contents	Description
 Introduction	This Terms of Reference is for the preparation of an Environmental Impact Assessment (EIA) Study for "Project Title".
 List of Consultant/Study Team	Details of each individuals (must be registered with DOE) who will carry out the EIA study, which include: • DOE Registration number. • Academic background. • Experience. • Area of study. • Declaration (signatures). The EIA consultant team is to be led by a Team/Project leader/ manager who is responsible for the EIA report. Include contact details (complete address, phone and fax numbers) of the appropriate and responsible person(s) to whom enquiries regarding EIA should be directed.
 Project Scope	List out those components of the Project which fall under the Prescribed Activities under the EIA Order, and describe with enough details to understand the scope of the significant project work components, without the technical details, including a well described engineering implementation programme of the Project.
 Alternatives Consideration	Outline alternative solutions (project site, technologies, etc) that will be studied or described to justify that the Project will result in the least environmental impacts.
 Environmental Impacts	List and describe those significant environmental impacts which will potentially be affected by the project works or components which will need to be covered in detail in the EIA.

Contents	Description
 Study Boundary	Delineate study boundaries for each of the above significant environmental elements to be investigated, and identifying the critical groups of sensitive receptors and how the impacts on the sensitive receptors will be studied.
 Assessment Standards	List out standards, criteria, acceptable limits, etc that will be used to obtain baseline data and assess the environmental impacts.
 Timeline of Study	Details of all studies/investigations to be carried out: who, where, when, how, etc. with indicative dates.
 Consideration of Concurrent Projects	List out potential concurrent or planned project that may result in cumulative impacts.
 Description of Modelling Tools and Assessment Methodologies	List out modelling tools, methodologies, etc for undertaking impact assessment and evaluation of significance. The extent of accuracy of these tools will also need to be provided, including, name of models, applicability of models and tools, verifiability of results, how results are verified, grid size (for water modelling).
 Possible Mitigation Measures	Outline possible mitigation measures or best management practices from similar projects that may be used to address the environmental impacts on this project.

EIA GUIDELINES

Waste Treatment and Disposal - Solid Waste

4



BASELINE DATA

CHAPTER 4

BASELINE DATA

4.1 INTRODUCTION

An EIA shall contain a description of the existing environment before the project development (termed as "baseline conditions") that may or may not be affected directly or indirectly from the proposed project.

Objectives for the description on baseline conditions include:

a) Identify existing environmental conditions which may influence project design decisions (e.g. site layout, structural or operational characteristics).
b) Identify sensitive issues or areas requiring mitigation or compensation.
c) Provide input data to analytical models for prediction of impacts.
d) Provide baseline reference for compensation during project implementation stage

The following Chapters shall detail the requirements for baseline data collection as part of the EIA.

4.2 BASELINE DATA COLLECTION

Usually, preliminary baseline data are required for the preparation of TOR/ESI. This is to provide an overview of the existing environment to determine the suitable approach and methodology for the impact assessment. For example, if the project were to discharge effluent into the estuarine area, suitable modelling tools and water sampling approaches should be used to consider the tidal effect.

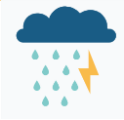
The approach and methodology in obtaining detailed baseline data and technical studies will be identified in the TOR/ESI. Generally, the detailed baseline data, particularly baseline monitoring (e.g. air, water and noise), can be carried out once the DOE endorses the TOR.

Baseline data can be collected from the following sources:

1) Primary source (field studies); and
2) Secondary source (desktop studies).

Baseline studies required for various components listed in **Table 4-1**.

Table 4-1 Scope and Requirement for Various Environmental Components

Components	Requirements	Data Sources
Physical		
 Land-use	• Land use maps and photos. • Description of existing and future land use. • Identification of Environmentally Sensitive Areas (ESAs) and impact receptors. • Land-use compatibility assessment. • Location of airport must be established (if required)	**Primary Source:** ✓ Site survey. ✓ Aerial photos (Drone). **Secondary Source:** ✓ Topography map (JUPEM). ✓ Satellite imagery (Google Earth). ✓ Structure Plan and Local Plan (PLANMalaysia). ✓ Local Authority. ✓ Industrial park developer.
 Geology and Hydrogeology	• Description of local and regional geology. • Locations of aquifer and groundwater abstraction wells.	**Secondary Source:** ✓ Geological maps (JMG). ✓ Hydrogeological maps (JMG). ✓ Past studies and literature within the project area
 Soil and Terrain	• Soil investigation (SI). • Soil erosion potential. • Description of existing topography. • Construction suitability map.	**Primary Source:** ✓ Site survey. ✓ SI report. ✓ Land surveyor report. **Secondary Source:** ✓ Soil erosion risk map (DOA). ✓ Reconnaissance soil map (DOA). ✓ Past studies and literature within the project area
 Hydrology and Drainage	• Description of hydrological systems within project area and zone of study or zone of impact, whichever is greater. • Flood prone areas. • Drainage network.	**Primary Source:** ✓ Site survey. **Secondary Source:** ✓ Topography map (JUPEM). ✓ Flood map (DID). ✓ Drainage network (Local Authority). ✓ Past studies and literature within the project area.
Environmental		
 Climate	• Climate data (minimum 10 years). • Surface air data. • Upper air data.	**Secondary Source:** ✓ METMalaysia. ✓ 5th Generation Mesoscale Model (NCAR MM5). ✓ Weather Research and Forecasting (WRF) mesoscale model. ✓

Components	Requirements	Data Sources
Environmental		
 Water Quality	**Surface Water:** • Sampling and analysis of surface water quality. • Measurement of flow rate in waterways at the project area (if required). • Locations of water pollution sources. • Identification of downstream receptors such as water intake points, fish cage cultures, recreational park, etc. • River hydraulic data. • River water quality trends. **Ground Water:** • Sampling and analysis of ground water quality. • Identification of ground water flow regime. **Marine Water (if necessary):** • Sampling and analysis of marine water quality.	**Primary Source:** ✓ Water sampling. ✓ Site survey. ✓ Geophysical study (if necessary). **Secondary Source:** ✓ Hydraulic data (DID). ✓ State Water Authority (e.g. LUAS). ✓ Groundwater (JMG). ✓ Environmental Quality Report and Environment Quality Monitoring System (DOE). ✓ Compendium of Environment Statistics by the Department of Statistics (DOSM). ✓ Past studies and literature within the project area.
 Air Quality	• Sampling and analysis of ambient air quality (including odour if necessary) of the project site and nearby sensitive receptors. • Locations of air pollution sources. • Identification of air sensitive receptors. • Air quality trends.	**Primary Source:** ✓ Air monitoring. ✓ Site survey. **Secondary Source:** ✓ Environmental Quality Report and Environment Quality Monitoring System (DOE). ✓ Compendium of Environment Statistics by the Department of Statistics (DOSM). ✓ Past studies and literature within the project area
 Noise and Vibration	• Measurement and analysis of ambient noise and vibration levels of the project site and nearby sensitive receptors. • Locations of noise pollution sources. • Identification of sensitive receptors.	**Primary Source:** ✓ Noise and vibration monitoring. ✓ Site survey. **Secondary Source:** ✓ Past studies and literature within the project area.

Components	Requirements	Data Sources
Biological		
 Ecology	• Description of existing ecology and habitats. • Identification of ESAs (forest reserve, wildlife reserves and sanctuaries, wetlands, mangroves, fisheries, etc.). • Presence of endemic, rare, threatened, endangered and near extinct flora and fauna.	**Primary Source:** ✓ Ecological survey. **Secondary Source:** ✓ JPSM. ✓ PERHILITAN. ✓ DOF. ✓ DOE. ✓ Past studies and literature within the project area.
Socio-economic		
 Demography	• Data on demography and socio-economic profiles of stakeholders within the ZOI.	**Primary Source:** ✓ Field survey. ✓ Social Impact Assessment (SIA) report. **Secondary Source:** ✓ Local profile reports from community leaders. ✓ Population Census (DOSM). ✓ Local Plans (Local Authority). ✓ Past studies and literature within the project area.
 Public Health	• Communicable disease data (monthly data for at least 1 year). • Chronic non-communicable disease (yearly data for at least 5 years). • Health prevalence within the ZOI. • Health issues within the ZOI. • Site specific exposure (not mandatory).	**Primary Source:** ✓ Field survey. **Secondary Source:** ✓ State Health Department. ✓ Past studies and literature within the project area.
 Road Network and Traffic	• Access to the project site. • Existing traffic condition within and surrounding the project site.	**Primary Source:** ✓ Traffic survey. ✓ Traffic Impact Assessment (TIA) report. **Secondary Source:** ✓ Road Traffic Volume Malaysia (JKR). ✓ Past studies and literature within the project area.

Components	Requirements	Data Sources
Socio-economic		
 Infrastructure, Utilities and Amenities	• Availability of existing and future utilities (water, electricity, sewerage, waste management, road networks, telecommunications, etc.). • Identification of existing and proposed sewerage lines.	**Secondary Source:** • Water Supply Authority/Providers. • Indah Water Konsortium (IWK) or State-based Sewerage Operator. • Tenaga Nasional Berhad (TNB). • JKR. • Local Authority. • Past studies and literature within the project area.
Cultural/Heritage		
 History, Culture and Archaeology	• Locations of historical and cultural sites. • Location of Orang Asli areas and settlements.	**Secondary Source:** ✓ National Heritage Department. ✓ Department of Museum. ✓ JAKOA. ✓ Past studies and literature within the project area.

Note: The list is not exhaustive, and not all items listed above are applicable to all EIA studies. The subject areas to be covered in the baseline study should focus only on those aspects that are likely to be affected. The areas generally depend on the nature, scale, location of the proposed project, and the extent of the impact.

4.3 BASELINE MONITORING AND ANALYSIS

Baseline monitoring is one of the primary sources of data. These data are collected to complement the information identified during the TOS/ESI stage for detailed assessment. Additionally, DOE also has the right to request for more additional baseline data if the Project impose significant impact(s) or the baseline data collected does not represent the extent of impact of the project.

The baseline monitoring area shall be carried within the boundary of the project site and nearby sensitive receptors within the Zone of Study (ZOS) as mentioned in **Chapter 3.5**. However, if the impacts are predicted to be much farther away, the Qualified Person shall include the sensitive receptors within the Zone of Impact (ZOI) in the baseline monitoring programme. For example, if there is a water intake point located outside of the ZOS but still within the impact range of the effluent discharge from the project, the water sample shall be collected there.

Generally, the validity of baseline data collection for an EIA study is within two (2) years from the date of field monitoring. If the duration of EIA study extends for more than 2 years, the collected baseline data can still be used provided that the Qualified Person can justify that there are no significant changes to the surrounding physical, biological and human environments within the zone of impact of the project site.

Samples collected must be analysed by a *Skim Akreditasi Makmal Malaysia* (SAMM) accredited laboratory. This includes ensuring that the analysis method for each parameter is SAMM accredited. The laboratory report or at least the Certificate of Analysis (COA) shall be included in the EIA as an appendix. The list of baseline monitoring and analysis is appended in **Appendix F**.

4.3.1 Good Practices for Sampling

The criteria for selection of suitable sampling sites for water quality, air quality, odour, noise quality and vibration as follows:

Water Quality

The sampling practice for water quality measurement can be referred field work and sampling from UNEP/WHO. Some general practice to be considered from the procedure when conducting water quality sampling are as follow:

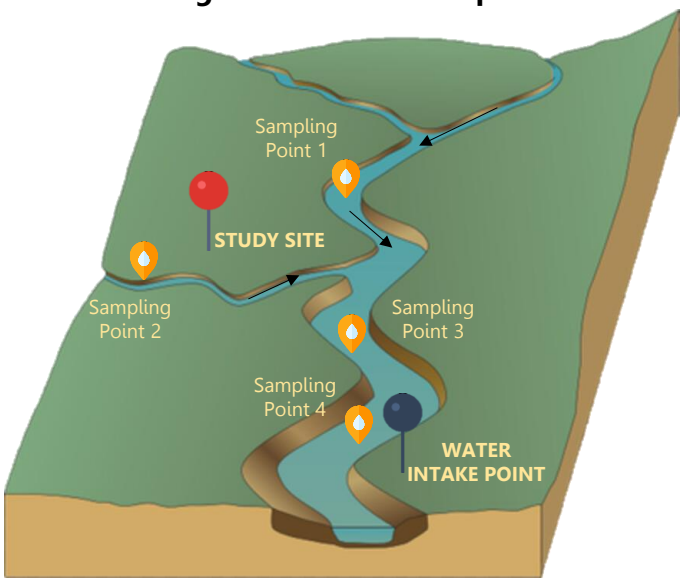
- Sites must be easily and safely accessed under all weather conditions.
- Sampling depth is measured from the water surface to the middle of the sampler.
- A bottle that is to be used for transport or storage of the sample should be rinsed three times with portions of the sample before being filled. This does not apply, however, if the storage/transport bottle already contains a preservative chemical.
- The temperature of the sample should be measured and recorded immediately after the sample is taken.
- At any time that the sample bottles are not closed, their tops must be kept in a clean place.
- A small air space should be left in the sample bottle to allow the sample to be mixed before analysis.
- All measurements taken in the field must be recorded in the field notebook before leaving the sampling station.
- All supporting information should be recorded in the field notebook before leaving the sampling station. Such conditions as the ambient air temperature, the weather, the presence of dead fish floating in the water or of oil slicks, growth of algae, or any unusual sights or smells should be noted.
- Samples should be transferred to sample bottles immediately after collection if they are to be transported.
- Sample bottles should be placed in a box for transport to the laboratory. Sturdy, insulated plastic boxes will protect samples from sunlight, prevent the breakage of sample bottles, and should allow a temperature of 4 °C to be attained and maintained during transport.

Example of water sampling is shown in **Figure 4-1** to **Figure 4-3**

Figure 4-1 Example of river water sampling

Figure 4-2 Example of water quality testing with a meter on a collected sample

Figure 4-3 Examples of water sampling locations



Note:

Sampling Point 1 & 2

To obtain baseline river water quality before sewage discharge point

Sampling Point 3

To obtain baseline river water quality after sewage discharge point

Sampling Point 4

To obtain baseline river water quality after sewage discharge point near

Water intake point (if present)

This is to observe the impact of sewage discharge to the water supply operation

Groundwater Quality

The sampling practice for groundwater quality measurement can be referred Groundwater Sampling Procedure from USEPA (SESDPROC-301-R4). Some general practice to be considered from the procedure when conducting groundwater sampling are as follow:

- Always sample from the anticipated cleanest, i.e., least contaminated location, to the most contaminated location. This minimizes the opportunity for cross-contamination to occur during sampling.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately.
- Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if purging and sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same cooler as environmental (i.e., containing low contaminant levels) or background samples.
- Clean plastic sheeting will be placed on the ground at each sample location to prevent or minimize contaminating sampling equipment by accidental contact with the ground surface.
- Samplers must use new, verified certified-clean disposable or non-disposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) for collection of samples for trace metals or organic compound analyses.
- During sample collection, make sure that the pump discharge line or the bailer does not contact the sample container.

- All samples requiring preservation must be preserved as soon as practically possible, ideally immediately at the time of sample collection.
- Sample containers should be placed in an ice-filled cooler as soon as possible after filling. Ice in coolers should be in bags with minimal pooled water and the cooler should be periodically checked and replenished to maintain sample storage temperature.
- In order to determine when a well has been adequately purged, field investigators should monitor, at a minimum, the pH, specific conductance and turbidity of the groundwater removed and the volume of water removed during purging. The measurements should be recorded in a purge table in the field logbook that includes the start time of purging, the parameter measurements at intervals during purging, estimated pumped volumes, depths to water for Low-Flow sampling, and any notes of unusual conditions.

Example of groundwater sampling is shown in **Figure 4-4**

Figure 4-4 Example of groundwater sampling

Air Quality

The Qualified Person should consider the following when placing air sampling station [adopted from the Superfund Program Representative Sampling Guidance, Volume 2: Air (Short-Term Monitoring) 1995 by USEPA and IS 5182 (Part 14):2000 Methods for Measurement of Air Pollution, Part 14: Guidelines for Planning the Sampling of Atmosphere]:

- Location of potential on-site emission sources, as identified from the review of site background information or from preliminary on-site inspections.
- The impact of potential off-site emission sources located upwind of the sampling location(s). Study local wind patterns to determine the location of off-site sources.
- Location of topographic features which affect the dispersion and transport of airborne toxic constituents. Avoid natural obstructions when placing air monitoring stations, and account for channelization around those obstructions. (As a general rule, the distance away from the obstruction should be 10 times the height of the obstruction.)
- Proximity of large water bodies which affect atmospheric stability and dispersion of air contaminants.
- Roadways (dirt or paved) which may generate dust that could mask site contaminants. Traffic patterns may also affect results.
- Vegetation such as trees and shrubs which stabilize soil and slow the process of subsurface contaminants becoming airborne. Vegetation also affects air flow and scrubs some contaminants from the air. Thick vegetation can make an otherwise ideal air monitoring station location inaccessible.
- Sampling station location should be representative of the area selected.

Noise

The sampling practice for noise measurement can be referred to Guidelines for Environmental Noise Limits and Control Third Edition by Department of Environment, Malaysia. Some general practice to be considered from the guideline when conducting noise measurement are as follow:

- Calibration of sound level meters and noise monitoring units should be conducted by a calibration laboratory or original equipment manufacturer at intervals not exceeding two years or other frequency recommended by manufacturer.
- The sound level meter may be hand held for simple spot readings, but for extended monitoring shall be mounted onto a tripod during the entire measurement duration. A standard accessory of extension cable with pre-amplifier may be used to enable the microphone to be installed at higher levels detached from the sound level meter body.

- Care should be taken not to make noises whilst observing the meter in this method and ensuring the least amount of reflective surface from your body is exposed to the meter.
- A noise reading should always be taken at the height of the receptor. If the receptor is at the ground level, take a measurement at the ground level (at least 1.2–1.5 m above the ground).
- The measurement location shall be at least 3.5 m away from walls, buildings or other sound reflecting structures. However, when circumstances dictate, measurements may be made at greater heights or closer to a wall and these special conditions must be indicated in the measurement records.
- The microphone must be placed in an open location without any obstructions or affected by reflections or shielded from the noise sources. This includes sound level meter underneath an umbrella or adjacent an air quality measurement equipment (which inherently emits noise)
- Hand held sound level meters shall preferably be manned during the duration of monitoring.
- Unmanned monitoring shall only be undertaken with monitoring units or smart monitors designed for automated unmanned environmental noise monitoring fitted with all-weather waterproof microphone and automatic data logging.
- A wind shield approved by the microphone manufacturer shall be used. Measurements cannot normally be made if the wind speed exceeds 5m/s at the microphone position. For continuous remote monitoring, the wind speed may be monitored concurrently with the sound levels.

It is important to note that all noise monitoring shall be carried out in accordance with the relevant standards such as follow:

- ISO1996-1:2016 Acoustics - Description and Measurement of Environmental Noise.
- BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.
- Any new standards that are available from time to time.

Figure 4-5 Minimum height of sound level meter above the ground level

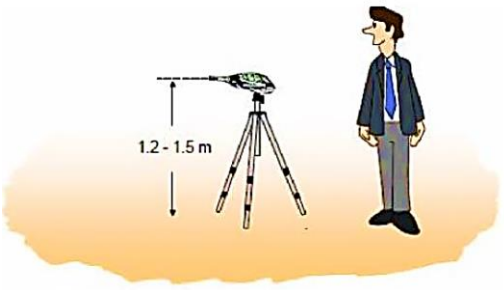
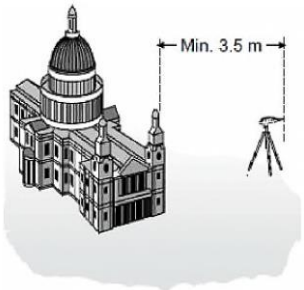


Figure 4-6 Minimum distance to nearest reflective surface outside premises



Vibration

The sampling practice for vibration can be referred to The Planning Guidelines for Vibration Limits and Control in the Environment by Department of Environment, Malaysia. Some general practice to be considered from the guideline when conducting vibration measurement are as follow:

- Vibration measuring equipment shall consist of the following parts: a transducer or pick-up sensor, an amplifying device, an amplitude or level indicator or recorder and/or signal analyser.
- Calibration of all vibration measuring equipment shall be done properly in accordance with current standards or recommendations based on the equipment manufacturer's instructions.
- Monitoring location should be normally be at the nearest building and/or locations; and the best position for the monitoring point(s) would often be on the floor slab or foundation. Monitoring points should be accessible to all parties concerned.
- When measuring vibration at the foundation, the transducers for the three axes of vibration shall be placed close to one another in the lowest storey of the building under investigation, either on the foundation of the outer wall or in the outer wall, or in recesses in the outer wall.
- When measuring buildings having no basement, the point of measurement shall lie no more than 0.5 m above ground level. The location of measuring points shall be located on the side of the building facing the source of excitation.
- For buildings of large ground area, measurements shall be taken simultaneously at several points.
- Measurements taken at the foundation and at the uppermost storey, where necessary the vertical axis vibration of floors shall be measured approximately at the centre of the floor area.
- Measurement for blasting and other explosions related impulsive vibration excitation, if measured outside buildings, shall preferably be measured on a hard surface on ground as close to the property of interest or real property boundary as the case may be. Transducers may be buried in the ground if no hard surface is available.
- Vibration measurements shall include:
    - Background (ambient) vibration levels at a receiver location(s) and/or at the real property boundary of a source(s). These may be undertaken at locations prior to a project development. It could also be undertaken in the absence of the source(s) operating
    - Vibration levels at a receiver location(s) and/or at the real property boundary of a source with the plant operating, construction in progress, and/or completion and operation of a project (transit trains, industrial plant, etc.).
    - Vibration characteristics of each source as may be required to evaluate the contribution of each source.
- Vibration measurements shall be undertaken within a frequency range of 1 Hz to 100 Hz minimum.

It is important to note that all vibration monitoring shall be carried out in accordance with the relevant standards such as follow:

- ISO 4866:2010 Mechanical vibration and shock — Vibration of fixed structures — Guidelines for the measurement of vibrations and evaluation of their effects on structures
- BS ISO 4866: 2010 Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures.
- ISO 7626-5: 2019 Mechanical vibration and shock. Experimental determination of mechanical mobility. Measurements using impact excitation with an exciter which is not attached to the structure
- BS ISO 7626-5: 2019 Mechanical vibration and shock. Experimental determination of mechanical mobility. Measurements using impact excitation with an exciter which is not attached to the structure
- Any new or revised standards that are available from time to time.

This page has been intentionally left blank.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

5

EVALUATION OF IMPACTS

CHAPTER 5

EVALUATION OF IMPACTS

5.1 INTRODUCTION

The prediction and evaluation of impact are carried out by comparing the existing environmental elements against the potential transformation derived from the project activities throughout the project development.

There are many methods to predict and evaluate the environmental impact either qualitative or quantitative method by considering the environmental elements in their most unfavourable condition (worst-case).

While there is no one method that fits all requirements, the predictive and assessment method chosen must have at least the following attributes:

a) **Method** - Established and proven models or methods.
b) **Data** - Adequate, accurate and up-to-date data for assessment.
c) **Results** - Results can be replicated and is reproducible by independent evaluators.
d) **Software** - Cost-effective and for any software, it can be purchased (propriety software and tools can also be used).

It is up to the Qualified Person to select the best method to conduct investigations and generate reliable scenarios and datasets to ascertain the magnitude, extent and significance of any impacts from the project.

5.2 PRESCRIBED ACTIVITY AND KEY ISSUES

Significant issues are identified from the Project activities during each phase of the Project. The nature of the impacts is different for each phase whereby usually all activities have common impact during pre-construction phase, construction phase and abandonment phase. Major activities during these phases are related to earthworks, civil and structural activities as well as decommissioning activities. **Table 5-1** shows the summary of the general project activities list and their potential significant environmental impacts during pre-construction, construction, operation and abandonment stages.

Table 5-1 Summary of the Typical Project Activities and the Key Environmental Impacts

Project Stage	Project Activities	Key Environmental Impacts
All Types of Solid Waste Prescribed Activities		
Pre-Construction	Access tracks.	• Soil erosion & sedimentation • Ecology
	Survey.	
	Site investigation.	• Soil contamination • Groundwater quality
	Land acquisition.	• Socio-economic
Construction	Site preparation and clearing.	• Soil erosion • Water pollution • Air quality • Soil contamination • Noise and vibration • Traffic • Solid & Scheduled Waste • Ecology • Socio-economic
	Earthworks	
	Site formation/reclamation.	
	Ancillary/Infrastructural works.	
	Abandonment during construction.	
Operation & Maintenance	Collection of wastes from waste generator.	• Water quality • Air quality • Soil contamination • Noise • Traffic • Ecology • Odour • Flies study
	Transportation of waste to recovery facility or residual waste to secure landfill.	
Abandonment	Decommissioning, dismantling and removal of Plant.	• Water quality • Soil contamination • Air quality • Noise • Solid & scheduled wastes • Health risk • Odour
First Schedule, Activity 14(b)(i) – Composting Plant		
Operation & Maintenance	Waste receiving	• Odour • Water quality • Groundwater quality • Air quality • Aesthetic • Soil contamination • Ecology • Flies study
	Pre-treatment of waste (shredding, pulverising, separation and mixing)	• Odour • Air quality • Water quality

Project Stage	Project Activities	Key Environmental Impacts
		• Soil contamination
	Processing (bio-degradation process)	• Odour • Air quality • Fire risk • Explosion risk • Health
	Biogas management	• Air quality • Fire risk • Explosion risk • Health • Odour
	Methane gas management (anaerobic process)	• Air quality • Fire risk
	Leachate	• Water quality • Ecology • Air quality • Noise • Waste • Odour
	Curing and finishing/ maturation	• Water quality • Air quality
Abandonment/ Post-closure	Demolition works / decommission	• Soil contamination • Noise and vibration • Air quality • Water quality
First Schedule, Activity 14(b)(ii) – Recycling or Recovery Plant		
Operation & Maintenance	Pre–treatment (separation, size reduction, classification, compaction)	• Odour • Water quality • Noise & vibration
	Treatment (crushing, shredding, bleaching, washing, heating, melting, purification, solidification)	• Air quality • Water quality • Noise & vibration • Scheduled waste • Solid waste
Abandonment/ Decommissioning	Demolition works / dismantling and removal of structures	• Soil contamination • Noise • Air quality • Water quality • Solid waste • Scheduled waste • Health
Second Schedule, Activity 14(b)(i) – Thermal Treatment Plant		
Operation & Maintenance	Waste preparation and handling (cutting, crushing, shredding, settling, separation, neutralisation, etc.).	• Noise & vibration • Air quality • Water quality • Odour

Project Stage	Project Activities	Key Environmental Impacts
	Thermal treatment process (incineration, gasification or pyrolysis).	• Air quality • Health risk • Noise & vibration • Scheduled waste • Fire & explosion risk • Socio-economic • Water quality
	Flue gas treatment system.	• Air quality • Health risk • Noise & vibration • Scheduled waste
Abandonment/ Decommissioning	Demolition works / dismantling and removal of structures	• Soil contamination • Noise • Air quality • Water quality • Solid waste • Scheduled waste • Health
Second Schedule, Activity 14(b)(ii) – Sanitary Landfill Facility		
Operation & Maintenance	Tipping of waste	• Soil erosion & sedimentation • Water quality • Traffic
	Landfill operations.	• Water quality • Groundwater quality • Air quality • Odour • Noise & vibration • Socio-economic • Flies
	Leachate treatment plant.	• Water quality • Ecology • Air quality • Noise • Solid waste
	Surface water treatment plant.	• Water quality • Noise • Solid waste
	Landfill gas venting.	• Air quality • Health risk • Fire & explosion risk
Abandonment / Closure	Safe closure / decommission	• Scheduled waste • Waste • Air quality • Water quality

Second Schedule, Activity 14(b)(iii) – Transfer Station		
Operation & Maintenance	Waste receiving	• Odour • Water quality • Air quality • Flies • Noise
	Waste feeding and size reduction (hopper and compactor system)	• Water quality • Odour • Air quality • Vector
	Odour and dust control system	• Air quality
	Leachate treatment plant	• Odour • Water quality
Abandonment / Decommissioning	Demolition / dismantling and removal of structures	• Scheduled waste • Waste • Air quality • Water quality • Noise • Socio-economic

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Qualified Person to determine the environmental impacts based on the Project activity.

5.3 PREDICTION AND EVALUATION OF IMPACTS

The basis for prediction and evaluation of impacts is the methodologies which consequently determine the suitable predictive tools to be used. The TOR /ESI would have determined the significant environmental impacts to be studied and how to assess and evaluate their significance. Certain outputs need to be achieved to evaluate the significance of the impact. The level of details in the prediction and evaluation of impact shall commensurate with the following factors:

i) The scale of the project (land area, total disturbed areas, etc.).
ii) The intensity of development (total land clearing, phasing of land clearing).
iii) Potential pollution sources from the project.
iv) Magnitude and complexity of impacts.
v) Area of impacts (localised versus transboundary).
vi) Probability of cumulative impacts (effects of the project on adjacent land areas and vice versa).
vii) The sensitivity of nearby receptors (e.g. Environmentally Sensitive Areas).

[Note: Only significant issues shall be assessed in detail in the EIA. Issues that are not significant shall only be addressed qualitatively. However, the DOE or the Appointed Individuals can request for a quantitative assessment with proper justification.]

The process begins with the identification of potential impacts, determination of inputs, execution of methods/tools and evaluation of outputs by comparing them with certain established criteria. It is important to make sure the accuracy of the input used for any kind of assessment. The quality of the output is determined by the quality of the input or GIGO (garbage in, garbage out). Any assumptions used in assessment as well as limitations and uncertainties of any data should be stated clearly in the EIA report.

Table 5-2 shows the summary of the prediction and evaluation of impacts for solid waste activities. Details of the relevant assessments to be carried out are described further in the following sub-chapters.

Table 5-2 Summary of Prediction and Evaluation of Impacts

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Soil Erosion and Sedimentation**	• Rainfall erosivity factor. • Soil erodibility factor. • Slope length and degree factor. • Land-cover management factor. • Conservation practice factor. • Runoff volume. • Peak discharge.	• Calculation (i.e. manual or aid of software like ArcGIS) of: ✓ Annual soil erosion rate – Revised Universal Soil Loss Equation (RUSLE). ✓ Sediment yield – Modified Universal Soil Loss Equation (MUSLE).	• Annual soil erosion rate. • Sediment yield. • Potential soil erosion risk map. • Impact significance evaluation.	Not available.
 **Water Pollution**	• Hydraulic data. • Discharge flowrate. • Pollutants data (i.e. concentration). • River water quality baseline data. • Marine water quality baseline data.	• Simple mass balance models. • Water quality simulation models: ✓ QUAL2K. ✓ WASP8. ✓ MIKE11.	• Graph of concentration of pollutants over spatial for normal scenario and worst scenarios. • Pollution loading calculation (if required).	**Discharge Limits:** • Environmental Quality (Sewage) Regulations 2009. • IETS: Environmental Quality (Industrial Effluent) Regulations 2009. • LTP: Discharge shall comply to the limits prescribed by the Director General of Environmental Quality. **Ambient Limits:** • National Water Quality Standards (NWQS). • Malaysia Marine Water Quality Standard (MMWQS).

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Groundwater Pollution**	• Topography. • Pollutants data (i.e. concentration). • Groundwater level. • Groundwater quality. • Rainfall data. • Hydraulic conductivity. • Geology data. • Geophysics work (if necessary). • Pumping rate. • Well yield.	• Groundwater flow models: ✓ MODLFOW. ✓ FEFLOW. ✓ Aqua3D. ✓ GoldSim.	• Contaminant transport maps for normal case and worst-case scenarios. • Geophysics plot (if necessary).	**Ambient Limits:** • Malaysia Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water).
 **Air Pollution**	• Air dispersion: ✓ Source data (stack dimension, pollutants etc.). ✓ Meteorological data. ✓ Terrain data. ✓ Building data (building dimension). ✓ Sensitive receptors (residential areas, etc.). • GHG estimation: ✓ Amount or quantity of parameter of concern. ✓ Type of technology. ✓ Emission factor.	• Modelling of air dispersion for normal case and worst-case scenarios using air dispersion modelling software (ADMS): ✓ SCREEN. ✓ AERSCREEN. ✓ AERMOD. ✓ CALPUFF. • GHG estimation: ✓ Equation in the 2006 IPCC Guidelines (i.e. Volume 5 – Waste).	• Air dispersion: ✓ Maximum average incremental concentration (MAIC). ✓ Ground level concentration (GLC). ✓ Dispersion contours. ✓ Impact significance evaluation. • GHG estimation: ✓ Total CO2 equivalent. ✓ Opportunities for GHG reduction.	**Emission Limits:** • Environmental Quality (Clean Air) Regulations 2014. **Ambient Limits:** • Malaysia Ambient Air Quality Standard (MAAQS) 2013. • Ontario Ambient Air Quality Criteria (AAQC), 2003.

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Odour Pollution**	• Predictive: ✓ Source data (source dimension, odour concentration etc.). ✓ Meteorological data (wind direction, wind speed, etc). ✓ Terrain data (elevation data). ✓ Building data (building dimension). ✓ Sensitive receptors (residential areas, etc.). • Observational/Empirical: ✓ Intensity, frequency, duration, offensiveness. ✓ Measured concentration (Dilutions-to-Threshold). ✓ Odour diaries. ✓ Community survey. ✓ Complaint records.	• Predictive: ✓ Qualitative (e.g. Source-Pathway-Receptor concept). ✓ Semi-quantitative (e.g. screening models, look-up tables & nomographs). ✓ Modelling (e.g. AERMOD & CFD tools). • Observational/Empirical: ✓ Monitoring of odour in ambient air (e.g. sensory & compound analysis). ✓ Actively using the community as the "sensor" (e.g. odour diaries & community surveys). ✓ Passively using the community as the "sensor" (e.g. complaints analysis).	• Predictive: ✓ A relative risk score or descriptor. ✓ Estimated concentration. ✓ Predicted concentrations (ou/m^3), usually as 98^{th} percentiles of 1-hour mean. ✓ Image representation of flow patterns. • Observational/Empirical: ✓ Odour exposure. ✓ Days (%) on which odour detected above a given intensity. ✓ Percentage (%) annoyed or % experiencing nuisance. ✓ Frequency of complaints.	**Recommended Ambient Limits:** • IAQM Guidance on the assessment of odour for planning – version 1.1.

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Noise**	• Sound power level. • Sound pressure level. • Source classification (area, point, line) and mobile sources. • Existing background noise and existing noise sources. • Type of noise (continuous, intermittent, impulse). • Propagation factors. • Directionality. • Ground effect (soft, hard, porous ground). • Location and height of source. • Total attenuation from factors such as atmospheric absorption, absorbing ground, diffraction by barriers and other miscellaneous factors.	• Calculation of noise incremental level for normal case and worst-case scenarios: ✓ BS 5228-1:2009. ✓ ISO 9613-2. ✓ FHWA Traffic Noise Model Version 2.5. ✓ Calculation of Road Traffic Noise (CRTN). ✓ CadnaA Datakustik. ✓ SoundPLAN. ✓ GIS based noise model.	• Absolute numerical noise limit. • Change in noise levels relative to the existing baseline level. • Noise map.	**Ambient Limits:** • Guidelines for Environmental Noise Limits and Control Third Edition, 2019.

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Vibration**	• Reference PPV from reliable publication. • Distance from equipment / activities to the receiver. • Attenuation rate of the ground.	• Equation for prediction of vibration level: ✓ Continuous vibration $PPV_{Equipment} = PPV_{Ref}(25/D)^{n}$ *(in/sec)* ✓ Ground vibration - Australian Standards 2187.2-2006 $V = K_G\,(\frac{R}{Q^{\frac{1}{2}}})^{-B}$	• Prediction of peak particle velocity (PPV). • Damage risk in structural damage. • Level of human annoyance.	**Ambient Limits:** • The Planning Guidelines for Vibration Limits and Control in the Environment 2nd Edition 2007.
 **Fire and Explosion Risks**	• Hazardous substance data (i.e. physical and chemical properties). • Equipment specifications (i.e. pressure, dimension, etc.). • Possible accident scenario (i.e. leak, rupture, etc.). • Failure frequency data. • Meteorological data (i.e. wind direction, atmospheric stability, etc.).	• Consequence modelling software for multiple and different type of hazard sources for normal case and worst-case scenarios using: ✓ ALOHA. ✓ PHAST. ✓ EFFECTS. ✓ TEREX. ✓ WHAZAN.	• Individual risk. • Societal risk. • Individual risk contours. • F-N Curve (societal risk). • Impact significance evaluation.	**Individual Risk Criteria:** • Industry: 1 x 10^{-5} fatalities/person/year. • Public: 1 x 10^{-6} fatalities/person/year.

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Health Risk**	• Community health data. • Local health statistics. • Air quality assessment result (inhalation pathway). • Water quality assessment result (skin contact and ingestion pathways). • Groundwater quality assessment result (ingestion pathway).	Health risk assessment (HRA): • Qualitative risk assessment. • Quantitative risk assessment: ✓ Issues identification ✓ Hazard identification. ✓ Dose-response assessment. ✓ Exposure assessment. ✓ Risk characterisation. ✓ Uncertainty analysis.	• Health risk calculation at certain level of exposure: ✓ Non-carcinogenic risk – Hazard Quotient (HQ). ✓ Carcinogenic risk – Lifetime Cancer Risk (LCR). • Impact significance evaluation.	**<u>Public Health Criteria:</u>** • Non-carcinogenic: Hazard quotient (HQ) < 1. • Carcinogenic risk: Generally acceptable risk (10^{-4} to 10^{-6}).
 **Socio-Economic Impact**	• Details of demographics • Local economic profile. • Feedback from stakeholder's engagement.	• Social impact matrix.	• Risk matrix with socio economic concerns and the magnitude of impact.	• Manual for Social Impact Assessment (SIA) for Project Development, Second Edition, 2018.

Potential Impacts	Typical Input	Methods and Tools	Typical Output	Evaluation Criteria
 **Waste Generation**	• Incoming waste information. • Source of waste. • Waste generation rate. • Number of workers.	• Estimation of total amount of waste: ✓ Waste generation rates (WGR) from published literatures are multiplied with the quantity (Q) of waste.	• Estimated weight of waste generated. • Estimated volume of waste generated. • Impact significance evaluation.	Not available.
 **Ecology**	• Presence of forest reserves in surrounding area. • Presence of protected areas. • Flora composition. • Fauna composition.	• Secondary data from existing literature • Basic fieldwork to document existing composition	• List and map of habitat type. • Species listing with conservation statues (to determine sensitivity). • Maps of plant and wildlife distribution.	• IUCN Listing. • CITES Listing.

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant information required for environmental assessment and compliance. Proposed assessment models shall be well established and acceptable to DOE

5.3.1 Soil Erosion Impact Assessment

5.3.1.1 Sources of Pollution

The following activities generally can contribute to soil erosion and sedimentation if not properly controlled as shown in **Table 5-3**.

Table 5-3 Potential Activity Contribute to Soil Erosion and Sedimentation

Project Stage	Description
Construction	• Site clearance and site formation including earthwork • Cell preparation of landfill • Establishment of access road • Mobilisation of machinery and equipment
Operation	• Site clearing of new cell

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity

5.3.1.2 Impact Assessment

Methodology

The assessment shall be guided by the following guidelines:

1. Appendix 3 - Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in the Environmental Impact Assessment (EIA) Report, EGIM;
2. Guidelines on Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) (DOE, 2017); and
3. Guideline for Erosion and Sediment Control in Malaysia (DID, 2010); and
4. Urban Stormwater Management Manual for Malaysia (MSMA) 2nd Edition (DID, 2012)

There are two parameters that needs to be considered in the assessment namely:

1. Annual potential soil loss.
2. Sediment yield.

Annual soil erosion rate can be calculated using the Revised Universal Soil Loss Equation (RUSLE) while the sediment yield can be calculated using the Modified Universal Soil Loss Equation (MUSLE). Factors to be considered for RUSLE and MUSLE are as shown in **Table 5-4**.

Table 5-4 RUSLE and MUSLE Equations

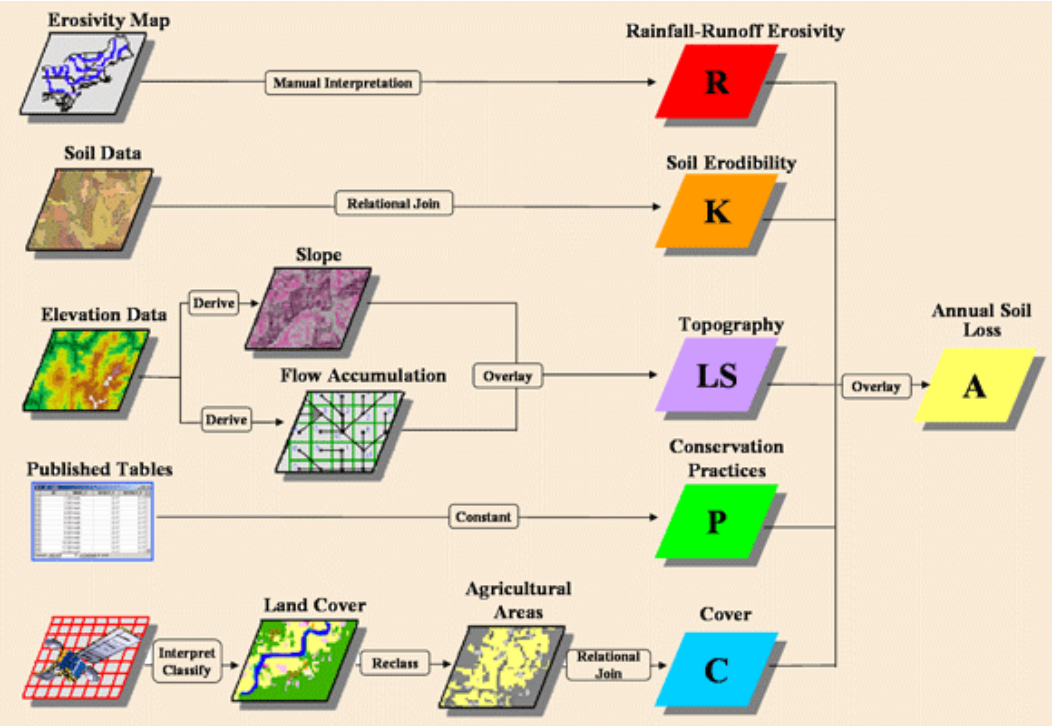
RUSLE	MUSLE
$A = R \times K \times LS \times C \times P$	$Y = 89.6 \times (VQ_p)^{0.56} \times (K \times LS \times C \times P)$
Where, **A** – Average annual potential soil loss (tons/acre/year). **R** – Rainfall-runoff erosivity factor. **K** – Soil erodibility factor **LS** – Slope length and degree factor. **C** – Land cover management factor **P** – Conservation practice factor.	Where, **Y** – Sediment yield per storm event. **V** – Runoff volume in cubic meter. **Q_p** – Peak discharge in m^3/s. **K** – Soil erodibility factor **LS** – Slope length and degree factor. **C** – Land cover management factor **P** – Conservation practice factor.

Source: Urban Stormwater Management Manual for Malaysia (MSMA) 2nd Edition (DID, 2012)

Assessment Tools

The above parameters can be calculated manually or using a geographic information system (GIS) software like ArcGIS. GIS integrates many types of data and analyses spatial location and organizes layers of information into visualizations using maps. **Figure 5-1** shows the protocol of calculation using ArcGIS software. All the factors will be overlaid together to calculate the annual potential soil loss and produce the potential soil erosion risk map.

Figure 5-1 Protocol of Calculation using ArcGIS Software



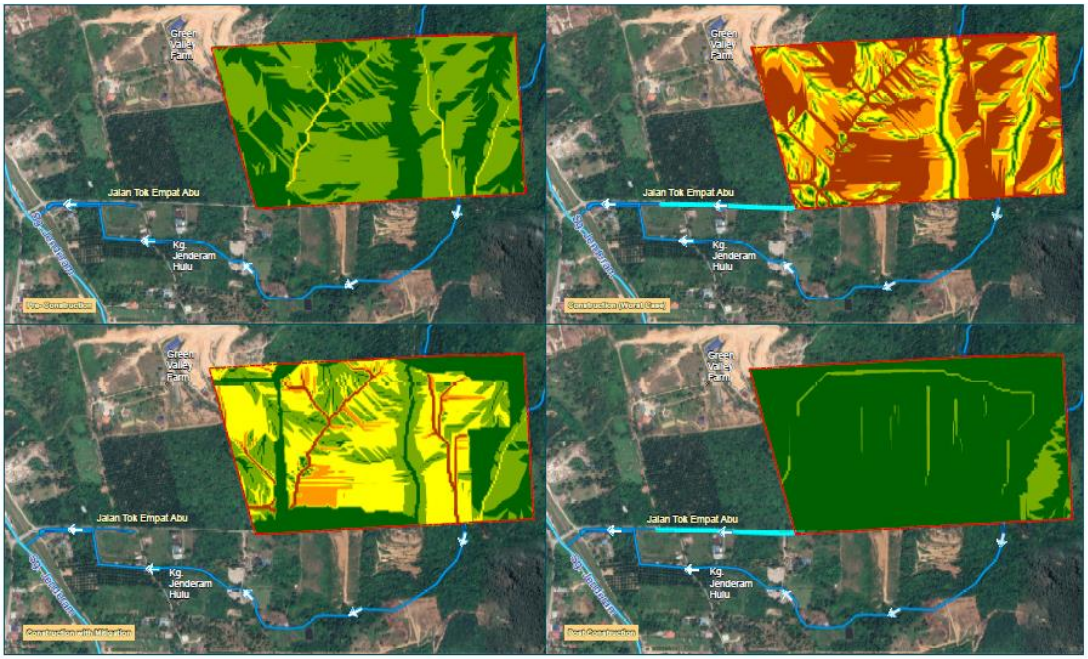
Note: Adopted from Soo Huey Teh, 2011

5.3.1.3 Outputs

The objective of the assessment is to ensure that the soil erosion and sediment risks are reduced by implementing Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) like cover and conservation practices. At the moment, there are no specific criteria for evaluation to assess the significance of the soil erosion and sediment impacts. Potential soil erosion risk map (**Figure 5-2**) is usually produced for four different scenarios:

- Pre-Construction (existing condition).
- Construction during worst case scenario (bare soil with no mitigation measures).
- Construction with mitigation measures.
- Post Construction.

Figure 5-2 Example of Potential Soil Erosion Risk Map Produced using ArcGIS



5.3.2 Water Quality Impact Assessment

Water quality impact assessment is conducted to predict whether the aquatic life and beneficial users are at risk, or that the assimilative capacity of receiving water body may be exceeded as a result of silt trap/sediment basin discharge during construction stage and sewage discharge during operational stage.

If the prediction modelling result shows the significant impact to the water quality of the receiving waterbodies, then suitable mitigation measures such as conducting pollution loading carrying capacity study shall be considered. Qualified Person may also refer to any available Total Maximum Daily Load (TMDL) Study for the same river within the Project Site area as reference.

5.3.2.1 Sources of Pollution

The possible sources of water pollution of solid waste treatment and disposal facilities can vary throughout the different stages of the project. (**Table 5-5**).

Table 5-5 Possible Sources of Water Pollution at Different Stages

Stage	Activities	Possible Source(s)	Pollutants of Concern
Pre-Construction	Soil Investigation	• Disturbance of soil from moving vehicles to and from site	• TSS • Turbidity
	Site Survey		
Construction	Site Clearance	• Disturbance of soil • Uncontrolled erosion and sedimentation • Discharge of silt trap / sediment basins • Improper disposal or handling of sewage, sullage and garbage by workers • Spillage or leakage from diesel fuel tanks • Biomass disposal on site	
	Establishment of Access Road		
	Mobilisation of Machinery and Equipment		
	Site clearance and excavation of new landfill cell		
	Civil and Structural Works		
	Mechanical and Electrical Installation		
Operation & Maintenance	Treatment Process and Effluent Discharge	• Outdated design capacity and technology unable to keep up with the current population • Discharge of untreated/partially treated leachate due to faulty equipment • Wastewater from wet scrubber system in thermal treatment plant • Leakage or spillage of lubricating oil or hydraulic oil to the waterways	• Ammoniacal Nitrogen (NH_3-N) • Biochemical Oxygen Demand (BOD) • Dissolved Oxygen • Heavy metals
	Maintenance of Plant Equipment		
	Sludge Treatment and Disposal	• Spillage of sludge to existing waterways	
Abandonment / Post Closure	Abandonment of Site	• Bare areas exposed may cause erosion and sedimentation	• TSS • Turbidity

Stage	Activities	Possible Source(s)	Pollutants of Concern
	Abandonment of Plant / Facility	• Direct discharge or bypass of untreated leachate, wastewater or sewage	• Ammoniacal Nitrogen (NH_3-N) • Biochemical Oxygen Demand (BOD) • Dissolved Oxygen

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity. The parameter of concern are the typical pollutants but there may be other pollutants which may be present and need to be included on a case-to-case basis.

5.3.2.2 Impact Assessment

Methodology

Before carrying out water quality impact assessment, the following details must be identified as inputs to the model:

- Potential point source and non-point source pollutions;
- Existing sensitive receptors;
- River data (flowrate and concentrations of pollutants/particles);
- Meteorological data (rainfall); and
- Terrain data (topography).

Baseline water quality sampling shall be carried out at various locations along the waterways near the solid waste treatment and disposal project site and sent to an accredited laboratory for analysis. This is to ensure that the model is calibrated according to the actual field measurements.

Modelling shall be carried out for low flow and impact scenarios (normal and worst-case scenario) based on the inputs identified earlier. Modelling results will be plotted out based on the modelled scenarios. The overall methodology for water quality impact assessment can be referred to in **Figure 5-3**.

Figure 5-3 Methodology for Water Quality Impact Assessment

Modelling Tools

Various assessment tools that can be used for water quality impact assessment. The appropriate tool can be determined based on the scale of the sensitivity of solid waste treatment and disposal projects and also the potential scale of impact. Assessment can either be carried out using mathematical models or simple mass balance models.
Some of the mathematical models and their respective features are mentioned in **Table 5-6**.

Table 5-6 Example of Water Quality Modelling Tools

Assessment Tool	Features
WASP8	• Able to dynamically model contaminate fate and transport in rivers, estuaries, lakes, • Can be applied in one, two or three dimensions • Simulation includes temperature, BOD, DO, nutrients, eutrophication, bacteria and other variables
QUAL2K	• One-dimensional river and stream water quality model • Able to represent a well-mixed channel both vertically and laterally with steady state hydraulics, non-uniform steady flow, and diel heat budget and water-quality kinetics • Multiple loadings and abstractions can be input to any reach
MIKE11	• One-dimensional river model for river water quality model • Able to simulate flow and water level, water quality and sediment transport in rivers, flood plains, irrigation canals, reservoirs and other inland water bodies

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Qualified Person to determine suitable assessment tools for environmental assessment and compliance. Proposed assessment models shall be well established and acceptable to DOE and that newer predictive models can be used if the models are more robust.

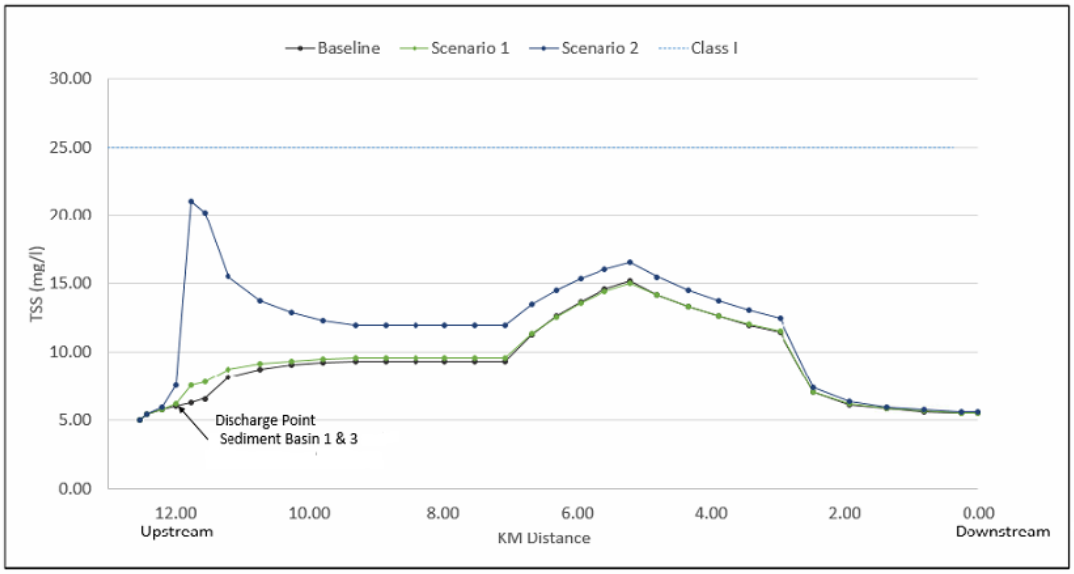
5.3.2.3 Outputs

The main objective of carrying out a water quality impact assessment is to predict the incremental values and ambient values of the discharges towards the waterbody. The ambient limits of river water shall be compared with the National Water Quality Standards for Malaysia and the ambient limits of marine water shall be compared with the Malaysian Marine Water Quality Standards and Index. Whereas, the values of leachate discharge shall be compared with the Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009. As for wastewater discharge, the values shall be compared with Environmental Quality (Industrial Effluent) Regulations 2009.

Outputs for water quality assessment to be included in the EIA report are as follows:

i) Describe the input data and the effect of different variations of data to the modelling result
ii) Presentation of predicted pollutants concentrations such as dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS), ammoniacal nitrogen (NH3-N) and other relevant pollutants (example as shown in **Figure 5-4**)
iii) Calculation of pollution loading carrying capacity if the modelling result shows significant impact to the river water quality.
iv) Identification of the highly impacted area where sensitive receptors such as water intake, aquaculture ponds, sensitive aquatic species spawning grounds, and water recreational park are located.
v) Discussion on the accuracy of modelling results

Figure 5-4 Example of TSS Modelling Result from Sediment Basin Discharge Using QUAL2K



5.3.3 Groundwater Quality Impact Assessment

Groundwater Quality Impact Assessment for solid waste treatment and disposal facility is conducted if the Project site is located near to a groundwater aquifer that is used for portable and non-portable usage. It is the responsibility of the Project Proponent and Qualified Person to engage with relevant agencies in order to determine requirement to conduct groundwater impact assessment.

5.3.3.1 Sources of Pollution

The impact of solid waste treatment and disposal project on the groundwater quality mainly originates from improper management of wastes and sludges as well as

leakage from the waste storage area which results in leachate generation and subsequent contamination (**Table 5-7**).

Table 5-7 Source of Groundwater Pollution

Stage	Activities	Possible Source(s)
Construction	Mobilisation of Machinery and Equipment	• Spillage or leakage from machineries or diesel fuel tanks
	Civil and Structural Works	
	Mechanical and Electrical Installation	
Operation & Maintenance	Operation of composting, landfill, thermal treatment plant, transfer station	• Leaks / seepage of contaminants from leachate • Leakage from waste storage, bunkers, for on-site material recovery facility (if any)
Abandonment / Post Closure	Abandonment of Plant / Facility	• Mismanagement of solid wastes

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity.

5.3.3.2 Impact Assessment

Methodology

To develop a model that mimics the catchment behaviour, the following parameters are required as model inputs:

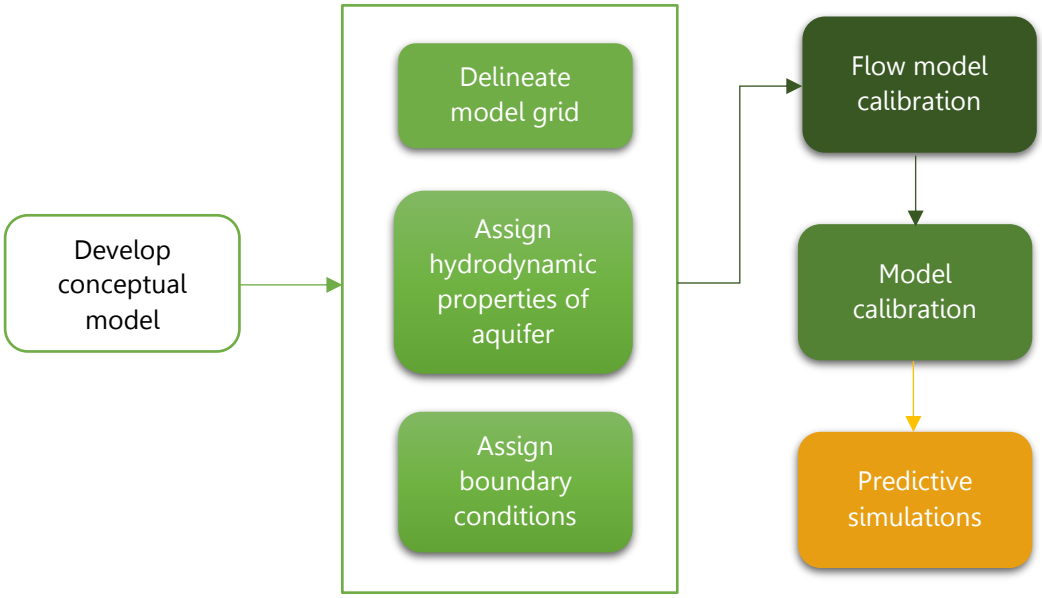
- Topography
- Hydrogeology (piezometric levels, well yield, pump rate, flow boundaries, geology, soil conductivity)
- Hydrology (rainfall, evapotranspiration, inflow and outflow)

The conceptual model developed will implement the integration of a geospatial database framework. A centralized geospatial database of the study basin is first developed to store all required data to develop the model. ArcGIS tools can then be used to delineate the model grid into smaller boundaries. The hydrodynamic properties of the aquifer and boundary conditions are also assigned to the model.

Groundwater flow model calibration will then be carried out with respect to water level measurements collected at intervals over a period of time. Following that, model calibration shall be demonstrated to ensure that the model can successfully simulate the observed aquifer behaviour.

After calibration is completed, the Qualified Person shall proceed to model predictive simulations based on the conditions of the project. The overall process for groundwater quality impact assessment is shown in **Figure 5-5**.

Figure 5-5 Methodology for Groundwater Quality Impact Assessment



Modelling Tools

There are various assessment tools (Table 5-8) that can be conducted to determine groundwater quality. The appropriate tool can be determined based on the scale of sensitivity of different projects and the potential scale of impact. One of the commonly used mathematical model is MODFLOW, FEFLOW and Aqua3D. The features are shown in **Table 5-8**:

Table 5 8 Example of Groundwater Quality Modelling Tools

Groundwater Model	Features
USGS science for a changing world **MODFLOW by USGS**	• Three-dimensional groundwater and porous media finite difference model • Able to simulate coupled groundwater/surface-water systems, solute transport, variable-density flow, aquifer-system compaction and land subsidence, parameter estimation and groundwater management • Modular system where new packages (functions) are added frequently • Cannot simulate complex geological features, such as angled faults and simulate steep hydraulic gradients such as rewetting/drying cells using the same code • Hydraulic conductivity must be perpendicular to the face of each model cell.

Groundwater Model	Features
FEFLOW by DHI group	• Two and three-dimensional groundwater and porous media finite element model • Able to model fluid flow, groundwater age, contaminant and heat transport in saturated and unsaturated porous media • Has direct coupling with solute and heat transport and fracture modelling • Accommodates more complex triangular model mesh which allows for better representation of anisotropy • Simulate complex hydrogeological features (such as re-wetting cells)
Aqua3D by Scientific Software group	• Three-dimensional groundwater and solute transport finite element model • Solves transient groundwater flow and contaminants; heat with advection, decay, adsorption and velocity-dependent dispersion and anisotropic flow conditions. • Able to handle flow and transport in saturated aquifers

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Qualified Person to determine suitable assessment tools for environmental assessment and compliance. Proposed assessment models shall be well established and acceptable to DOE and that newer predictive models can be used if the models are more robust.

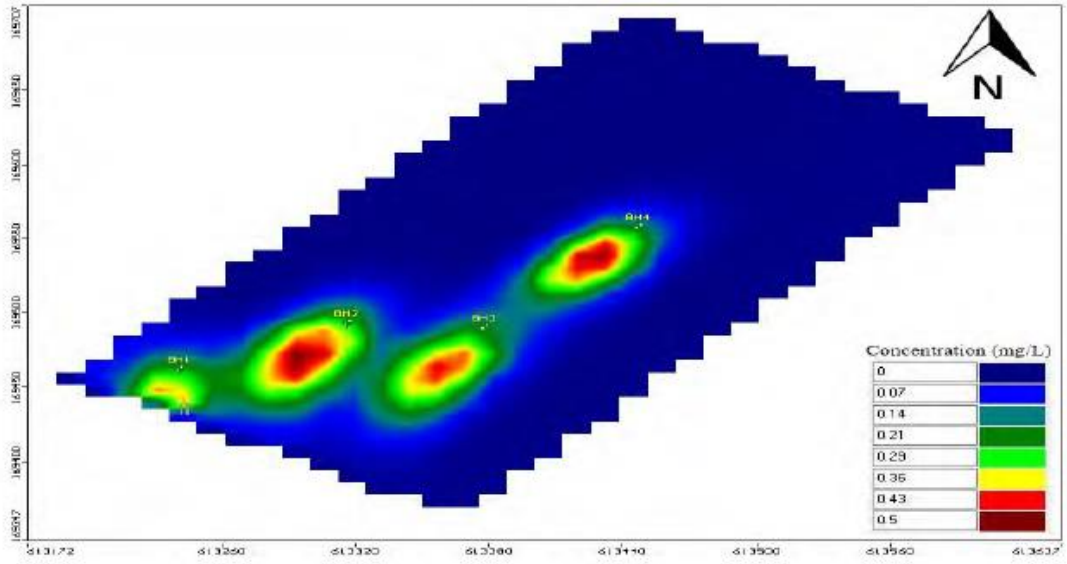
5.3.3.3 Outputs

By carrying out groundwater quality impact assessment, the qualified person shall be able to develop groundwater flow and transport using site-specific parameters, and simulate and predict the potential migration of contaminants. The values of concentration predicted should compare with the limits listed in the Malaysia Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water).

Some of the key information to be included in the report are:

i) Describe the input data and the effect of different variations of data to the modelling result
ii) Presentation of predicted pollutants concentrations (example as shown in **Figure 5-6**)
iii) Identification of the highly impacted surrounding community, especially the sensitive receptors
iv) Discussion on the accuracy of modelling results

Figure 5-6 Example of Simulation Result for COD Contaminant Using MODFLOW



Source: EIA for Proposed Development of Solid Waste Transfer Station, on 12.474 Acres of Land on Lots 1336 & 1337, Pekan Nenas,Mukim Jeram Batu, Daerah Pontian, Johor Darul Takzim for the Department of National Solid Waste Management (JPSPN).

5.3.4 Air Quality and Odour Impact Assessment

Air quality assessment for solid waste treatment and disposal project is conducted for dust dispersion due to construction vehicle movement during construction stage. Meanwhile, odour impact assessment is conducted for odour emission from solid waste treatment and disposal facilities during operation stage.

Air quality and odour impact assessment is to predict whether the dust and odour emission will cause health risk towards the nearby sensitive receptors such as residential areas, commercial areas, and schools.

5.3.4.1 Sources of Pollution

The possible sources of air pollution from solid waste treatment and disposal facilities can vary throughout the different stages of the project, namely construction stage, operation & maintenance stage, and abandonment/post closure as shown in **Table 5-9**.

Table 5-9 Possible Sources of Air Pollution at Different Stages

Stage	Activities	Possible Source(s)	Pollutants of Concern
Pre-Construction	Soil Investigation	• Disturbance of soil from moving vehicles to and from site	• Particulate Matter <10 micron (PM_{10}) • Particulate Matter <2.5 micron ($PM_{2.5}$)
	Site Survey		
Construction	Site Clearance	• Site clearing and earthworks when soil is exposed • Dust dispersion from the movement of construction machineries and vehicles.	
	Establishment of Access Road		
	Mobilisation of Machinery and Equipment		
	Site clearance and excavation of new landfill cell		
	Civil and Structural Works		
	Mechanical and Electrical Installation		
Operation & Maintenance	Thermal treatment process	• Flue gas emission from air pollution control system of thermal treatment plant	• Total PM, NMVOC, SOx, NOx, PCDD/PCDF, mercury, other heavy metals • Greenhouse gases (GHG) (e.g. CO_2, CH_4, N_2O)
	Operation of landfill	• Landfill gas emission • Landfill compactor	• Carbon dioxide (CO2), methane, hydrogen sulphide, methyl mercaptan
	Clearing of new landfill cell	• Site clearing and earthworks when soil is exposed	• Particulate Matter <10 micron (PM_{10}) • Particulate Matter <2.5 micron ($PM_{2.5}$)
Abandonment / Post Closure	Abandonment of Site	• Bare areas exposed may cause erosion and sedimentation	
	Abandonment of Plant / Facility	• Direct discharge or bypass of untreated flue gas emission	

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity. The parameter of concern are the typical pollutants but there may be other pollutants which may be present and need to be included on a case-to-case basis.

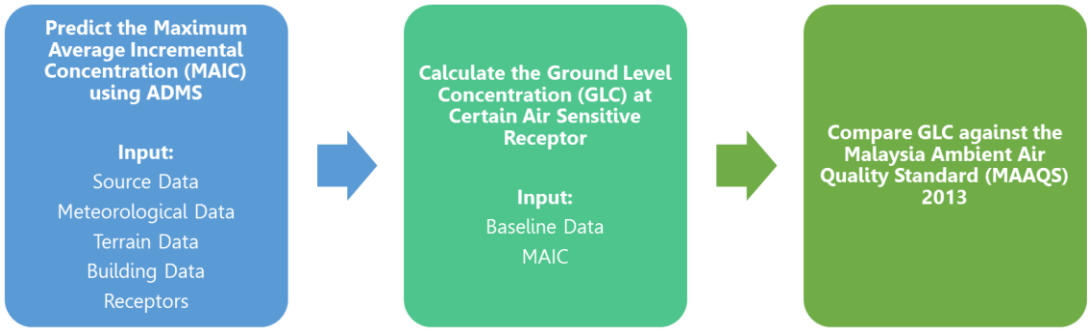
5.3.4.2 Impact Assessment

Methodology for Air Quality Impact Assessment

The general methodology to conduct air quality assessment is shown in **Figure 5-7**. There are several inputs required for the prediction of the Maximum Average Incremental Concentration (MAIC) and calculation of Ground Level Concentration (GLC) of a specific pollutant. The Ground Level Concentration (GLC) of a specific pollutant at the identified Air Sensitive Receptor (ASR) is calculated by adding the MAIC with the baseline data.

This GLC will then be compared with the ambient limits in the Malaysia Ambient Air Quality Standard (MAAQS) 2013. Other ambient air quality standard limits such as the Ontario Ambient Air Quality Criteria (AAQC), 2003 can be adopted if the ambient air quality standard limits of certain pollutants are not available in the MAAQS 2013.

Figure 5-7 General Methodology for Air Quality Assessment



Methodology for Odour Impact Assessment

There are various methods to assess the odour impact from the solid waste treatment and disposal project (e.g. incineration plant). Details of the methods can be referred in Bull *et al* (2018) - IAQM Guidance on the assessment of odour for planning – version 1.1.

One of the methods is to predict the odour impact by using ADMS like AERMOD. The general methodology for air quality assessment as shown in **Figure 5-7** can be used for odour impact assessment. The differences are in terms of:

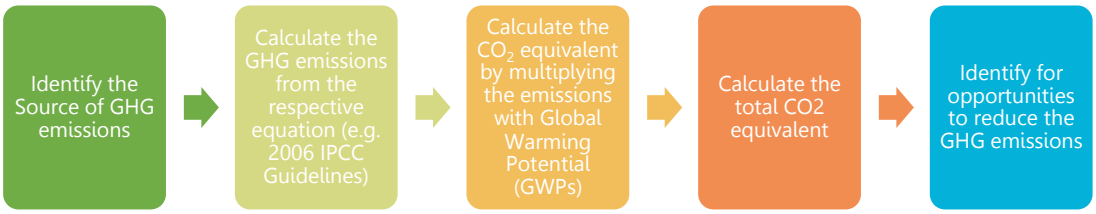
- Odour concentration unit (ou/m^3).
- Compliance limits.
- Evaluation criteria.

At the point of the preparation of this guidance document, the regulations for odour compliance are still in draft stage.

Methodology for Greenhouse Gas Assessment

Greenhouse gas (GHG) emissions from the solid waste treatment and disposal facilities (i.e. incineration can be calculated by following the steps given below:

Figure 5- 8 General Methodology for GHG Calculation



The 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) and the 2006 IPCC Guidelines (i.e. Volume 5 – Waste) can be referred to calculate the GHG emissions.

Assessment Tools for Air Quality and Odour Impacts

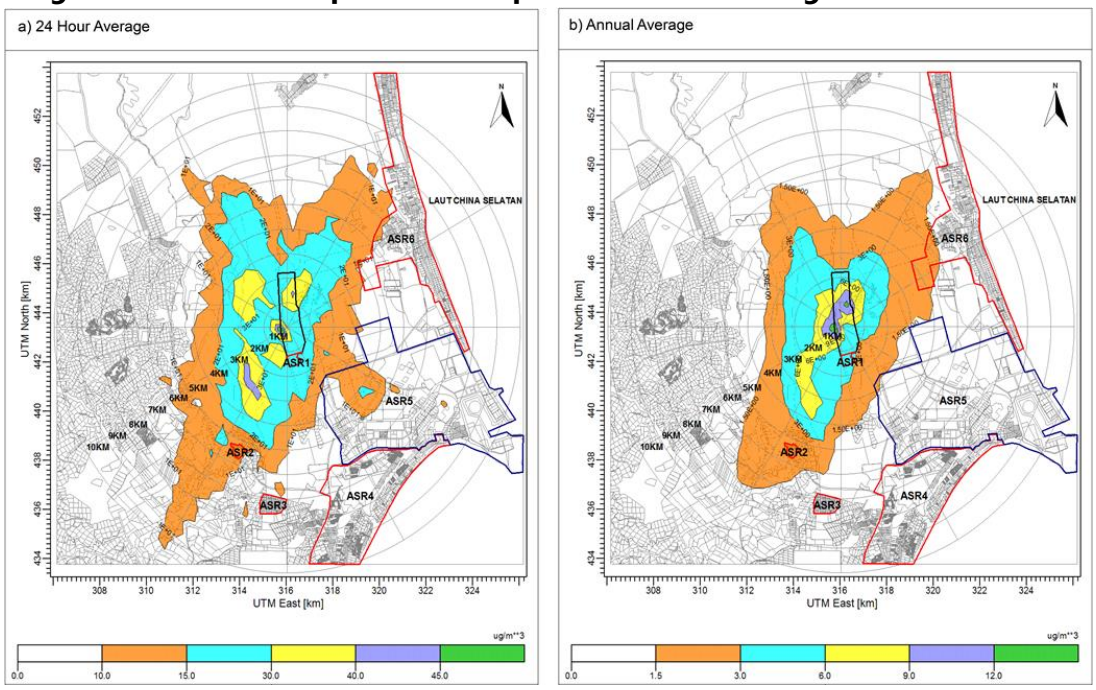
There are a few Air Dispersion Modelling Software (ADMS) that can be used to predict the maximum average incremental concentration from the point, area and volume sources release. AERMOD and CALPUFF are among the most common software used for air modelling. There are several other ADMS available in the market that can be used as well. The comparison of selected ADMS can be found in **Appendix G.**

5.3.4.3 Outputs

Maximum Average Incremental Concentration (MAIC)

The output from the modelling will be in the form of iso-plots of MAIC of a specific pollutant as shown in **Figure 5-9**. It will show the extent and magnitude of the pollutant dispersion.

Figure 5-9 Example of Air Dispersion Contour using CALPUFF ViewTM



Ground Level Concentration (GLC)

As mentioned above, the GLC of a specific pollutant at the identified ASR is calculated by adding the MAIC with the baseline data. Hence, it is expected that the GLC results at the identified ASR are tabulated in the table and where available compared with the limits in the MAAQS 2013 or other ambient air quality standard limits.

Evaluation Criteria:

The main evaluation criteria for air quality assessment are the MAAQS as shown in **Table 5-10**. As mentioned above, the Ontario Ambient Air Quality Criteria (AAQC), 2003 can also be adopted if the ambient air quality standard limits of certain pollutants are not available in the MAAQS 2013.

Table 5-10 Malaysia Ambient Air Quality Standard 2013

Pollutants	Averaging Time	Standard 2020 (μg/m³)
Particulate Matter <10 micron (PM_{10})	1-Year	40
	24-Hour	100
Particulate Matter <2.5 micron ($PM_{2.5}$)	1-Year	15
	24-Hour	35
Sulphur Dioxide (SO_2)	1-Hour	250
	24-Hour	80
Nitrogen Dioxide (NO_2)	1-Hour	280
	24-Hour	70
Ground Level Ozone (O_3)	1-Hour	180
	8-Hour	100
Carbon Monoxide (CO) in mg/m^3	1-Hour	30
	8-Hour	10

5.3.5 Noise Quality Impact Assessment

5.3.5.1 Sources of Pollution

Noise impact assessment is conducted to predict the noise impact from the Project development towards sensitive receptors such as residential area, public facilities such as school, hospital and others during construction and operation stage. From the assessment, the severity of noise impact and the significance of impact to the sensitive receptors can be determined. The possible sources of noise emission are as shown in **Table 5-11**.

Table 5-11 Possible Sources of Noise Pollution at Different Stages

Stage	Activity	Possible Sources
Construction	Site preparation and clearing.	• Movement of trucks loading and unloading material • Stationary equipment such as pumps, power generators and air compressors which run continuously at relatively constant power and speed. • Earth-moving equipment such as excavators, backhoes, and front loaders • Material handling equipment like graders, pavers, rollers and dump trucks. • Impact equipment such as pile drivers, jackhammers, pavement breakers, rock drills and other pneumatic tools. • Metal-on-metal impacts and noise from falling objects
	Earthworks	
	Site formation/reclamation	
	Ancillary/ Infrastructural works.	
Operation	Transportation of solid waste	• Movement of trucks and vehicles • Noise from reversing beepers

Stage	Activity	Possible Sources
	Waste handling, pre-treatment and treatment	• Unloading of waste onto tipping floor, pit, steel drop box or trailer • Landfill compactor • Screening equipment such as grinders, turners and screening • Mechanical processes such as separating, shredding, baling, grinding, compacting and crushing • Air extraction fans and ventilation systems such as exhaust fans • Vehicles movement or manoeuvring such as forklift within plant • Vibrating motors and rotating equipment such as conveyors, fan blade • Noise from turbine • Compressors for compressed air
Abandonment/ Decommissioning	Dismantling plant	• Dismantling works such as breaking up concrete, brickworks, metals

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity.

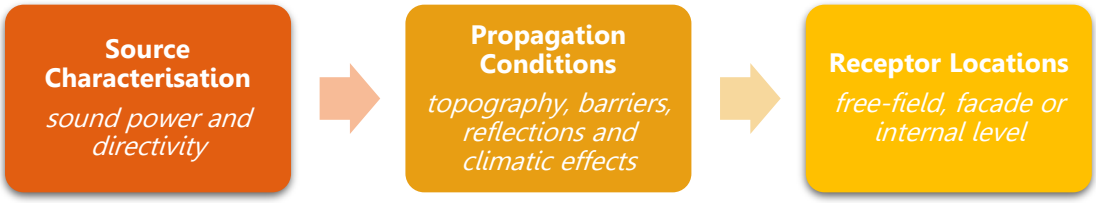
5.3.5.2 Impact Assessment

Methodology

The ultimate aim of any noise assessment is to determine the effect of the expected change in the ambient noise level arising from the proposed development. Prediction of noise at the receptor is estimated based on the sound pressure level generated at source of noise. Different prediction methods may be necessary during site preparation, construction, operation and decommissioning stage. For example, when planning for waste disposal sites, consideration needs to be given to site preparation, fixed plant noise, mobile plant noise, site restoration and vehicle movements.

The basic prediction procedure involves consideration of the nature and noise level of the sources, the propagation along the paths between sources and receptors and location as shown in **Figure 5-10** below:

Figure 5-10 Components of Noise Assessment



Prior to carrying out noise impact assessment, the following information must be identified as inputs to carry out the assessment shown in **Table 5-12**.

Table 5-12 Typical Input for Noise Impact Assessment

Information	Description
Source Characterization	• Sound power level, sound pressure level • Source classification (area, point, line) and mobile sources • Propagation factors (reduction in level with distance from a point source correspond to the sound wave) • Directionality • Ground effect (soft, hard, porous ground) • Location of source • Height of source • Type of noise (continuous, intermittent, impulse) • Phasing of works (if any) • Existing background noise and existing noise sources
Meteorological Effects	• Atmospheric absorption • Atmospheric refraction • Wind speed • Temperature gradients
Topographical Effects	• Barriers (types, height) • Reflections from vertical surfaces such as tall building • Total attenuation from factors such as atmospheric absorption, absorbing ground, diffraction by barriers and other miscellaneous factors
Receiver	• Existing background noise and existing noise sources • Land use of receiver (residential, institution, public facilities) • Location of receiver, distance between source to receiver, height of receiver
Attenuation	• Topography of assessment area, ground effect (soft, hard, porous), screening, reflection

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Qualified Person to determine the relevant information required for environmental assessment and compliance.

The selection of assessment method shall depend on the nature of noise source and available information that are needed as input to the assessment method. It is important for the noise assessor to strike a balance between the convenience of a simple model or assessment and the need for accurate predictions. Some of the prediction schemes and models for noise assessment are shown in **Table 5-13**.

Table 5-13 Example of Assessment Tools

Prediction Tools	Modelling Software
• BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise • ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation • FHWA Traffic Noise Model Version 2.5 • Calculation of Road Traffic Noise (CRTN)	• CadnaA Datakustik • SoundPLAN • GIS based noise model

Note: It is the responsibility of the Qualified Person to determine suitable assessment tools for environmental assessment and compliance. Proposed assessment models shall be well established and acceptable to DOE and that newer predictive models can be used if the models are more robust.

5.3.5.3 Outputs

Noise could be assessed against an absolute numerical noise limit or on the change in noise levels relative to an existing baseline level as described in Guidelines for Environmental Noise Limits and Control 2019 Third Edition published by Department of Environment, Malaysia. As for the community annoyance of the noise, assessment will be based on the human perception of the change in ambient noise levels.

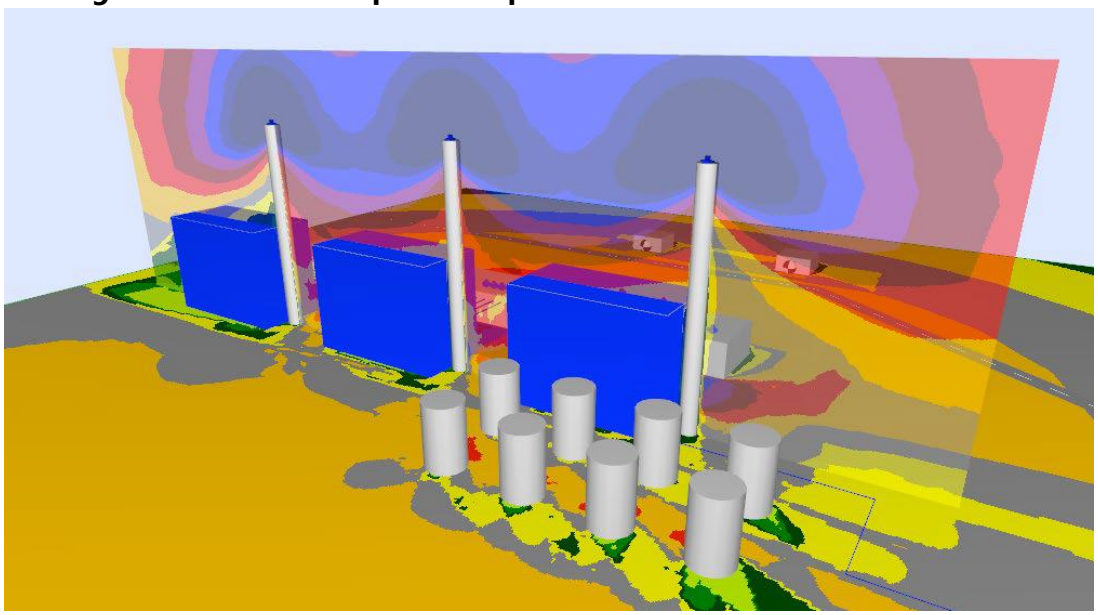
Output for noise impact assessment can be presented in tabular form (**Table 5-14**) or noise contours from modelling software (**Figure 5-11**).

Table 5-14 Example of Output for Noise Impact Assessment in Tabular Form

Site Activity	Sub Activity	Machinery / Equipment	Sound Power Level (dBA	Sound Pressure Level at 220m (dBA)	Sound Pressure Level of Sub Activity (dBA)
Site preparation	Site Clearing	Tracked loader (205 kW)	96.0	38.0	48.4
		Tracked excavator (71 kW)	105.0	47.0	
		Bulldozer (240 kW)	103.0	45.0	
Access Road Works	Ground Excavation	Tracked excavator	105	47.0	46.5
		Tracked loader	96.0	38.0	
	Tipping and Spreading Fill	Dump truck (50 t)	107	49.0	49.8
		Tracked excavator	105.0	47.0	
		Bulldozer	103.0	45.0	
	Levelling Ground	Bulldozer	103.0	45.0	46.1
		Grader	101.0	43.0	

Source: ERE Consulting Group Sdn Bhd

Figure 5-11 Example of output from CadnaA Datakustik software



Source: CadnaA Datakustik

5.3.6 Vibration Impact Assessment

5.3.6.1 Sources of Pollution

Vibration impact assessment is conducted to predict the potential structural damage in buildings, human response and annoyance and re-radiated structure borne noise from the works carried out for the Project development.

The possible source of pollution for vibration is shown in **Table 5-15**.

Table 5-15 Possible Sources of Vibration Impact

Stage	Activity	Possible Sources
Construction	Site preparation and clearing.	• Drilling or excavation in close proximity to sensitive structure • Blasting activity • Impact equipment such as pile drivers, jackhammers, pavement breakers, rock drills and other pneumatic tools. • Dynamic compaction
	Earthworks	
	Site formation /reclamation.	
	Ancillary/Infrastructural works.	
Operation	Operation of machineries	• Machinery vibration that is caused by: - imbalance of rotating equipment - misalignment of machine - wear (e.g. worn conveyor belts) - looseness (e.g. loose bearing)
Abandonment/ Decommissioning	Dismantling plant	• Dismantling works such as breaking up concrete, brickworks, metals • Demolition works

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity.

5.3.6.2 Impact Assessment

Construction vibration shall be assessed in cases where there is a significant potential impact from construction activities. The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant information required for environmental assessment and compliance. Proposed assessment models shall be well established and acceptable to DOE and that newer predictive models can be used if the models are more robust.

Methodology

i. Continuous Vibration

The assessment for the prediction of peak particle velocity (PPV) from the construction machinery is estimated by the following formula:

$$PPV_{Equipment} = PPV_{Ref}(25/D)^{n} \quad \textit{(in/sec)}$$

Where:

PPV_{Ref}	=	Reference PPV at 25 ft
D (ft)	=	Distance from equipment to the receiver
n	=	1.1 (the value related to the attenuation rate through ground)

ii. Ground Vibration

Based on Australian Standards 2187.2-2006, ground vibration is estimated using the following equation:

$$V = K_G \left(\frac{R}{Q^{\frac{1}{2}}}\right)^{-B}$$

Where:

V (mm/s)	=	Peak vector sum ground vibration peak particle velocity (mm/s)
R (metres)	=	Distance from blast area to the nearest structures
K_G, B	=	Site constraints related to site and rock properties for estimation purpose
Q (kg)	=	Maximum instantaneous charge (kg)

iii. Human Annoyance and Discomfort

Human annoyance and discomfort are assessed by comparing the level of peak particle value with the Recommended Limits for Human Response and Annoyance

from Short Term Vibrations in accordance to the Planning Guidelines for Vibration Limits and Control In The Environment 2007.

5.3.6.3 Output

Vibration could be assessed against an absolute numerical vibration limit and/or assessed based on the increase of the vibration levels with respect to the ambient level without the offending source. Based on the assessment, damage risk of building, predicted vibration level and human annoyance from the predicted vibration level will be compared with the permissible levels stated in The Planning Guidelines for Vibration Limits and Control in the Environment Second Edition 2007 published by Department of Environment, Malaysia.
The output for vibration assessment can be presented in tabular in **Table 5-16** and **Table 5-17** and in graph form as shown in **Figure 5-12.**

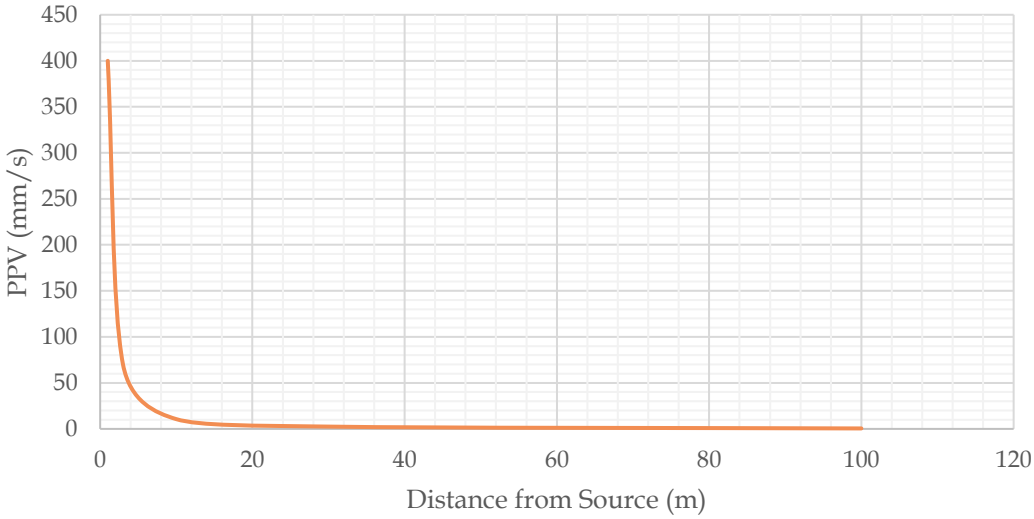
Table 5-16 Sum of Vibration Levels and Recommended Limits for Damage Risk in Building from Short Term / Steady State Vibration

Vibration Axes	Vibration Velocity (mm/s)	Recommended Limits for Damage Risk in Building from Short Term / Steady State Vibration
Transverse (z-axis)		
Vertical (y-axis)		
Longitudinal (x-axis)		
Sum ($\sqrt{(x^2 + y^2 + z^2)}$		

Table 5-17 Sum of Vibration Levels and Recommended Limits for Human Response and Annoyance

Vibration Axes	Vibration Velocity (mm/s)	Recommended Limits for Human Response and Annoyance
Transverse (z-axis)		
Vertical (y-axis)		
Longitudinal (x-axis)		
Sum ($\sqrt{(x^2 + y^2 + z^2)}$		

Figure 5-12 Typical Vibration Levels, PPV with Distance from Source



5.3.7 Quantitative Risk Assessment

5.3.7.1 Sources of Hazards

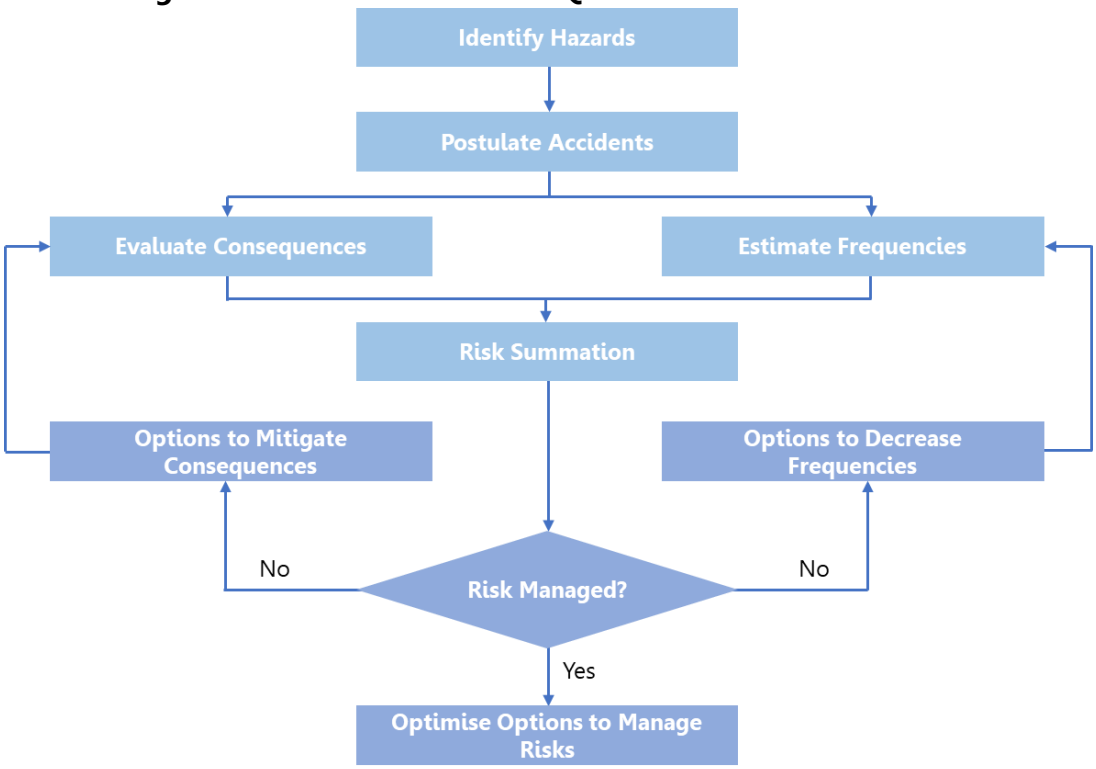
Main risk is identified related to fire hazards within the facility which is associated with the on-site diesel storage for thermal treatment plant project.

5.3.7.2 Impact Assessment

Methodology

A quantitative risk assessment (QRA) shall be carried out according to the Environmental Impact Assessment Guidelines for Risk Assessment (DOE, 2004). The risks of the solid waste treatment and disposal project to the surrounding areas can be analysed by the application of methodology shown in **Figure 5-13**. As a result, a numerical representation of the frequency and extent of a specified level of exposure or harm, to specified people or the environment are produced to quantify the risk.

Figure 5-13 Procedure for Quantitative Risk Assessment



Assessment Tools

There are a few modelling software packages that can be used to predict the consequences or severity of the pre-identified hazardous events such as fire, explosion and also toxic gas dispersion. ALOHA and PHAST are among the most common software used to perform the consequence analysis. Comparison of selected software for consequence analysis is shown in **Appendix H**.

5.3.7.3 Outputs

Individual Risk

Individual risk is the probability of fatality in a year of an individual in a given location as a result of the realization of the any hazardous events. The surrounding population is not taken into account in the individual risk calculation. The individual risk results are usually plotted as a series of iso-risk contours originating from the source of hazard. **Figure 5-14** shows the example of individual risk contours produced using PHAST overlaid onto Google Earth.

Societal Risk

Societal risk provides the actual risk measurement to a given population at or near the source of hazard. Results are usually plotted in the F-N Curve to determine the risk acceptability. F-N Curve provides a logarithmic plot of cumulative frequency of fatal events versus the number of fatalities within a given period of time, usually set for 1 year. **Figure 5-15** shows the example of societal risk F-N Curve.

Figure 5-14 Example of Individual Risk Contours using PHAST

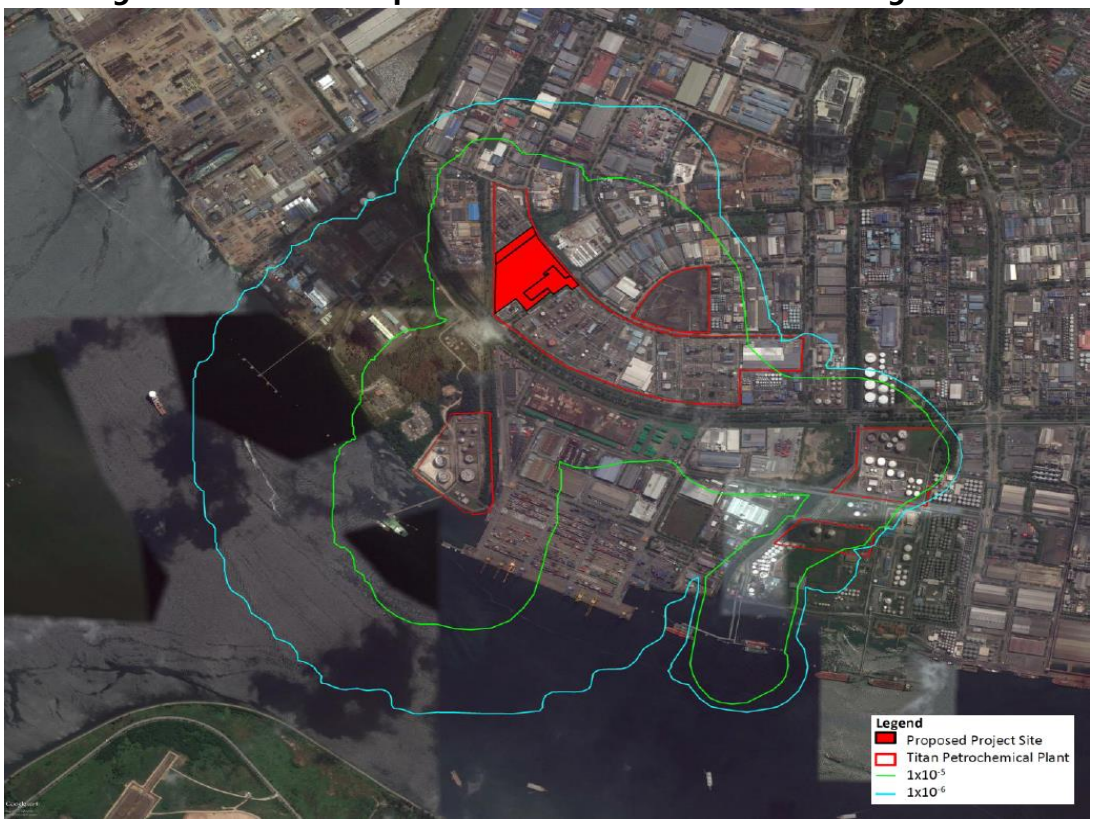
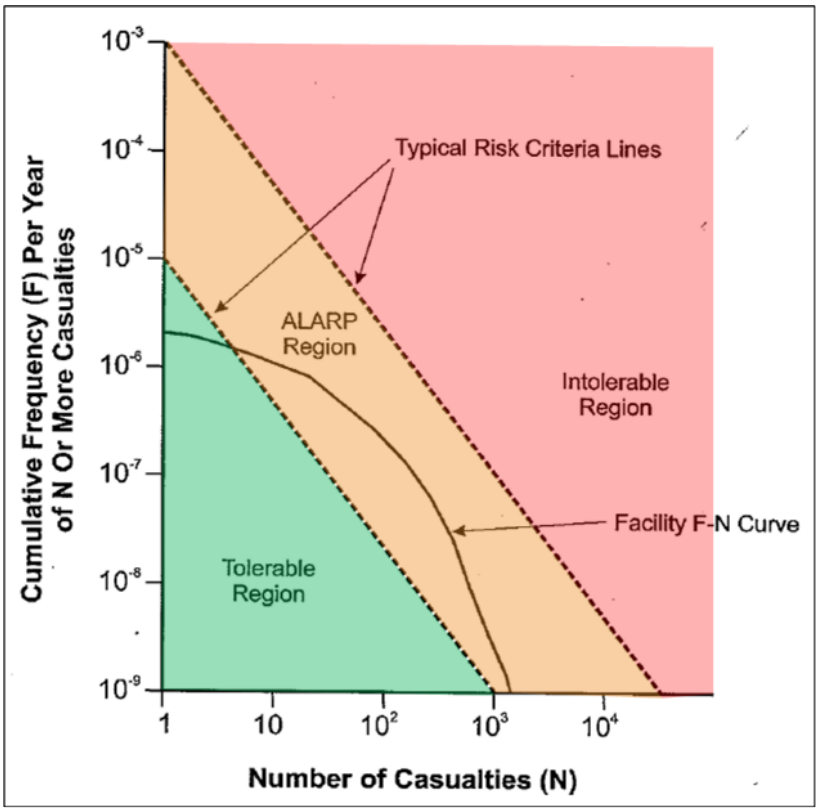


Figure 5-15 Example of Societal F-N Curve



Evaluation Criteria

The sum of the individual risk calculation for each hazardous event can be compared against the individual risk criteria set in the Environmental Impact Assessment Guidelines for Risk Assessment (DOE, 2004). The recommended risk tolerability criteria for Malaysia are:

- **Industry:** $1x10^{-5}$ fatalities/person/year individual risk contour should not extend beyond industrial developments.
- **Public:** $1x10^{-6}$ fatalities/person/year individual risk contour should not encompass involuntary recipients of industrial risks.

5.3.8 Health Impact Assessment

5.3.8.1 Sources of Health Risk

Possible sources of health risk from the solid waste facilities are shown in **Table 5-18**.

Table 5-18 Possible Sources of Health Risk from Solid Waste Facilities

Stage	Activities	Possible Source(s)	Pollutants of Concern
Operation & Maintenance	Thermal treatment process	Emission of air pollutants	• Total PM, NMVOC, SOx, NOx, PCDD/PCDF, mercury, other heavy metals
	Operation of landfill	Landfill gas emission	• Carbon dioxide (CO2), methane, hydrogen sulphide, methyl mercaptan
		Discharge of untreated leachate	• Heavy metals

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity. The parameter of concern are the typical pollutants but there may be other pollutants which may be present and need to be included on a case-to-case basis.

5.3.8.2 Impact Assessment

Methodology

Health Impact Assessment (HIA) shall be carried out according to the Guidance Document on Health Impact Assessment (HIA) in the Environmental Impact Assessment (EIA) 2012. There are 4 steps taken in the HIA study as follows:

i) **Step 1** – Screening.
ii) **Step 2** – Scoping.
iii) **Step 3** – Description of Existing Public Health Status.
iv) **Step 4** – Health Risk Assessment (HRA).

Assessment Tools

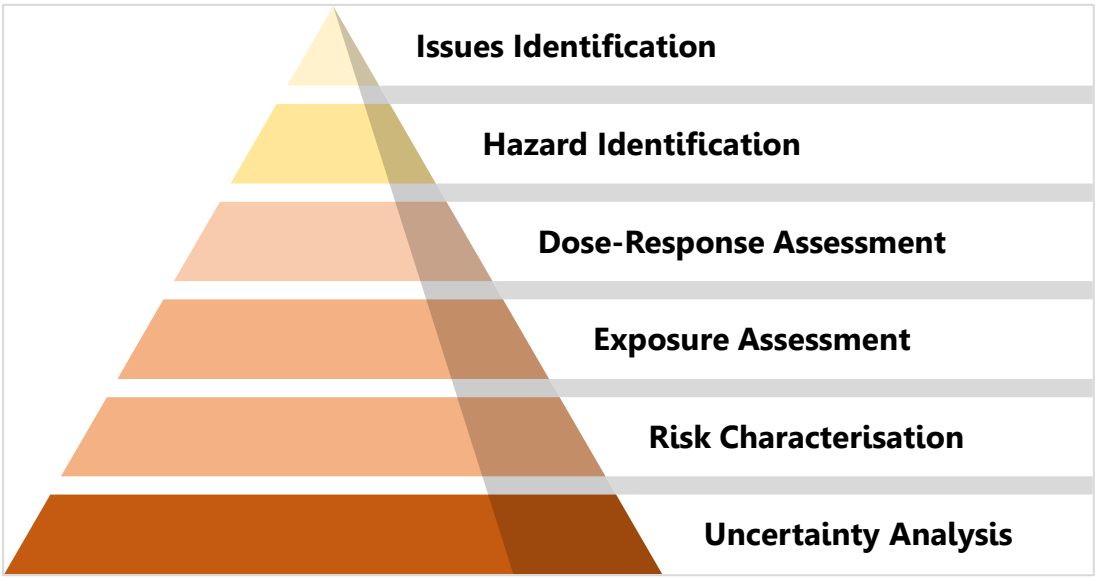
HRA is the main tool to assess the impact of the proposed project towards the health of the surrounding population. There are two forms of HRA namely:

- **Qualitative risk assessment** – Merely characterizes or compares the hazard of a chemical relative to others or defines the hazard in only qualitative terms such as mutagen or carcinogen.
- **Quantitative risk assessment** – Generates a numerical measure of the risk or safety (i.e. non-carcinogenic and carcinogenic) of a chemical exposure.

Quantitative risk assessment is the preferred assessment for HIA in EIA whenever this is possible. However, certain health risk that may associated with risk due to communicable diseases may not lend well to quantitative risk assessment. Therefore, the Qualified Person shall identify the suitable method to be used for HIA.

There are 6 steps involve in the quantitative health risk assessment as shown **Figure 5-16**. Details of the method can be referred in the guidance document mentioned above.

Figure 5-16 Quantitative Health Risk Assessment Procedure



5.3.8.3 Outputs

Chronic Health Risk

The main objective of HIA is to determine the acceptability of the health risks either non-carcinogenic risk or carcinogenic risk. Different sets of formula are used to calculate the health risk depending on the route of intake namely ingestion and inhalation.

Evaluation Criteria

The risk tolerability criteria recommended in the Guidance Document on HIA in Environmental Impact Assessment by DOE Malaysia (2012) are:

- **Non-carcinogenic risk:**
  - ✓ A Hazard Quotient **(HQ) < 1** is categorised as an acceptable risk.
  - ✓ A Hazard Quotient **(HQ) > 1** signifies a hazardous condition.

- **Carcinogenic risk:**
  - ✓ Lifetime excess cancer risk within **10^{-6} to 10^{-4}** are given as a range of acceptable risk; or
  - ✓ Between 1 cancer for every millions of exposed populations to 1 cancer for every 10,000 of exposed population, over a lifetime duration of 70 years.
  - ✓ Lifetime excess cancer risk $<10^{-6}$ will be deemed as "clearly acceptable''
  - ✓ Lifetime excess cancer risk $>10^{-4}$ will be deemed as ''clearly unacceptable''.

5.3.9 Socio-Economic Study

Project Proponent and Qualified Person should conduct socio economic study through stakeholder engagements with sensitive receptors nearby the Project site. Following are the information should be gathered during the stakeholder engagement.

- Main stakeholders that will be affected by the Project implementation
- Main social concerns from the Project implementation
- Documentation of expectation and suggestion by the main stakeholders

The project activities may affect the people's lifestyle, physical and mental health. It can also give impact to the public in terms of aesthetics and heritage, perception of belonging, security, liveability and aspiration

5.3.9.1 Sources of Impacts

Community living around the proposed solid waste treatment and disposal facilities will be directly or indirectly affected during pre-construction, construction and operation of the project. Some of the possible concerns that may arise can be due to the activities as listed in **Table 5-19**.

Table 5-19 Possible Sources of Socio-Economic Effects at Different Stages

Stage	Activities	Possible Sources
Pre-Construction	Land Acquisition	• Possible relocation or resettlement of community • New job opportunities for local community
Construction	Site Clearance	• Possible relocation or resettlement of community • Increment of traffic that may cause potential accidents or disturbances if not properly controlled • Possible provision of new employment opportunities for local people • Foreign workers involved may contribute to criminal case within the area • Increment of traffic that may cause potential accidents or disturbances if not properly controlled
	Establishment of Access Road	
	Mobilisation of Machinery and Equipment	
	Civil and Structural Works	
	Mechanical and Electrical Installation	
Operation & Maintenance	Waste receiving and handling	• Odour generation from leachate which would cause a nuisance to the nearby community • Air quality and health impact due to emission from landfill gas and flue gas emission from air pollution control system of thermal treatment plant • Possible provision of new employment opportunities for local people • Improving solid waste management and reducing illegal solid waste dumping (positive impact).
	Treatment process	
Abandonment / Post Closure	Abandonment of Plant / Facility	• Health risk due to possible breeding ground for vermin

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity.

5.3.9.2 Impact Assessment

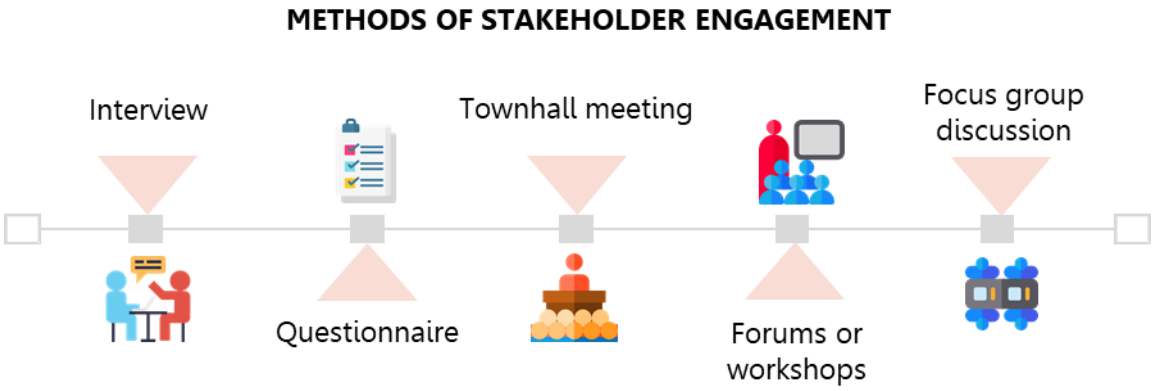
Methodology

Project Proponent can refer to Manual for Social Impact Assessment of Project Development Second Edition (2018) as one of the references to conduct socio-economic study. There are 4 steps to follow in conducting socio-economic study:

i. **Step 1: Scoping** - Identify key stakeholders, issues to be covered by the study, and level of stakeholder engagement.
ii. **Step 2: Collect social baseline data** - Population and demographic data from DOSM will be used to give an overview of the social profile.

iii. **Step 3: Conduct stakeholder engagement** - Quantitative method for collecting basic socio-economic information and gathering opinions/issues from local population about the Project. Example of stakeholder engagement is shown in figure below.

iv. **Step 4**: **Assess socio impact** – Conduct social impact matrix based on the inputs from stakeholder engagement.



Assessment Tools

Socio-economic study can be carried out using the social impact matrix where a list of social impacts is identified from the data collected. The probability of the occurrence and severity of the impact shall then be assessed accordingly by using the equation below. The calculated significance scoring will be ranked on a scale from 1 to 16 (**Figure 5-17**). The higher the score is, the more significant the impact will be on the surrounding community.

Figure 5-17 Scoring Matrix Scale

Significance = Probability x Severity

Scale for Probability
1 = Remotely and rarely occurring
2 = Rarely occurring
3 = Frequently occurring
4 = Continuously occurring

Scale for Severity
1 = Minor social impact
2 = Moderate social impact
3 = High social impact
4 = Severe negative impact

Colour Code	Green	Yellow	Orange	Pink	Red
Score	1-2	3-5	6-7	8-11	12-16
Rating	Not significant	Significant (Low Priority)	Significant (Medium Priority)	Significant (High Priority)	Significant (Very High Priority)
Outcome	No mitigation needed	Continual improvement or control mitigation measures	Preventive measures	Immediate preventive and mitigation measures	Project shall not be approved unless site is relocated or redesigned

Source: Manual for Social Impact Assessment of Project Development Second Edition (2018)

5.3.9.3 Outputs

Output of the socio-economic study may be presented in risk matrix tabulation or in discussion format in the EIA reporting. Example of scoring for social impact matrix is shown in **Figure 5-18**.

Figure 5-18 Example for Participatory Impact Analysis Using Social Impact Matrix

Identified Social Impacts	Probability				Average Scale	Severity				Average Scale	Colour Code
	1	2	3	4		1	2	3	4		
1. Influx of foreign/temporary workers in local settlements	0.7	6.9	15.9	76.6	3.7	1.4	6.9	20.0	71.7	3.6	13.3
2. Increased employment/downstream economic opportunities to local communities	37.9	38.6	20.0	3.4	1.9	39.3	44.1	12.4	4.1	1.8	3.4
3. Local communities do not have access to employment/downstream economic opportunities	30.3	25.5	23.4	20.7	2.3	29.0	26.2	24.1	20.7	2.4	5.5
4. Increased security issues in local settlements	1.4	2.8	19.3	76.6	3.7	1.4	2.1	19.3	77.2	3.7	13.8
5. Negative impacts on the environment	1.4	8.3	34.7	55.2	3.4	2.1	8.3	29.9	59.7	3.5	12.0
6. Negative impacts on local lifestyle, cultural and religious values	35.2	36.6	11.0	17.2	2.1	36.6	35.2	11.0	17.2	2.1	4.4
7. Positive impacts on local lifestyle, cultural and religious values	59.7	35.9	4.1	-	1.4	59.7	36.1	3.5	0.7	1.5	2.1
8. Negative impacts on the health of local communities	2.8	6.2	20.0	71.0	3.6	0.7	5.5	24.8	69.0	3.6	13.0
9. Negative impacts due to increase in natural disasters	10.4	20.8	35.4	33.3	2.9	9.7	22.2	34.7	33.3	2.9	8.5
10. Increase in the living conditions of the local communities	38.6	39.3	18.6	3.4	1.9	38.6	40.7	16.6	4.1	1.9	3.5
11. Increase opportunities for rental of temporary housing for foreign/temporary workers	58.6	24.1	11.0	6.2	1.6	57.9	21.4	13.8	6.9	1.7	2.8
12. Increased pressure on existing facilities and amenities originally meant for the local communities	54.5	25.5	13.1	6.9	1.7	55.2	22.8	12.4	9.7	1.8	3.0
13. Increased pressure on natural resources and recreational areas previously only used by the local communities	48.3	26.9	12.4	12.4	1.9	51.7	17.2	15.9	15.2	1.9	3.7

Source: Manual for Social Impact Assessment of Project Development Second Edition (2018)

5.3.10 Solid Waste Assessment

5.3.10.1 Source of Pollution

a. Sources of Solid Waste

The possible sources of solid waste during construction and operation of solid waste treatment and disposal project are as shown in **Table 5-20**.

Table 5-20 Possible Sources of Solid Waste Generation

Stage	Activity	Possible Sources
Construction	Site preparation and clearing	• Tree biomass • Unsuitable material • Construction waste • Demolition waste • Domestic waste from site workers
	Earthworks	
	Site formation /reclamation	
	Ancillary/Infrastructural works	

Stage	Activity	Possible Sources
Operation	Operation of leachate treatment plant	• Sludge from leachate treatment plant for landfill • Leachate generation from the waste
Abandonment/ Decommissioning	Dismantling plant	• Dismantling works such as breaking up concrete, brickworks, metals • Demolition works

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity

b. Sources of Scheduled Waste

The possible sources of scheduled waste during construction and operation of solid waste treatment and disposal project are as shown in **Table 5-21**.

Table 5-21 Possible sources of scheduled waste generation

Stage	Activity	Possible Sources
Construction	Site preparation and clearing	• SW 305 Spent lubricating oil • SW 306 Spent hydraulic oil • SW 312 Oily residue from automotive service workshop, oil or grease interceptor • SW 408 Contaminated soil, debris or matter resulting from cleaning-up of a spill of chemical, mineral oil or scheduled wastes • SW 410 Used oil filter from vehicles
	Earthworks	
	Site formation /reclamation	
	Ancillary/Infrastructural works	
Operation	Residue from flue gas cleaning system of thermal treatment plant	• SW 406 Bottom ash, fly ash
	Sludge from leachate treatment plant	• SW204 Sludges containing one or several metals including chromium, copper, nickel, zinc, lead, cadmium, aluminium, tin, vanadium and beryllium

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible sources of pollution based on the Project activity

5.3.10.2 Impact Assessment

<u>Waste Estimation of Solid Waste</u>

Waste estimation from the Project shall be assessed in the construction and operation stage. To estimate the total amount of waste, waste generation rates (WGR) from published literature were multiplied with the quantity (Q) that has been determined from the Project (i.e. estimated area of cleared vegetation, roadworks areas, amount of excavation and demolished structures and number of workers). Example of waste generation rates is shown in **Table 5-22**.

Amount of Waste Generated= WGR×Q

Table 5-22 Example of Waste Generation Rates

Project Stage	Category of Waste	Waste Generation Rates
Site clearing	Palm Oil Tree	40.77 tonnes / hectare
	Mangrove	99.4 tonnes / hectare
	Small, growing stands	Low: 26 tonnes/hectare High: 116 tonnes/ hectare
	Mixed small, mature stands	Low: 130 tonnes/hectare High: 155 tonnes/ hectare
	Mature, dense stands	Low: 168 tonnes/hectare High: 414 tonnes/ hectare
	Mature, very dense stands	Low: 427 tonnes/hectare High: 569 tonnes/ hectare
Construction	IBS	0.018 tonne/ m^2
	Conventional	0.046 tonne/ m^2
	Mixed construction method	0.0446 tonne/ m^2
	Demolition	1.3086 tonne/ m^2
Operation	Industry, commercial	0.41 tonne/ m2

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible types of waste generated based on the Project activity

Scheduled Waste Generation

Scheduled waste generated from specific activities like the operation of flue gas treatment system, IETS and LTS can be calculated from the mass balance approach.

Leachate Estimation

A knowledge of the likely leachate generation of a landfill is a prerequisite to the planning of a leachate management strategy. Water balances are used to assess likely leachate generation volumes. Some of the methods can be adopted to estimate the leachate production are as shown in **Table 5-23**.

Table 5-23 Example of Equation for Estimation of Leachate Generation

Equation	Source of Publication
$Q = (1 / 1000) \cdot C \cdot I \cdot A$ Where, Q = Average leachate amount (m^3/day) C = Leaching Coefficient I = Average daily rainfall (mm/day) A = Landfill site area (m^2)	The Technical Guidelines for Sanitary Landfill Design and Operation, JPSPN
$L_o = [I – E] A – aW$ Where, L_o = leachate produced (m^3/year) *I* = total liquid input precipitation plus liquid waste plus any surface or ground water inflow) (m/year) *E* = evapotranspirative losses (m^3/year) *A* = area of site, m^2 a = absorptive capacity of the waste (as received) *W* = volume of waste deposited (m^3/year)	Aziz, H.A., Adlan, M.N., Amilin, K., Yusoff, M.S., Ramly, N.H., Umar, M. Quantification of leachate generation rate from a semi-aerobic landfill in Malaysia, Environmental Engineering and Management Journal, (2012), 11 (9), 1581-1585.
V = 0.15 x R x A Where, V = Volume of leachate discharge in a year (m^3/year) R = Annual rainfall (m) A = Surface area of the landfill (m^2)	Department of Environment, Water, Heritage and the Arts, Australian Government
$L_o = [ER(A) + LW + IRCA + ER(l)] - [aW]$ Where, L_o = leachate produced (m3) ER = effective rainfall (use actual rainfall (R) for active cells) (m) A = area of cell (m2) LW = liquid waste (also includes excess water from sludges) (m3) IRCA = infiltration through restored and capped areas (m) l = surface area of lagoons (m2) a = absorptive capacity of waste (m3/t) W = weight of waste deposited (t/a)	Landfill Manuals; Landfill Site Design 2000, EPA Ireland

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant information required for environmental assessment and compliance. Proposed assessment method shall be well established and acceptable to DOE and that newer predictive models can be used if they are more robust.

5.3.10.3 Outputs

The output from the estimation of waste generation shall be presented in the tabular, graph or in any manner which is suitable. The output shall consist of the weight or volume of waste generation. Examples of output shall contain the category of waste, weight of waste or volume of waste as shown in **Table 5-24**.

Table 5-24 Output for Estimated Waste Generation from the Project

Project Stage	Category	Details	Quantity (Q)	Waste Generated	
				Tonne	Percentage (%)
Construction	Biomass				
	Construction Waste				
	Domestic Waste				
	Excavated Materials				
	TOTAL				
Operation	Domestic Waste				
	Sludge				
	TOTAL				

Based on the volume or weight of waste generation, the impacts of improper waste management shall be described in detail in relevant to the type and source of waste. The waste impacts shall be described in the following manner shown in **Table 5-25**.

Table 5-25 Potential Impact from Poor Waste Management

Impacts	Sensitive Receptors
Water Pollution • Increased level of total suspended solids and turbidity due to runoff from excavated materials • Increased concentration of ammoniacal nitrogen, BOD, COD, and high risk of eutrophication due to high organic content of biomass and domestic waste • Toxic pollution of river due to illegal dumping of scheduled waste	Receiving river and its beneficiaries and urban storm/ perimeter drain
Flooding • Waterway obstruction and disruption of water flow from illegal dumping of excavated materials, biomass, construction, and domestic waste	Flood prone areas
Air Pollution • Localised haze and air pollution from open burning of biomass, construction and domestic waste • Foul odour due to the breakdown of organic matter from domestic waste • Release of toxic fumes from illegal dumping of scheduled waste	Residential (including indigenous and local community villages) and public areas

Impacts	Sensitive Receptors
Others • Disease outbreak (e.g. dengue, leptospirosis) due to illegal dumping of biomass, construction, and domestic waste that serves as pest/vermin breeding ground • Littering problem of domestic waste from workers' camps and construction site • Ground contamination from scheduled waste spillage	Residential (including indigenous and local community villages) and public areas

Note: The impacts are not exhaustive and there may be other impacts which may be present and need to be included on a case-to-case basis.

5.3.11 Ecological Impact Assessment

5.3.11.1 Sources of Impact

The possible sources of ecological impacts from solid waste treatment and disposal facilities particularly sanitary landfill can vary throughout the different stages of the project as shown in **Table 5-26**.

Table 5-26 Potential Activities Contributing to Ecological Impacts

Project Stage	Type of Impact	Description
Construction	• Habitat disturbance • Habitat fragmentation • Human-wildlife conflicts	• Site clearance including earthwork • Cell preparation of landfill • Establishment of access road • Mobilisation of machinery and equipment • Attracting nuisance wildlife due to construction waste
Operation	• Habitat disturbance • Habitat fragmentation	• Site clearing of new cell

Note: This list is not exhaustive and it is the responsibility of the Qualified Person to determine the possible impacts based on the Project activity

5.3.11.2 Impact Assessment

Methodology

Core components that need to be considered in the assessments include:

- Type of habitat in the surrounding area (between 500m – 2km from the project site).
- Presence of forest reserves (if any) in the surrounding area.
- Flora composition.

- Fauna composition.

Information pertaining to the four core components can be collated through collation of secondary data and consultation with relevant stakeholders such as:

- State Forestry Departments.
- State Department of Wildlife and National Parks.
- Research institutions.
- Local environmental NGOs (e.g. Malaysian Nature Society, WWF-Malaysia).

Where secondary data is not available, quick fieldwork should be conducted to document the existing conditions of the surrounding environment in terms of habitat and species composition (for both flora and fauna). The collected data can then be used to assess the sensitivity of the surrounding environment and the severity of potential impacts in terms of habitat disturbance and fragmentation, as well as potential loss of flora and fauna species that are of conservation importance.

Figure 5-19 Methodology for Ecological Impact Assessment

Assessment Tools

Supporting tools that can be used to facilitate ecological impact assessments are generally in the form of ecological planning documents, and species conservation rankings. These supporting tools can be used to assess if the project site is situated within a sensitive landscape, and whether project activities, especially during the construction stages, may pose threats in terms of species loss (for both flora and fauna) (**Table 5-27**).

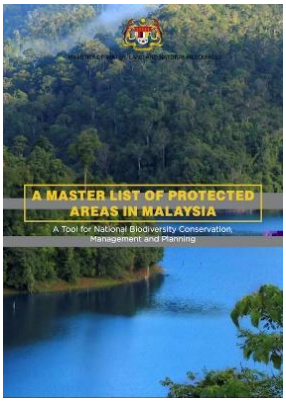
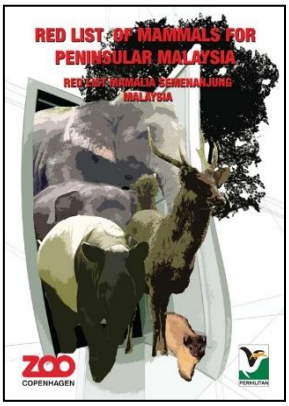
Where applicable, Google Earth can be used to calculate potential habitat fragmentation impacts, especially if construction of access road through forested areas are expected to occur. Components required for this type of assessment include:

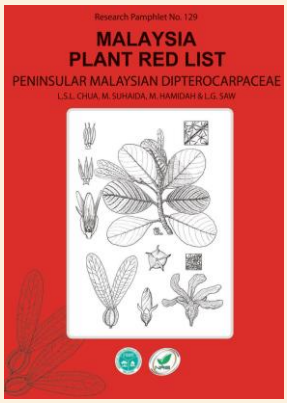
- Forest reserve / protected area boundary
- Project site boundary
- Access road alignment

The degree of potential habitat fragmentation can be calculated as follows:

$$\frac{Area\ of\ individual\ forest\ fragments\ (ha)}{Overall\ area\ of\ PRF\ (ha)}\ X\ 100\%$$

Table 5-27 Examples of Supporting Tools for Ecological Assessment

Assessment Tool	Supporting Info
 **Master List of Protected Areas in Malaysia**	• Presents a list of forest reserves that are considered to be protected areas for strict conservation. • Covers both Peninsular Malaysia, Sabah and Sarawak. • Examples of forest reserves considered as protected areas: ✓ Water catchment forest ✓ Soil protection forest ✓ Virgin jungle reserves ✓ Wildlife reserves ✓ Bird sanctuaries
 **Central Forest Spine Master Plan**	• Presents a network of ecological corridors to improve ecological connectivity throughout Peninsular Malaysia. • Areas within the ecological corridors include state land forests as well as plantations. • Corridors were developed based on movement of large mammals e.g. deers, tapirs, elephants. • Best management practices are proposed to preserve or enhance ecological connectivity.
 **Red List of Mammals for Peninsular Malaysia**	• Presents a list of mammals that are threatened due to declining population. • Can be used to determine if there are any wildlife in the surrounding landscape that are of conservation importance. • List is ranked using the IUCN Red List categories: ✓ Least Concern ✓ Near Threatened ✓ Vulnerable ✓ Endangered ✓ Critically Endangered ✓ Extinct in Wild ✓ Extinct

Assessment Tool	Supporting Info
 **Malaysia Plant Red List**	• Presents a list of plants, specifically dipterocarps, that are threatened due to declining population. • Can be used to determine if there are any plants in the surrounding landscape that are of conservation importance. • List is ranked using the IUCN Red List categories: ✓ Least Concern ✓ Near Threatened ✓ Vulnerable ✓ Endangered ✓ Critically Endangered ✓ Extinct in Wild ✓ Extinct

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Qualified Person to determine suitable assessment tools or models for environmental assessment and compliance. Proposed assessment tools or models shall be well established and acceptable to DOE and newer tools or models can be used if they are more robust.

5.3.11.3 Output

The objective of the ecological assessment is to ensure that impacts such as habitat disturbance and fragmentation are minimised. At the same time, this will help reduce or avoid potential loss of plants and wildlife, if any are present in the surrounding landscape.

The main output of ecological assessments are tables documenting the type of plants and wildlife that can be found within and around a project site (**Table 5-28**).

Table 5-28 Example of Species Listing with Conservation Status

Family	Common Name	Species Name	Conservation Status	
			IUCN Red List	Local Red List[1]
Sciuridae	Plaintain Squirrel	*Callosciurus notatus*	LC	LC
	Black Giant Squirrel	*Ratufa bicolor*	NT	NT
Cercopithecidae	Long-tailed Macaque	*Macaca fascicularis*	LC	LC
	White-thighed Leaf Monkey	*Presbytis siamensis*	NT	NT
	Dusky Leaf-monkey	*Presbytis obscurus*	NT	NT
Lorisidae	Sunda Slow Loris	*Nycticebus coucang*	VU	NT
Mustelidae	Smooth Otter	*Lutrogale perspicillata*	VU	LC

Family	Common Name	Species Name	Conservation Status	
			IUCN Red List	Local Red List[1]
Suidae	Eurasian Wild Boar	*Sus scrofa*	LC	LC
Cervidae	Barking Deer	*Muntiacus muntjak*	LC	NT
Ursidae	Malayan Sunbear	*Helarctors malayanus*	VU	VU
Tapiridae	Malayan Tapir	*Tapirus indicus*	EN	EN
Elephantidae	Asian Elephant	*Elephas maximus*	EN	VU
Felidae	Leopard Cat	*Prionailurus bengalensis*	LC	NT
	Leopard	*Panthera pardus*	VU	EN

Notes:
[1] Red List of Mammals for Peninsular Malaysia
Legend:
LC – Least Concern
NT – Near Threatened
VU – Vulnerable
P – Protected
TP – Totally Protected
EN – Endangered

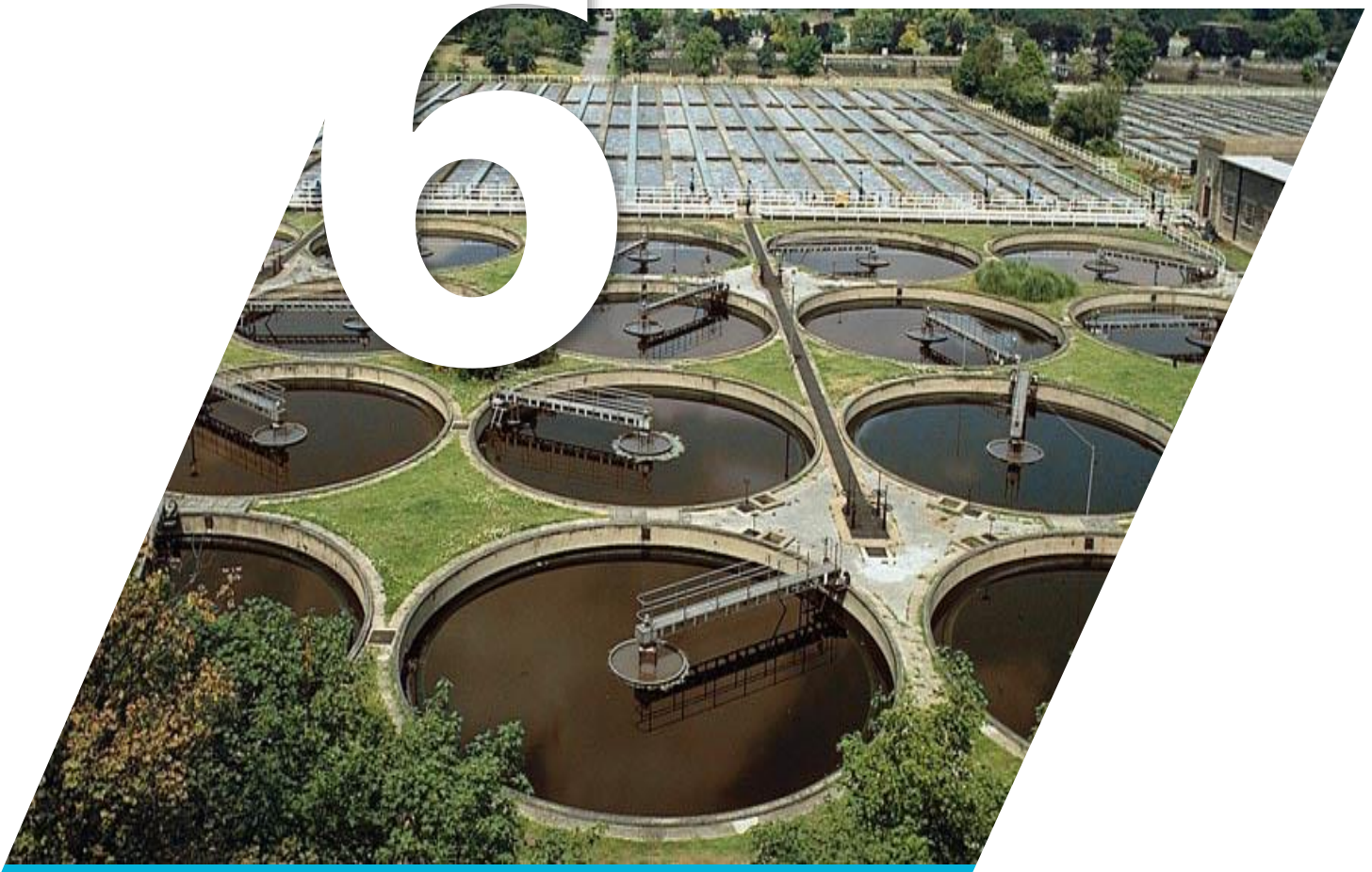
Where applicable, maps can also be generated to show potential habitat fragmentation. These outputs intend to guide the development of suitable mitigation measures to address the identified impacts during both construction and operation stages of a project.

This page has been intentionally left blank.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

6



MITIGATION MEASURES

CHAPTER 6

MITIGATION MEASURES

6.1 INTRODUCTION

This chapter aims to focus on the pollution prevention and mitigation measures (P2M2s) to reduce the significant adverse environmental impacts identified during the scoping and impact assessment of the EIA. The purpose of implementation of the P2M2 are as follows:

i) Avoid negative impacts by selecting alternatives to implement preventive measures
ii) Adopt relevant mitigation measures and best management practices (BMP) to minimize impacts when an impact cannot be avoided
iii) Enhance and amplify the beneficial impacts
iv) Ensure residual impacts are kept within acceptable levels

This chapter illustrate the minimum mitigation measures to be implemented by Project Proponent and serves as a guide only. It is the responsibility of the Project Proponent and Qualified Person to detail out the mitigation measures based on the project parameters such as technology and project site location. Project Proponent must understand all P2M2s stated in the EIA and implement all P2M2s throughout the development of the project phases.

6.2 PRINCIPLES OF ADOPTION OF P2M2

The main principles of P2M2 adoption are as follows:

i) The need and extent of P2M2s required shall correspond to the significance of the predicted impact. Once an impact is identified as significant, P2M2 shall be recommended in the EIA Report (i.e. type of technologies, engineering design of solid waste treatment and disposal facilities). For minor issues, simple management actions will be sufficient (i.e. operating water bowser for dust control at site and hoarding installation as noise control at site)

ii) Priority shall be given to control at source (i.e. use of erosion control covers on slopes and platforms to reduce erosion), then to rectifying the impacts (i.e. maintenance of silt traps and removal of accumulated silt from drainage).

iii) Propose P2M2 should not be a generic measure. It has to be project-specific and designed for the site conditions. P2M2 should be practical, easy to implement and effective with a minimum cost.

iv) **Adequate explanation** on the design and function of a P2M2 should be included in EIA reports. It can be supported by diagrams, illustrations, photos and maps. The EIA report should also include technical reports and specifications as appendix.

v) Project Proponent is encouraged to use **new technology, green technology, best available technique (BAT), best available control technique (BACT) as well as benchmarking with alternative technology and adopting zero waste concept or zero emissions options.** These options shall be considered by the Project Proponent based on the effectiveness in mitigating the impacts. Project Proponent or the Qualified Person should provide proof and supporting documents that the proposed technology is tried and tested, and able to address the impacts. Example of BAT and BACT can be referred in **Appendix I**.

vi) P2M2s require regular **inspection, maintenance and rehabilitation**. These shall be incorporated as part of the management requirements of the project, including the allocation of adequate budgets for such purposes.

vii) Effectiveness of P2M2s shall be documented through the implementation of a **monitoring programme**.

viii) Qualified Person should propose **Best Management Practices (BMPs)** based on the findings of the EIA for the project site.

The P2M2s and BMPs shall be incorporated into the overall design of the project. Submission of the EIA and the pledge given by the Project Proponent shall reflect the agreement and commitment towards ensuring implementation of the mitigation measures on-site throughout the Project phases.

6.3 APPROACHES TOWARDS P2M2 ADOPTION

The Qualified Person shall detail out P2M2s as specific as possible in the EIA report. The Project Proponent and Qualified Person shall also recommend any alternative measures and/or introduce newer technology provided it is proven effective.

The key P2M2s that are applicable include:

- Air Pollution Control
- Water Pollution Control
- Noise and Vibration Control
- Erosion and Sediment Control
- Scheduled Waste
- Odour Control
- Waste Management

Other mitigation measures that may be required include:
- Safety and Health
- Traffic
- Aesthetics
- Ecological Management

A list of recommended P2M2 for solid waste treatment and disposal facilities can be referred in **Appendix J**.

6.4 LAND-DISTURBING POLLUTION PREVENTION AND MITIGATION MEASURES

The LD-P2M2 is required for any land disturbing activities during the construction phase. Qualified Person should prepare LD-P2M2 document by following Guidance Document for the Preparation of the Document on LDP2M2 in Appendix 4 of the EGIM and Guidelines on LD-P2M2 2017.

The LD-P2M2 report shall include all required information as per the LD-P2M2 standard requirements for submission (**Table 6-1**) and accompanied by relevant technical drawings and maps.

Table 6-1 Standard Requirements for the LD-P2M2 Submission

Requirement	Information to be Included
Project Activity and Implementation	• Phasing plan. • Project implementation schedule. • Description of construction activities. • Construction schedule complete with timeline or charts for P2M2s installation. • Construction method statements.
Information and Analysis on Project Development	• Selected weather and rainfall data. • Site runoff velocity and flow rates (pre and post-development). • Description of site soil and geological characteristics (type, erodibility, hydrologic group, percentage dispersible material, • excavation depth, etc.). • Description of adjacent affected areas by land disturbance. • List of drainage, streams and river onsite as well as receiving streams and rivers. • List of P2M2s proposed. • Access roads and project components located outside of • project boundary. • Earthworks cut and fill volume. • Availability of rocks materials. • Biomass management. • Solid (construction waste) and domestic waste management. • Spill prevention and control plan. • Hazardous waste management. • Soil loss prediction (pre, during and post-development) for with and without LD-P2M2 implementation scenarios. • Calculation for sediment traps/basins and projected runoff flows.
Map of Site Plan with Existing Conditions	• Topographic survey map. • Geological Terrain Map. • Erosion risk map. • Land use map. • Site development plan map.

Source: Guidance Document for the Preparation of the Document on LD-P2M2, EGIM 2016.
Note: The list of recommended mitigation measures is not exhaustive and more effective mitigation measures through advanced technologies may be available. It is the responsibility of the Project Proponent and Qualified Person to detail out the mitigation measures in the EIA report.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

7

ENVIRONMENTAL MANAGEMENT PLAN

CHAPTER 7

ENVIRONMENTAL MANAGEMENT PLAN

7.1 INTRODUCTION

The Environmental Management Plan (EMP) is a legal document prepared by the Project Proponent, incorporating pollution prevention and mitigation measures (P2M2s) and best management practices (BMPs) stipulated in the Conditions of Approval (COAs) by the DOE.

The EMP shall function as a project implementation tool for the Environmental Management Team to carry out mitigation works on-site. The key contents of the EMP are required to be translated into a format for incorporation into the Bill of Quantities (BQ) for the work scopes of the contractors during construction and operations.

Other than mitigation measures, the EMP shall include self-regulation requirements, which are environmental monitoring and audit programme. This is to assess the effectiveness of the P2M2 implementation.

The EMP is a living document that has to be updated if there are major changes to the project design, layout or method statement that may result in environmental impacts not originally stated in the EMP.

7.2 EMP FRAMEWORK

During the EIA stage, the project may not have sufficient information on the project work plan to produce a comprehensive EMP. The EMP chapter in the EIA should only be an EMP framework which serve as a guide before the preparation of a full EMP during post EIA approval stage.

The Project Proponent can submit the detailed EMP concurrently with the EIA Report if there is already sufficient information for the EMP. The EMP can later be updated to incorporate the requirements of the COAs. The standard COAs to be included are:

a. Monitoring of water quality of receiving water body by Accredited Laboratory or any other frequency as determined by DOE.

b. Monitoring of TSS and Turbidity at inlets and outlets of sediment structures or any other frequency as determined by DOE.

c. Monitoring of leachate discharge

d. In-situ monitoring of TSS and Turbidity after rain event.

e. Monitoring of air, noise and vibration qualities depending on receptor sensitivity.

f. Planning, construction and maintenance of LD-P2M2 on site.

g. P2M2 notification and implementation.

h. Identification of need of competent persons to undertake specific task on site such as leachate treatment system shall be operated by certified environmental professionals in the leachate treatment plant operation (CePLTPO).

i. Description and implementation details of EMT.

j. Clear documentation on any transfer of ownership or proponent of Approved EIA.

k. Allocation and reporting of sufficient resources to undertake the project activities on-site

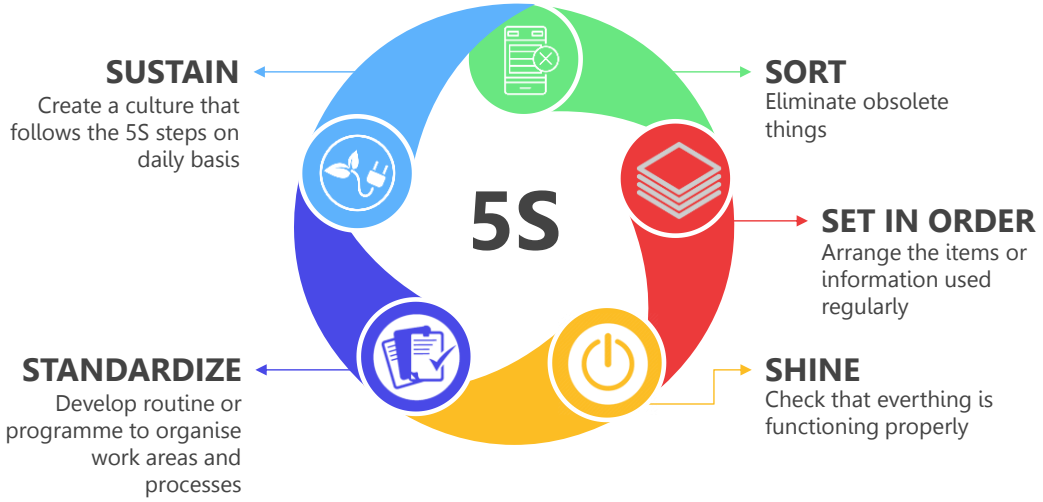
l. Temporary/permanent abandonment/project closure plan details for all phases.

m. Implementation of 5S concept in good housekeeping practices (**Figure 7-1**).

n. Any other green initiatives undertaken for site development activities.

The EMP format shall be based on the requirements stated within the EGIM (or any updated requirements / guidelines / laws and shall contain details from the LD-P2M2 Document, and the proposed monitoring and audit programmes.

Figure 7-1 Application of 5S in Upkeeping Environmental Compliances

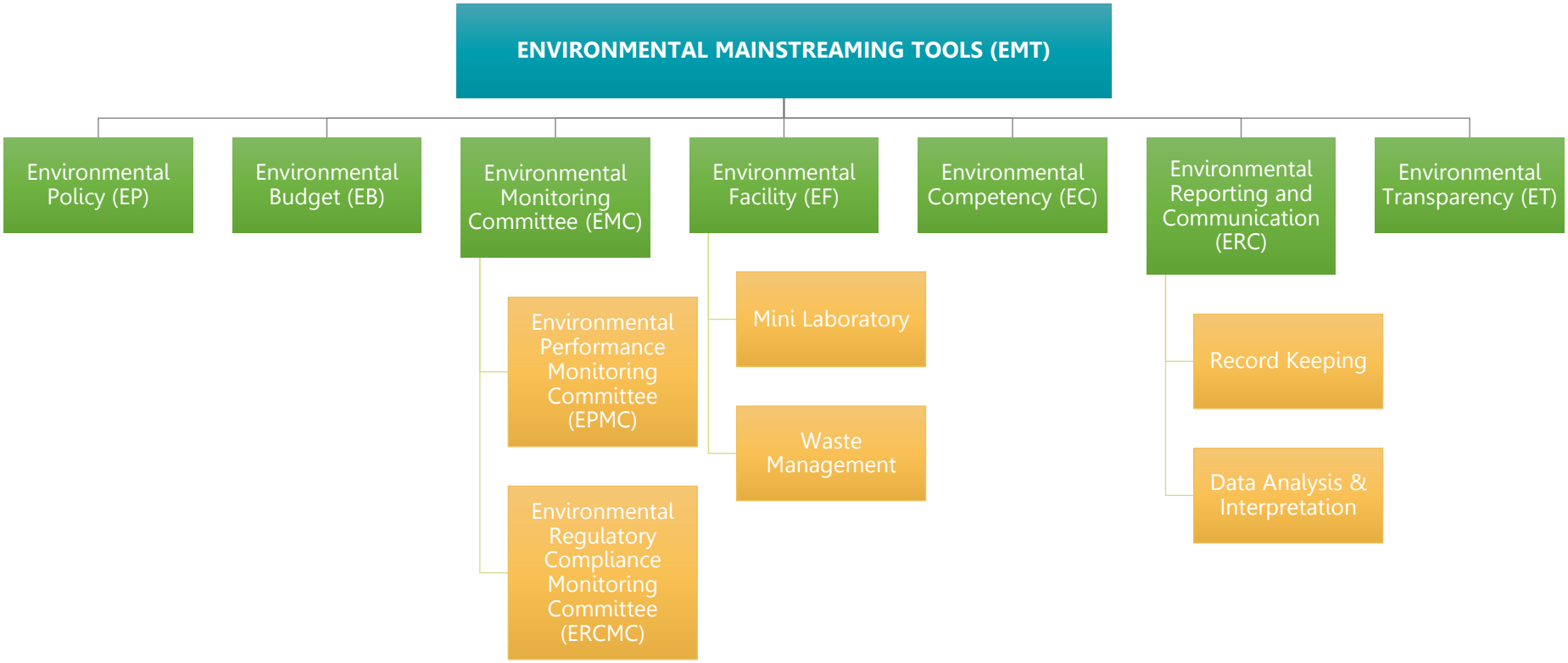


Note: 5S was developed in Japan by Hiroyuki Hirano.

7.3 SELF-REGULATION

Environmental Mainstreaming Tools (EMT) are strategic tool that allows for the cultural evolution of embracing the environmental agenda at all levels of the organisational structure of the Project proponent. All key personnel in an organisation can play a role in effectively safeguarding the environment through the execution of Guided Self-Regulation required for all prescribed activities during the project implementation stages. An overview of the EMT can be referred in **Figure 7-2**.

Figure 7-2 Environmental Mainstreaming Tools



Source: DOE Malaysia (2018)

7.3.1 Environmental Policy

Environmental Policy refers to the commitment from the Project Proponent on their strong environmental accountability to ensure compliance is through the responsibility of all personnel.

7.3.2 Environmental Budgeting

A sufficient budget shall be allocated for the implementation of the EM in the Organisation and shall be reviewed regularly to ensure top priority is given to achieve environmental excellence in its perpetuity.

The Project Proponent has to provide an environmental budget for environmental related commitments, i.e. personnel, P2M2, monitoring, auditing, training, remedial and rehabilitation works.

The budget requirements shall also form part of the bill of quantity (BQ) for the contractors at the contractual stage.

7.3.3 Environmental Monitoring Committee

EMC shall play an important role in identifying all future improvements needed to ensure the EM has achieved its goal. Implementation of future improvements must be scheduled, and financial resources allocated to ensure that these improvements can be made without delay. The EMC shall comprise of the Environmental Performance Monitoring Committee (EPMC) members and the Environmental Regulatory Compliance Monitoring Committee (ERCMC) Members.

At the operational level, the EPMC is chaired by a senior officer of the organisation. Whereas at the policy level, the ERCMC is headed by the Chief Executive Officer or the chairman of the organisation.

For large-scale projects involving multiple contractual work packages by many contractors, the respective main contractors are required to have their respective Environmental Management Teams (EMTs) comprising at least a minimum number of personnel such as an Environmental Manager (EM) and an Environmental Officer (EO).

7.3.3.1 Environmental Performance Monitoring Committee

EPMC is a committee set up to monitor operations, maintenance and performance of all P2M2s implemented to minimize any adverse impacts of the company's operations on the receiving environment. Members must be appointed by the

decision makers in the company and must meet monthly to monitor and report on Environmental Targets met.

The objectives of the EPMC are as follows:

(a) Establish a maintenance programme for pollution control structures, waste management, nuisance factors and all erosion and sedimentation control elements regularly.

(b) Develop training programmes for on-site workers to include awareness of the requirements on good environmental practices and consistent environmental compliance.

(c) Allocate administrative responsibilities for planning and managing the environmental requirements as outlined in the EIA COA.

(d) Ensure the implementation of P2M2.

(e) Implement a monitoring programme (i.e. Impact Monitoring, Compliance Monitoring and Performance Monitoring) to check the effectiveness of the mitigation measures provided.

Ensure that mitigation measures are incorporated in all relevant contracts and design of the site.

7.3.3.2 Environmental Regulatory Compliance Monitoring Committee

ERCMC is a committee set up to monitor the implementation of the EP and to review the regulatory compliance of the EP periodically.

The objectives of the ERCMC are as follows:

(a) Implement the EP and make revisions as and when necessary.

(b) Study implications of new environmental regulations on the Company's activities.

(c) Provide financial resources for any environmental improvement projects.

(d) Understand and take ownership of the Company's performance in EM.

(e) Address any non-compliance issues.

7.3.4 Environmental Facility

The EMP shall provide the range of environmental facilities in the project, such as an air pollution control system (APCS), odour pollution control, leachate collection and removal system (LRCS), sewage treatment systems (STS), BMPs, P2M2 structures and associated supporting utilities and facilities that need operational and maintenance support.

Monitoring is required to show compliance with the relevant standards as stipulated in the Environmental Quality Act 1974 and its subsidiary Regulations.

Besides, Project Proponent and contractors must ensure to comply with all the EIA terms of approval conditions, P2M2 mentioned in EIA report, applicable laws, regulations and guidelines.

7.3.4.1 Mini Laboratory

Project Proponent should set up a mini laboratory on site to ensure immediate results on the performance of P2M2 on site. Qualified Person should analyse treated effluent by using proper equipment and follow the accredited analysis. In-situ instruments such as pH meter, DO meter, and Turbidity meter should also be provided.

7.3.4.2 Waste Management

The Project Proponent has to establish an efficient waste management system by ensuring that proper waste collection or disposal complies with the environmental regulatory requirements and prevents environmental pollution. Examples of best available techniques (BAT) and best available control techniques (BACT) is shown in **Appendix J**.

7.3.5 Environmental Competency

Training requirements are needed to ensure competency for environmental management for all relevant site personnel. The competency also acts as a bridge between the Project Proponent to ensure that there is continuous regulatory compliance from the Project Proponent.

The role of the Competent Person is as follows:

(a) Ensures P2M2 is implemented on site.
(b) Conducts and supervises in-situ sampling and testing.
(c) Supervises environmental monitoring.
(d) Ensures corrective actions are implemented.
(e) Conducts daily inspection on site.
(f) Reviews Environmental monitoring reports (EMRs) for compliance to COAs.

(g) Ensure timely submission of the Environmental Monitoring Compliance Reports (EMCRs) and other reports to DOE.

7.3.6 Environmental Reporting and Communication

EMP framework shall contain a reporting schedule for various submissions during the post EIA stage, which includes:

(a) Environmental Management Plan.
(b) Environmental Monitoring Reporting.
(c) Environmental Audit Reporting

The mode of communication between the ERCMC, EPMC and the respective EMTs should be clearly defined. Lines of communication between the Project Proponent and EMC with the relevant stakeholders must also be spelled out, these are not only limited to project site management but also in engagements with affected communities and the general public to manage any potential grievances and expectations.

7.3.7 Environmental Transparency

This refers to the Project Proponent's initiative to be transparent on its implementation and performance of environmental management. Such sharing may be in the form of the environmental sustainability report, website, billboard, or fliers.

7.4 MONITORING PROGRAMME

The environmental monitoring programme is an important component of the EMP. Monitoring shall be implemented during the post-EIA stage.

7.4.1 Monitoring Category

Environmental monitoring can be categorised into three main types:

(a) Performance Monitoring (PM)
(b) Compliance Monitoring (CM)
(c) Impact Monitoring (IM)

7.4.1.2 Performance Monitoring

PM relates to the monitoring of the performance treatment systems such as air pollution control systems (APCS), industrial effluent treatment system (IETS) and leachate treatment system.

This shall be undertaken by a Competent Person with expertise in the related treatment system

7.4.1.3 Compliance Monitoring

CM relates to the monitoring of P2M2 within the site and their performance. Samplings and measurements are usually taken either at the emission or discharge points (i.e. stacks, sediment basin, leachate treatment plant).

This shall be carried out by a Competent Person associated with an accredited laboratory.

7.4.1.4 Impact Monitoring

IM may only be required in cases where there is a possibility that the impacts may still affect receptors outside of the project boundary despite the implementation of P2M2. Samplings and measurements are usually taken either from the ambient air, odour, water, noise and vibration and/or from sensitive receptors such as nearby residents and if there are water beneficial activities downstream of the Project.

This shall be carried out by a Competent Person associated with the accredited laboratory.

7.4.2 Monitoring Programme

The extent of monitoring shall be determined by the scale of the project and of the predicted impacts. Monitoring covers both within the project site and outside of its boundary where the impacts are perceived to affect sensitive receptors.

Details of the monitoring programme are decided upon by the Qualified Person and approved by DOE, before implementation. The monitoring locations, frequencies, parameters to monitor, recommended limits, instrumentation and personnel requirements have to be identified in the EMP. The monitoring programme shall be tailored for requirements of the project, based on the site conditions and types of development activities (**Appendix K**).

DOE has the authority to mandate any changes to or requires additional information and data apart from those specified in the EMP.

7.5 AUDIT PROGRAMME

Environmental auditing is a post-EIA evaluation process to determine the effectiveness and performance of the P2M2s in compliance with the COAs by the Project Proponent.

Audit requirements are guided by the Environmental Audit Guidance Manual (DOE, 2011). The audit shall be undertaken by an independent third party and DOE registered auditor.

7.5.1 Pre-Audit

Preparation of a pre-audit checklist and information request to the auditee. Submission of a notification of audit to DOE and auditee.

7.5.2 On-Site Audit

Briefing to the auditee by Lead Auditor. Audit shall include documentation review, site inspection, interviews with relevant personnel to obtain the necessary information to gauge compliance and site sampling (optional). Auditee will be briefed at the Closing Meeting with the on-site Audit Summary submitted to the state DOE.

7.5.3 Post Audit

Lead Auditor shall submit an Audit Report to DOE within 14 calendar days after the site audit. The auditee shall develop a Corrective Action Plan for any non-compliances which shall be submitted to DOE within 21 calendar days of the site audit.

7.6 EMERGENCY RESPONSE PLAN

Emergencies may occur during project implementation and operation. Types of emergencies can be caused by natural hazards and human-induced hazards. Examples of natural hazards include natural disaster such as floods, thunderstorms, forest fires, local and national outbreak, outbreaks due to pathogens with pandemic potential and pandemic. As for human-induced hazards, the emergencies may be due to technological hazards that can originate from dangerous procedures, infrastructure failures, technological or industrial conditions or specific human activities. Examples include industrial pollution, transport accidents, factory explosions, fires and chemical spills.

Anticipating emergencies and planning a response can greatly lessen the extent of injuries and limit equipment, material and property damage. During EIA stage, it is important for the Project Proponent to provide the expected types of emergencies

that may occur in their facility and the basic framework of ERP that shall be included in the EIA report. While it is not possible to plan and be ready for all emergencies, preparedness for emergencies is a means to reduce risks to the project and to the environment. Emergency Response Plan(s) or ERP(s) are intended to provide appropriate guidance on what to do in an emergency.

This guideline is not intended to deal in detail how ERPs are to be formulated. This is best left to the project proponent working in tandem with the relevant authorities, such as the police, fire department, Department of Safety and Health and other emergency services. Nevertheless, ERPs should outline the basic preparedness steps needed to handle the anticipated emergencies and should provide appropriate guidance on what to do during an emergency. A sound response plan should include:

- Clear, written policies that designate a chain of command, listing names and job titles of the people (or departments) who are responsible for making decisions, monitoring response actions and recovering back to normal operations;
- Names of those who are responsible for assessing the degree of risk to life and property and who should be notified for various types of emergencies.
- Specific instructions controlling the spread of the damage arising from the emergency situation to the environment including the nearest sensitive receptors
- Procedures for evacuation of surrounding population who are at risk;
- Specific training and practice schedules and equipment requirements for employees who are responsible for rescue operations, medical duties, hazardous responses, firefighting and other responses specific to the work site; and
- The preferred means of reporting fires and other emergencies.

7.7 ABANDONMENT PLAN

Project abandonment can occur during the construction stage or operation stage of the Project due to unforeseen circumstances. The Project Proponent must submit a project abandonment plan to the DOE prior to the abandonment of the Project. In essence, the project abandonment plan shall address the environmental issues arise from the decommissioning including demolition and dismantling activities (but not limited to) such as:

- Air pollution.
- Noise impact.
- Soil erosion.
- Water pollution.
- Solid waste.
- Scheduled waste.

Action plans or measures to be taken shall be outlined in the abandonment plan following all the requirements set by the relevant agencies.

7.8 LANDFILL CLOSURE AND REHABILITATION PLAN

A closure plan is a document that describes the types of works and activities that will be undertaken for the proper and safe closure of the landfill site. In Malaysia, the guidance documents for safe and post closure of solid waste sanitary landfill is the *Guidelines for Safe Closure and Rehabilitation of Municipal Solid Wastes (MSW) Landfill Sites* by the Ministry of Housing and Local Government, Malaysia.

The goals of undertaking safe closure and post-closure are as follows:

- Minimize or eliminate to extent necessary the impacts from post-closure releases of hazardous constituents or contamination to the ground, water and atmosphere in order to protect human health and the environment.
- To document and describe the works that will be carried out to ensure that the site will be safely closed in an appropriate and timely manner.
- To plan the post-closure monitoring to ensure that post-closure releases is kept at minimum and eliminated if possible.

7.8.1 Process of Landfill Closure

The processes of landfill safe closure are as follows:

i. The operator or owner of landfills should assess their respective sites in order to clarify the environmental pollution potential and land use potential.

ii. Based on the assessment, the operator/owner should setup a closure level of the landfill site as follow:

Table 7-1 Closure Levels and Measures Facilities

Measures	Safe Closure Level			
	C1	C2	C3	C4
Final cover soil	++	+++	+++	+++
Drainage system	+	++	+++	+++
Gas ventilation	+	++	+++	+++
Leachate		+	+++	+++
Groundwater			++	+++
Post closure measures		+	+++	+++
Monitoring	+	++	+++	+++

Source: Guidelines for Safe Closure and Rehabilitation of SW Landfill Sites

iii. The operator/owner of landfills should prepare the "Safe Closure (SC) Plan" for submission to the JPSPN and relevant agencies for approval. The SC plan should be submitted one year before closure of the landfill site.

iv. After the approval, the operator/owner of landfills will implement the physical closure works and post closure management activities. These activities should be informed to the related authorities periodically.

v. JPSPN and relevant agencies should examine the SC plan and approve if it meets the requirement. Safe closure activities (PC and PCM) carried out by the operator/owner should be managed and monitored by the relevant authority.

vi. The developer should prepare the "Post-closure Land Use Plan" and submit to the relevant authority in the State government for approval.

vii. The developer can implement the post-closure land use after obtaining the approval. Implementation activities including PCM shall be informed to the related authorities periodically.

7.8.2 Safe Closure Plan

A closure plan is a document that describes the types of works and activities that will be undertaken for the proper and safe closure of the landfill site. The guidance documents for safe and post closure of solid waste sanitary landfill is the Guidelines for Safe Closure and Rehabilitation of Municipal Solid Wastes (MSW) Landfill Sites. The closure plan prepared for the landfill site shall comprise the components as tabulated in **Table 7-2**, depending on the level of closure.

Table 7-2 Components of Landfill Closure Plan

Component	Objective
Capping or Cover System	To contain the wastes to minimize the general environmental nuisances such as visual intrusion, windblown litter, dust and odour. To minimize the infiltration of rainwater and surface runoff into the site To minimize leachate generation To minimize gas migration produced by decomposing wastes To provide a growing medium for restoration planting and re-vegetation of the site

Leachate Management System	To comply with the Standard as stipulated in the Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations, 2009 To prevent water pollution of water body and other possible use downstream of the site
Landfill Gas Management System	To minimize risk of fire and explosion to the surrounding residential areas To minimize release of greenhouse gases especially methane
Drainage System	To channel rainwater and runoff to series of runoff drains for proper sediment removal prior to discharge To reduce runoff from percolating into the waste layers as well as to prevent soil slope erosion and landslide
Landscaping	To establish a good cover to prevent erosion to the final soil cover To improve the visual and landscape of the site To act as a buffer zone to its surrounding land use

7.8.3 Post Closure Landfill Plan

Post-closure works of the landfill site will focus on operating and maintaining proper functions of the closure works in order to prevent pollution and minimize risks to the adjacent community and environment.

The main objectives of post-closure works are as follows:

- To document and implement closure works monitoring and maintenance activities for safe closure of the landfill site.

- To monitor the performance closure works as well as other maintenance works such as leachate treatment system, landfill gas management system, drainage system and slope protection works

- To undertake environmental monitoring works which include surface water quality, groundwater quality, leachate effluent, air quality, landfill gas and settlement or erosion

The post-closure works will consist of monitoring and maintenance works that will be carried out and shall include the following components:

Environmental Management

Environmental monitoring is part of the post closure maintenance plan and is a basic need in the environmental management programme which the effectiveness of the implementations on site are assessed. Environmental monitoring also provides information against which compliance to the relevant conditions and regulations can be checked to help identify areas for improvement. Monitoring of the following aspect is recommended:

- Surface water
- Groundwater
- Raw leachate
- Leachate discharge
- Ambient air and odour
- Landfill gas

Site Inspection and Maintenance

The site inspection shall be carried out via visual inspection. The site inspection shall include the final capping system, drainage system and settlement and slope monitoring. The summary of the monitoring and maintenance are tabulated in **Table 7-3**.

Table 7-3 Summary of Maintenance Works

Monitoring and Maintenance	Items	Methods
Final Capping System	• Cracks • Soil erosion • Plants conditions	Periodic visual inspections
Drainage System	• Clogging by soil or leaves • Damage by sedimentation	Periodic visual inspections
Site Settlement	• Level of monument	Topography survey
Slope Monitoring	• Slope erosion • Accumulated water • Blockage of drains • Silted drains	Periodic visual inspections
Leachate Treatment Plant	• Mixer and pumps • Aerators • Pumps • Blockage of pipes	Periodic visual inspections

Monitoring and Maintenance	Items	Methods
Landfill Gas Management System	• Blockage of pipes • Conditions of gas wells	Periodic visual inspections

Leachate Treatment Management System

The leachate treatment plant (LTP) shall be operated and maintained to ensure the effluent discharge from the plant will be treated to meet the standard of Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009, before discharging into the water body. The operation and maintenance shall be carried out as per follows:

i. The treatment plant pipeline shall be inspected daily for leakage at the joints and pumps.

ii. An operation and maintenance (O&M) manual shall be prepared as a tool in the proper operation and maintenance of the plant. The maintenance procedure should follow the instructions in the equipment supplier's service manual.

iii. The daily checklist on the operational and preventive maintenance schedule is also included in the O&M manual for the operation and maintenance records.

iv. The leachate treatment system equipment shall be inspected and maintained to prevent any operational failure occurs during the operation

Landfill Gas Management System

The landfill gas management system shall be operated and maintained to ensure the landfill gas is well captured and not released to the atmosphere. The operation and maintenance shall be carried out as per follows:

- The gas management system pipeline extraction and collection shall be inspected daily for blockage or leakage of the landfill gas.

- An operation and maintenance (O&M) manual shall be prepared as a tool in the proper operation and maintenance of the system. The maintenance procedure should follow the instructions in the equipment supplier's service manual. The daily checklist on the operational and preventive maintenance schedule is also included in the O&M manual for the operation and maintenance records.

- The operation of the flares and gas detection equipment shall be inspected daily for any blockage or leakage of the landfill gas.

- A stock of spare parts should be stored and ready for delivery for emergency repairs or breakdown.

Land Use Plan

The type of post-closure land use of closed landfills should be carefully considered based on the clear understanding of the landfill conditions during operations, closure, and together with impacts it may have had on the surroundings.

There are several patterns of development of closed landfill sites which can be classified into two aspects:

i. Public access

- Few - very limited people will enter into the area like an agricultural field.
- Controlled - some people will enter into the area under the control like a warehouse.
- Open - everybody can enter into the area like a park and a shopping market.

ii. Times of exposure

- Short - people spend very limited time at the site like car parking.
- Controlled - the hours to stay at the site are controlled like a visitor to the park and/or shop
- Full time - people spend most of the daily hours on the site like a resident

Clean Development Mechanism

Landfill gas CDM projects offer the chance to reduce GHG emissions while upgrading landfill management practices using revenue generated by the sale of electricity generated.

The waste sector offers tremendous potential for CDM, such as recovering emissions from methane sources. Thus, sanitary landfill in Malaysia is highly encouraged to implement CDM project.

This page has been intentionally left blank.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

8

REPORTING AND REVIEW

CHAPTER 8

REPORTING AND REVIEW

8.1 INTRODUCTION

This chapter provides the format and procedures for an EIA report to be submitted to the DOE for approval, after the completion of all other necessary studies and requirements.

8.2 EIA REPORT

An EIA shall be written in a concise manner that is easy to understand and be able to convey the main message to the decision makers. EGIM provides the specifications and format for EIA reporting.

8.2.1 EIA Report Format

The EIA Report shall typically include the following contents:

(a) Environmental Pledge from the Project Proponent and Declaration from the Qualified Person in the format detailed in Appendix 9 of the EGIM. The environmental pledge must be printed in the respective company's letterhead and attached to the EIA report.

(b) Executive Summary of the EIA Report in Bahasa Malaysia and English.

(c) Brief Introduction to the Project, Project Proponent (address, key person and contact information), Environmental Firm (address, key person and contact information) and EIA Team Members (name, academic qualifications, areas of study, signature).

(d) Review of the policy, regulatory and legal requirements for the Project (refer to **Chapter 2** of this EIA Guideline for details).

(e) Terms of Reference (TOR) for the EIA Study as endorsed by the DOE (refer to **Chapter 3** of this EIA Guideline for details). Endorsement letter from DOE to be attached as an appendix to the EIA Report.

(f) Statement of need for the Project. Supporting arguments for the project to justify its needs and necessity shall be included as part of the report.

(g) Deliberation on the alternatives and project options.

(h) Detailed description of the project including site information, concept and breakdown of major components, material and manpower requirements, project activities (refer to **Appendix A**). Mandatory to be addressed is rehabilitation of site if the project is abandoned at any stage of project activity.

(i) Description of the baseline conditions (physical-chemical, biological and human environment) within the ZOS or the ZOI, whichever is greater that may be impacted by the Project (see **Chapter 4** of this EIA Guideline).

(j) Assessment of the significant impacts (positive and negative), prediction of the extent and effects on nearby sensitive receptors and proposal of P2M2 to minimise or enhance these impacts and any potential residual impacts (see **Chapter 5 and 6** of this EIA Guideline).

(k) Details of public consultation and engagement as part of EIA requirements.

(l) Environmental Management Plan (EMP) incorporating the LD-P2M2, monitoring and audit programme (see **Chapter 7** of this EIA Guideline).

(m) Appendices containing technical studies, supporting documentation, results of analysis, list of references, etc. to be included.

8.2.2 Executive Summary

The Executive Summary shall be prepared in infographic format in both Bahasa Malaysia and English, presenting the following information:

(a) Introduction.
(b) Project Proponent & Qualified Person.
(c) Legislative requirements.
(d) Statement of need.
(e) Project location including relevant maps showing project location and sensitive receptors.
(f) Project Description – include flow diagram of main process.
(g) Project Activities:
- Pre-construction Stage.
- Construction Stage.
- Operation Stage.

(h) Existing Environment.
(i) Impact Assessment & Mitigation Measures:

- A description of performance monitoring (PM) program, compliance monitoring (CM) for pollution prevention and mitigation measure (P2M2) and tabulation of relevant PM parameter, recommended limits, monitoring, locations and frequencies.

Softcopy of the Executive Summary (in PDF format) shall be submitted to the DOE along with softcopy of the full EIA Report.

8.2.3 Data Deliverables

The Project Proponent shall make available all relevant data collected during the EIA study (in raw or processed format) along with the EIA Report, when requested by the DOE.

Examples of such data include sampling results (certificates and raw data), modelling databases, baseline data (surveys, hydrographic data and climate data), metadata files, etc. This data shall also be provided to the relevant government agencies upon request

8.2.4 Conclusion to the EIA Report

When concluding the EIA Report, the Qualified Person should provide fair and unbiased conclusion of the EIA study based on the expert opinion of the impact assessment for informed decision-making purpose.

8.3 EIA REPORT SUBMISSION AND REVIEW PROCESS

EIA report submission shall be in line with the steps and procedures outlined in the EGIM and the current requirements by the DOE mentioned above. The EIA submission and review process for First Schedule and Second Schedule EIA is presented in **Table 8-1**.

Table 8-1 Submission and Review Process for First Schedule and Second Schedule EIA

Components	First Schedule Activities	Second Schedule Activities
Submission of Report	• DOE State	• DOE HQ
TOR/ESI Report Submission	• Three (3) hardcopies and one (1) softcopy in PDF format via email • Distribution of softcopy (CD) to agencies/AI/NGO for comments	• Three (3) hardcopies and one (1) softcopy in PDF format via email • Distribution of softcopy (CD) to agencies/AI/NGO for comments
EIA Report Submission	• Three (3) hardcopies and one (1) softcopy (CD) to DOE State • One (1) softcopy (CD) to DOE HQ • Distribution of softcopy (CD) to agencies/AI/NGO for comments • Executive Summary (ES) and Ringkasan Eksekutif (RE) in infographics	• Three (3) hardcopies and one (1) softcopy (CD) to DOE HQ • One (1) hardcopy to DOE State* • Distribution of softcopy (CD) to agencies/AI/NGO for comments • Executive Summary (ES) and Ringkasan Eksekutif (RE) in infographics
Review Timeline	• Twenty-five (25) working days (5 weeks)	• Sixty (60) working days (12 weeks)
Public Participation in EIA Study	• Required	• Required
Public Display of EIA Report	• Not required	• Required
Advertisement of EIA Report	• Not required	• Online advertisement in two (2) major newspapers for three (3) consecutive days

Note: The Qualified Person shall refer to the latest or updated requirements by the DOE.

REFERENCES

Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

Bull et al (2018). IAQM Guidance on the assessment of odour for planning – version 1.1, Institute of Air Quality Management, London.
www.iaqm.co.uk/text/guidance/odour-guidance-2018.

Code of Federal Regulations (CFR). (2020, June 1). Title 40 Protection of Environment Chapter 1(I) §246.101 Definitions of Recovery.

Department of Environment (1985). Development of Water Quality Criteria and Standards for Malaysia.

Department of Environment (2004). Environmental Impact Assessment Guidelines for Risk Assessment.

Department of Environment (2007). The Planning Guidelines for Vibration Limits and Control in the Environment. Second Edition.

Department of Environment (2009). Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009.

Department of Irrigation and Drainage (2010). Guideline for Erosion and Sediment Control in Malaysia.

Department of Environment (2013). Malaysian Ambient Air Quality Standards (MAAQS).

Department of Environment (2014). Environmental Quality (Clean Air) Regulations.

Department of Environment (2015). Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order.

Department of Environment (2016). Environmental Impact Assessment Guideline in Malaysia (EGIM).

Department of Environment (2017). Environmental Essentials for Siting Of Industries In Malaysia (EESIM).

Department of Environment (2017). Guidelines on Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2).

Department of Environment (2019). Malaysia Marine Water Quality Standards and Index.

Department of Environment (2019). The Planning Guidelines for Environmental Noise Limits and Control. Third Edition.

Department of Irrigation and Drainage (2012). Urban Stormwater Management Manual for Malaysia (MSMA). Second Edition.

Department of National Solid Waste Management (2016). National Solid Waste Management Policy.

Frederik Neuwahl, Gianluca Cusano, Jorge Gómez Benavides, Simon Holbrook, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste Incineration; EUR 29971 EN; doi:10.2760/761437.

International Solid Waste Association (ISWA). 2019. Landfill Operational Guidelines.

Manual on the Basic Set of Environment Statistics of the FDES 2013. 2018. Retrieved via https://unstats.un.org/unsd/environment/FDES/MS_3.3.1_3.3.2_Waste.pdf

Ministry of Economic Affairs (2018). Mid-Term Review of The Eleventh Malaysia Plan (2016-2020).

Ministry of Health. National Drinking Water Quality Standards.

Ministry of the Environment (2003). Ontario Ambient Air Quality Criteria (OAAQC). Ministry of Environment, Ontario.

Misra, R. V., Roy, R. N., & Hiraoka, H. (2003). On-Farm Composting Methods. Rome: Food and Agriculture Organization of the United Nations.

National Land Code (1965) (Act 56).

Natural Resources and Environment Board Sarawak (1994). Natural Resources and Environment (Prescribed Activities) Order (1994).

Ministry of Housing and Local Government (2019). National Cleanliness Policy.

PLANMalaysia (2018). Manual for Social Impact Assessment of Project Development. Second Edition.

Registration of Engineers Act (1967). Revised in 2015.

Road Transport Act (1987) (Act 333).

Solid Waste and Public Cleansing Management Act (2007).

Solid Waste and Public Cleaning Management (Prescribed Solid Waste Management Facilities and Approval for Construction, Alteration and Closure Facilities) Regulations 2011

Solid Waste and Public Cleansing Management (Licensing) (Management or Operation of Prescribed Solid Waste Management Facilities) Regulations 2011.

Solid Waste and Public Cleansing Management (Scheme for Construction Solid Waste) Regulations 2018.

Street, Drainage and Building Act (1974) (Act 133).

Town and Country Planning Act (1976) (Act 172).

United States Environmental Protection Agency (USEPA). 2011. Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Municipal Solid Waste Landfills

United Nations (2015). Sustainable Development Goals.

Waste Framework Directive 2008/98/EC, Article 3 (Definitions), No. 17.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX A
PROJECT DESCRIPTION DETAILS

APPENDIX A – PROJECT DESCRIPTION DETAILS

Content	Description
Project Location	• General site plan including ZOS (5-km radius). • Project boundary and layout (with coordinates). • Description of location in relation to identifiable landmarks (i.e. city centres, main roads, towns etc.).
Project Components	Descriptions of the project components together with the complete layout plan should be given as follows: • Waste collection system – capacity, number of waste trucks, design of leachate containment system in waste trucks, collection area • Waste delivery and acceptance procedures • Waste pre-treatment information (description of the pre-treatment plant) • Waste storage area capacity • Thermal treatment plant – processing capacity • Flue gas treatment system – type of system utilised and flowrate of flue gas to be treated • Leachate treatment plant – type of system utilised and flowrate of leachate to be treated • Residues (fly and/or bottom ashes) storage system capacity • Fuel storage – type of fuel used and storage capacity • Reception area with weighbridge and laboratory unit for sampling purposes. • Tipping bay of waste. • Recovery and treatment plant buildings, machinery, and related infrastructure. • Truck cleaning area. • Bund walls and drainage systems isolating handling/storage/cleaning and operational areas. • Stormwater drainage system • Landfill cell development. • Ancillary facilities such as entrance and admin building, weighbridge, perimeter fencing, fuel storage tank, leachate treatment facility, gas flaring, energy recovery facility, retention ponds and monitoring well. • Cell liner system • Processing/recovery/treatment systems. • Sanitary landfill area and phasing. • Industrial effluent treatment system (IETS). • Leachate treatment system (LTS). • Air pollution control system (APCS). • Ventilation systems. • Fire-fighting system, sprinkler system and facilities. • Security fencing, boundary fencing and controlled access.
Type of Solid Waste	To indicate the type of solid waste for recovery/treatment/final disposal.
Waste Acceptance Criteria (WAC)	WAC for the solid waste to be received by the treatment and disposal facility. • Level of pollutants (impurities) in the solid waste that can be accepted in the recovery/treatment/final disposal including the level/percentage of precious metals that can be economically recovered.
Process Technology	• Detailed specification of solid waste management technologies and processes • Technical process flow diagram and mass balance.

Content	Description
	• Produce track record data of similar plant that is in operation. • Expected lifespan of the project.
Detailed Design for Pollution Control System (refer to DOE's memo)	Detailed design of the pollution control system should be included in the report as follows: • Effluent/leachate/air emission information. • Process flow chart including the pollution generation points and mass balance. • Flowrate and quality of effluent/leachate/air emission for each source. • Discussion of the significant effluent/leachate/air emission parameters (maximum and average concentration). • Description of the technologies proposed. • Discussion and statement that the pollution control systems are the "best available technologies" or "best available technologies not entailing excessive cost" or "state of the art technologies". • Working engineering drawings, P&ID, performance monitoring procedure and instruments.
Mass Balance Calculation	• Overall waste flow. • Quantification of total materials into and out of the process. • Difference between inputs and outputs (waste streams).
Project Activities	• Method statement for major project activities during pre-construction, construction, and operational stages. • Manpower requirements. • Workers quarters location (on-site or off-site). • Resource requirements (i.e. soil and aggregate sources, spoil disposal area, etc.).
Infrastructure, Utilities and Amenities Requirement	Details of the estimated demand for: • Water supply. • Electricity. • Sewerage. • Telecommunications. • Transport system. • Waste management.
Project Implementation Schedule	• Estimated timeline for phases implementation from planning to construction and operational phases. • Details of each stages of implementation. • Lifespan of Project

Note: The list is not exhaustive and not all the above may be relevant to the project. It is the responsibility of the Project Proponent and Qualified Person to determine the relevant information required for environmental assessment and compliance.

EIA GUIDELINES

Waste Treatment and Disposal - Solid Waste

APPENDIX B
GENERAL SITE SELECTION CRITERIA

APPENDIX B - SITE SELECTION CRITERIA FOR SOLID WASTE ACTIVITIES

Criteria	Description
Visual / Aesthetics	Select areas with natural screening, isolated settings, or existing natural depressions. Preserve in particular natural amenities (views, trees, landscape etc.). It is preferable that solid waste facility operations be kept out of view from present or future residences near the site. If unavailable, consider sites that can allow provision for screening around landfill sites through construction of berms, fences, planting, or enhancement of existing vegetation.
Land use category	Solid waste treatment and disposal facilities should be sited within an area that is currently zoned in accordance to the local plan.
Agricultural Area	Avoid areas of agricultural importance such as paddy fields. If landfill site is located on agriculture land, the development will take the land out of production and is likely to receive a negative public response. A site with little agricultural value would be preferred.
Meteorological Conditions	• Area with high annual rainfall potentially affects quantity of leachate generated as well as surface runoffs. Areas with heavy rainfall need extra care to avoid side effects of drainage and erosion. Areas of low precipitation are generally preferred. • Wind strength, wind patterns and windbreaks shall be considered to avoid blowing or flying debris/litter and direction of landfill gas and odour.
Offensive Odour	• Waste treatment and disposal facilities which would emit odour are best located downwind of human dwellings to minimize odour nuisance, and as far from the public right-of-way and habitable buildings as economically practicable.
Ecological Resources	Avoid areas: • Identified as ecological sensitive areas and areas gazetted as forest reserves, national parks, marine parks • Areas with existence of rare species or protected plants and/or animals; • Areas with particular features of habitats (terrestrial and aquatic) which should be protected. • Important ecological resource areas such as wetlands, swamp, near lakes or rivers.
Cultural / Archaeological Resources	Avoid areas gazetted or identified as Cultural Sites, Heritage Sites
Geology/Soils	Geologically unstable areas are defined as locations where natural or manmade features pose a substantial risk to the integrity of the landfill structure. Landfills should generally not be sited within these areas. • areas directly underlain by karstified limestone; • areas prone to subsidence caused by previous mining activity; • areas underlain by weak or unstable sub-soils not capable of remediation; and • areas prone to landslip or slope failure
Flooding Potential	• Avoid siting within the 100 year floodplain of rivers. A 100m buffer is recommended to 100 year flood plain areas.

Criteria	Description
	• Avoid areas that are prone to flooding in order to prevent the waste from washing out. • Site located within 100 meters of floodplain or wetlands areas that may be seasonally inundated are likely to be flooded in a major rain event.
Hydrology/Water Quality	• Avoid locating landfill within ESA Rank 1 and Rank 2. • Avoid location of solid waste facility such as landfill, transfer station within important water catchment areas or river for drinking water schemes.
Hydrogeology	Any solid waste facility that have leachate discharge shall avoid: • Areas of significant natural resource quality in terms of usable groundwater or ground water recharge areas. • Development on regionally important aquifers. • Areas with shallow ground water table. Deep water table region is preferred to avoid contamination of underground water by the leachate.
Tidal effect	Site that is located within 100 meters of coastal or estuarine areas are subject to tidal inundation or storm surge is likely to be flooded in a major rain event. Avoid location of landfill next to or by the coastline.
Proximity to airport	Siting of landfill near to airport may create a potential hazard to aircraft. This will depend on the location of the landfill in relation to airport flight paths, the nature of waste deposited, and the types of birds expected in the vicinity. Recommended buffer of not closer than 10km from the nearest airport to be provided in order to avoid bird strike. Other requirements by the International Civil Aviation Authority (ICAO) must be complied with.
Noise	Secluded locations are best if feasible. If not, suitable buffers and distances from human dwellings must be kept.
Land use / Planning	Solid waste treatment and disposal facilities should be sited within an area that is currently zoned for this type of facility that is in line with the land use zoning map by local authorities.
Populations / Public Acceptance	• Solid waste facility should not be located near residential areas in order to protect the public from the nuisance and health impacts due to the potential hazards from landfill. • Nearby communities need to be identified and addressed. In view of cultural differences, human sensitivity must be considered in landfill siting. Discussion and dialog must be conducted to address peoples concern.
Health risks	Risks to public health and impacts on the areas surrounding the landfill can be limited by providing buffer zones between the landfill and sensitive areas. Landfills often attract large numbers of birds, thus increasing the risk to public health by spreading scavenged items away from the landfill facility. Other likely health risks to communities include water pollution, litter, vermin and flies.
Cover material	• The availability of suitable cover material (daily cover material and cover for final restoration) for the duration of the landfilling operation is essential. A good landfill site is one that can provide the cover materials within the landfill area itself. • Topography of the site plays important role in determining the availability of cover materials. Undulating or hilly terrain of the site is an added advantage since it present needed cover material from excavated soil from within the site. • In event site is not able to provide the cover material, this has to be imported with preference that suitable and sufficient source is available within

<table>
<tr><th>Criteria</th><th>Description</th></tr>
<tr><td></td><td>proximity of the landfill site. Access and traffic volume for delivery of cover material must be considered.</td></tr>
<tr><td>Access</td><td>• Good all-weather access roads should be provided. For easy entry and exit of waste transportation, the facility should be preferably positioned near a highway. The utilization of secondary roadways or streets is undesirable because of noise impacts and traffic congestion on routes not designed for heavy truck use.
• Avoid access via high densely populated areas, villages or through town or commercial areas as this will result in discomfort and nuisance in form of odour, noise, littering, debris, leachate dripping, etc.</td></tr>
<tr><td>Traffic / Transportation</td><td>• Siting at remote locations must also take into consideration long distances for transporting waste and volume of traffic to the landfill site. Landfill siting should consider haulage distance for economic reasons.
• In view of environmental concerns, distance travelled by waste vehicles and traffic volume has potential impact on discomfort and nuisance in form of odour, noise, littering, debris, leachate dripping, etc.</td></tr>
<tr><td>Buffer</td><td>Appropriate buffer zones should be included for a specific category of solid waste treatment and disposal facilities with potential to give rise to air, water and noise pollution and solid and toxic waste problems.

The minimum buffer requirement for treatment and disposal of solid waste (SZIRA 2012) are as follows:

<table>
<tr><th rowspan="2">Treatment and Disposal of Solid Waste</th><th colspan="2">Buffer (in meters)</th></tr>
<tr><th>Overall</th><th>Primary</th></tr>
<tr><td>Composting facility</td><td>500</td><td>400</td></tr>
<tr><td>Recycling / recovery plant</td><td>350</td><td>300</td></tr>
<tr><td>Thermal treatment</td><td>350</td><td>350</td></tr>
<tr><td>Sanitary landfill</td><td>500</td><td>500</td></tr>
</table>

• As mentioned in Chapter 3.4, The Local Authority will have the final decision on the buffer requirement which essentially depends on the findings of the impact evaluation in the EIA study and advice from the DOE.</td></tr>
</table>

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX C
EXAMPLES OF PROCESS TECHNOLOGIES

APPENDIX C – EXAMPLE OF PROCESS TECHNOLOGY

Component	Process Technology	Type
Sorting	• Metals Separation	• Magnetic separation of ferrous metals by using an overband magnetic separator or a magnetic drum • Electromagnetic separation of nonferrous metals by means of eddy current separators • All-metal separators by means of a detection coil
	• Optical Separation	• N/A
	• X-ray Separation	• N/A
	• Density separation	• Air classification • Ballistic separation • Sink-float tanks • Vibration tables
	• Size separation	• Drum screens • Linear and oscillating screens • Flip-flop screens • Flat screens • Tumbler screens • Moving grates
Thermal Treatment	• Grate incinerators	• Reciprocating • Travelling • Rocking • Roller • Water cooled • Grate plus rotary kiln
	• Rotary kilns	• Conventional rotary kiln • Rotary kiln stoker
	• Fluidized bed	• Bubbling • Circulating • Rotating
	• Plasma technologies	• Argon plasma arc • Inductively coupled radio frequency plasma • Alternating current plasma • Microwave plasma • Nitrogen plasma arc
Leachate Treatment Plant	• Anaerobic biological	• Anaerobic lagoons, reactors
	• Biological	• Activated sludge process • Sequencing batch reactors • Membrane bioreactors • Aerobic lagoon
	• Chemical	• Activated carbon adsorption • Chemical oxidation
	• Physical-chemical	• Oxidation • Coagulation/ flocculation • Activated carbon • Air stripping • Ion exchange

Component	Process Technology	Type
Landfill Gases Collection System	• Flares	• Open flares • Enclosed flares
	• Electricity Generation	• Internal combustion engines • Turbines • Microturbines
	• Cogeneration	• Internal combustion engines
		• Gas turbines
		• Microturbines
		• Boiler / steam turbine
	• Direct Use	• Boiler • Direct thermal technologies (e.g. dryers, heaters, kilns) • Leachate evaporation
	• Alternate Fuels (Purification Technique)	• Adsorption (molecular sieve) • Absorption with a liquid solvent • Membrane separation
Bioreactor Landfill System	• Addition of liquid and air into the landfill cell	• Aerobic • Anaerobic • Anaerobic-Aerobic (Hybrid)
Landfill Covers	• Evapotranspiration Covers	• Monolithic – any precipitation water is stored in a layer of soil and later removed through evapotranspiration • Capillary break – two-layer system to increase water storage capacity of the cover • Dry barrier – uses wind-driven airflow through the layer of coarse material to remove water from a storage layer

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX D
KEY PROJECT ACTIVITIES

APPENDIX D – KEY PROJECT ACTIVITIES

Prescribed Activities	Stages			
	Pre-Construction	**Construction**	**Operation**	**Abandonment**
First Schedule, Activity 14(b)(i) – Composting Plant	• Survey / Studies • Investigation • Land Acquisition • Site and Building Analysis • Design Concepts • Value Engineering • Scheduling and Logistics	• Temporary Occupation • Site Clearing • Earthworks • Civil Works • Buildings • Machinery • Fuel Storage Facility	• Waste Receiving (waste acceptance, weighing, documentation, tipping) • Pre-processing (debagging and contaminant removal, size reduction, mixing and blending) • Processing (pile formation/ vessel loading, aeration, monitoring) • Curing and finishing/ maturation (discharge from reactor-based system, turning, screening, analysing)	• Dismantling and removal of structures • Demolition waste management (disposal) • Site restoration and rehabilitation
First Schedule, Activity 14(b)(ii) – Recycling or recovery plant			• Waste receiving • Pre-treatment - Size reduction unit (shredders, glass crusher, wood grinder) - Screening unit (vibrating screen, rotary screen, disc screen) - Separation unit (size separation, density separation, electric and magnetic field separation) - Densification (compaction unit) • Treatment (crushing, shredding, bleaching, washing, heating, melting, purification, solidification) • Materials handling unit (for transport and storage of municipal solid waste and recovered materials)	

Prescribed Activities	Stages			
	Pre-Construction	Construction	Operation	Abandonment
Second Schedule, Activity 14(b)(i) – Thermal Treatment Plant			• Waste receiving (waste acceptance, weighing, record) • Waste preparation • Thermal treatment process • Leachate treatment plant • Landfill gas collection • Fuel storage and handling	
Second Schedule, Activity 14(b)(ii) – Sanitary landfill facility			• Waste receiving (waste acceptance, weighing, recording) • Tipping of waste (spreading, waste compaction, daily cover application) • Landfill operation • Landfill gas venting	
Second Schedule, Activity 14(b)(iii) – Transfer Station			• Waste receiving (waste acceptance, weighing, record) • Waste feeding (hopper, vessel) • Size reduction (compactor, shredder) • Waste transportation • Leachate treatment plant • Odour and dust control system	

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX E
ENVIRONMENTAL IMPACT MATRIX FOR SCOPING

APPENDIX E – ENVIRONMENTAL SCOPING MATRIX

A. All Solid Waste Prescribed Activities

Key Project Activities	Environmental Components											
	Air Quality & Odour	Surface Water Quality	Noise & Vibration	Geology & Soil	Groundwater Quality	Waste Generation	Terrestrial & Aquatic Flora and Fauna	Land Use	Land Traffic & Transportation	Socio-Economic	Public Health	Risk
Pre-Construction												
Survey												
Site Investigation												
Land Acquisition												
Construction												
Site Clearing												
Earthworks												
Civil Works												
Buildings												
Machinery												
Fuel Storage Facility												
Abandonment												
Dismantling and Removal of Structures												
Demolition Waste Management (Disposal)												
Site Restoration and Rehabilitation												

B. First Schedule, Activity 14(b)(i) – Composting Plant

Key Project Activities	Environmental Components											
	Air Quality & Odour	Surface Water Quality	Noise & Vibration	Geology & Soil	Groundwater Quality	Waste Generation	Terrestrial & Aquatic Flora and Fauna	Land Use	Land Traffic & Transportation	Socio-Economic	Public Health	Risk
Operation												
Waste receiving												
Pre-treatment of waste (shredding, pulverising, separation and mixing)												
Processing (bio-degradation process)												
Biogas management												
Methane gas management (anaerobic process)												
Leachate												
Curing and finishing/ maturation												

C. First Schedule, Activity 14(b)(ii) – Recovery / Recycling Plant

Key Project Activities	Environmental Components											
	Air Quality & Odour	Surface Water Quality	Noise & Vibration	Geology & Soil	Groundwater Quality	Waste Generation	Terrestrial & Aquatic Flora and Fauna	Land Use	Land Traffic & Transportation	Socio-Economic	Public Health	Risk
Operation												
Pre–treatment (separation, size reduction, classification, compaction)												
Treatment (crushing, shredding, bleaching, washing, heating, melting, purification, solidification)												

D. Second Schedule Activity 14(b)(i) – Thermal Treatment Plant

Key Project Activities	Environmental Components											
	Air Quality & Odour	Surface Water Quality	Noise & Vibration	Geology & Soil	Groundwater Quality	Waste Generation	Terrestrial & Aquatic Flora and Fauna	Land Use	Land Traffic & Transportation	Socio-Economic	Public Health	Risk
Operation												
Waste preparation and handling (cutting, crushing, shredding, settling, separation, neutralisation, etc.).												
Thermal treatment process (incineration, gasification or pyrolysis).												
Flue gas treatment system.												

E. Second Schedule Activity 14(b)(ii) – Sanitary Landfill

Key Project Activities	Environmental Components											
	Air Quality & Odour	Surface Water Quality	Noise & Vibration	Geology & Soil	Groundwater Quality	Waste Generation	Terrestrial & Aquatic Flora and Fauna	Land Use	Land Traffic & Transportation	Socio-Economic	Public Health	Risk
Operation												
Tipping of waste												
Landfill operations.												
Leachate treatment plant.												
Surface water treatment plant.												
Landfill gas venting.												

F. Second Schedule Activity 14(b)(iii) – Transfer Station

Key Project Activities	Environmental Components											
	Air Quality & Odour	Surface Water Quality	Noise & Vibration	Geology & Soil	Groundwater Quality	Waste Generation	Terrestrial & Aquatic Flora and Fauna	Land Use	Land Traffic & Transportation	Socio-Economic	Public Health	Risk
Operation												
Waste receiving												
Waste feeding and size reduction (hopper and compactor system)												
Odour and dust control system												
Leachate treatment plant												

Note:

Positive Impact

P1 Low
P2 Medium
P3 High

Negative Impact

N1 Low
N2 Medium
N3 High

0 Neutral

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX F
PARAMETER AND ANALYSIS FOR BASELINE SAMPLING

APPENDIX F – PROPOSED BASELINE MONITORING AND ANALYSIS

Environmental Components	Parameters	Unit	Criteria for Data Analysis	Remarks
Ambient Air Quality	Particulate Matter (PM_{10})*	24 hours	• Malaysia Ambient Air Quality Standards (MAAQS) 2013.	• Within project site and surrounding sensitive receptors(s) especially at sensitive receptor(s) located downwind to the project area. • * air quality monitoring should consider the basic parameters in MAAQS 2013. • Wind measurement (wind direction and wind velocity) at each monitoring location should be taken throughout the monitoring period (i.e. 24-hr). • The Qualified Person should consider baseline for the sensitive receptor(s) and other parameters that will be predicted/modelled in the air quality impact assessment.
	Particulate Matter ($PM_{2.5}$)*	24 hours		
	Sulphur Dioxide (SO_2)*	24 hours		
	Nitrogen Oxides (as NO_2)*	1 hour		
	Carbon Monoxide (CO)*	8 hours		
	Ground Level Ozone (O_3)*	8 hours		
	Volatile Organic Compounds (VOC)	Total & Screening (24hr)		
	Hydrogen Chloride (HCl)	Total (8hr)		
	Hydrogen Fluoride (HF)	Total (8hr)		
	Heavy metals – Cadmium, Thallium, Mercury, Antimony, Arsenic, Lead, Chromium, Cobalt, Copper, Manganese, Nickel, Vanadium, Aluminium	Total in PM samples		
	Dioxin and Furan (PCDD/PCDF)	Total (24hr)		
Odour	Perceived Odour	D/T	• Currently no standards/guidelines available.	• Within project site and surrounding sensitive receptor(s) especially at sensitive receptor(s) located downwind to the project area. • To note the wind speed, wind direction, surface temperature and relative humidity at each sampling point during sampling. • The Qualified Person should consider baseline for the sensitive receptor(s) that will be predicted/modelled in the odour impact assessment.
	Odour Concentration	OU/m^3		
Noise	LA_{eq}, LA_{max}, LA_{min}, LA_{90}, LA_{10}	24 hours	• The Planning Guidelines for Environmental Noise Limits and Control (Book 1 of 3), Schedule 1 to Schedule 9	• Within project site and surrounding sensitive receptor(s).

Environmental Components	Parameters	Unit	Criteria for Data Analysis	Remarks
			of Annex A: Schedule of Permissible Sound Levels.	• The Qualified Person should consider baseline for the sensitive receptor(s) that will be predicted/modelled in the noise impact assessment.
Vibration	Peak particle velocity be measured simultaneously in the three orthogonal x, y, z axes, computed vectorial sum	m/s	• The Planning Guidelines for Vibration Limits and Control in the Environment (Book 3 of 3), Schedule 1 to Schedule 6 of Annex A: Schedule of Recommended Vibration Limits.	• Within project site and surrounding sensitive receptor(s). • The Qualified Person should consider baseline for the sensitive receptor(s) that will be predicted/modelled in the vibration impact assessment.
Surface Water Quality	Temperature (in-situ reading)	^{o}C	• National Water Quality Standards (NWQS).	• Samples should be analyzed for all parameters coherent to the Environmental Quality (Industrial Effluent) Regulations 2009. • **#** Parameters in the Water Quality Index (WQI) should be included the baseline sampling. • Upstream and downstream of the project point of discharge. • ***** means parameter to be considered if the river has a tidal effect. • Hydraulic measurement (depth, width and velocity) should be taken for modelling purposes. • The Qualified Person should consider baseline for the sensitive receptor(s) that will be predicted/modelled in the water quality impact assessment.
	pH (in-situ reading)**#**	-		
	Biological Oxygen Demand (BOD_5)**#**	mg/l		
	Suspended Solids**#**	mg/l		
	Mercury (Hg)	mg/l		
	Cadmium (Cd)	mg/l		
	Chromium Hexavalent (Cr^{6+})	mg/l		
	Chromium Trivalent (Cr^{3+})	mg/l		
	Arsenic (As)	mg/l		
	Cyanide (Cn)	mg/l		
	Lead (Pb)	mg/l		
	Copper (Cu)	mg/l		
	Manganese (Mn)	mg/l		
	Nickel (Ni)	mg/l		
	Zinc (Zn)	mg/l		
	Boron (B)	mg/l		
	Iron (Fe)	mg/l		
	Silver (Ag)	mg/l		
	Aluminium (Al)	mg/l		
	Selenium (Se)	mg/l		
	Barium (Ba)	mg/l		
	Fluoride (F)	mg/l		
	Formaldehyde	mg/l		

Environmental Components	Parameters	Unit	Criteria for Data Analysis	Remarks
	Phenol	mg/l		
	Free Chlorine	mg/l		
	Sulphide	mg/l		
	Oil and grease	mg/l		
	Ammoniacal Nitrogen (NH_3-N)#	mg/l		
	Colour	ADMI		
	Chemical Oxygen Demand (COD)#	mg/l		
	Dissolved Oxygen (DO) (in-situ reading)#	mg/l		
	DO Saturation (in-situ reading)	%		
	Turbidity	NTU		
	E.coli count	Count/100 mL		
	Salinity (in-situ)*	ppt		
	Conductivity (in-situ)*	µS/cm		
Marine Water Quality	Dissolved Oxygen (DO) (in-situ reading)#	mg/l	• Malaysian Marine Water Quality Standards (MMWQS).	• Sampling needed if the project site is located adjacent to the coast. • # Parameters in the Malaysian Marine Water Quality Index (MMWQI) should be included in the baseline sampling.
	Total Suspended Solids#	mg/l		
	Phosphate#	µg/l		
	Nitrate#	µg/l		
	Ammonia#	µg/l		
	Mercury	µg/l		
	Cadmium	µg/l		
	Chromium (VI)	µg/l		
	Copper	µg/l		
	Cyanide	µg/l		
	Lead	µg/l		
	Zinc	µg/l		
	Arsenic (III)	µg/l		
	Aluminium	µg/l		
	Tributyltin (TBT)	µg/l		

Environmental Components	Parameters	Unit	Criteria for Data Analysis	Remarks
	Polynuclear Aromatic Hydrocarbons (PAH)	µg/l		
	Total Phenol	µg/l		
	Oil & Grease	mg/l		
	Faecal coliform#	CFU/100 ml		
	Temperature	°C		
	pH	-		
Groundwater Quality	Total Coliform	CFU/100 ml	• Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water).	• Upstream and downstream of the project site in the direction of groundwater flow. • Focus on aquifer important as source of water for drinking purposes. • **#** Parameters in the National Groundwater Quality Index (NGQI) should be included in the baseline sampling.
	E. Coli#	CFU/100 ml		
	Turbidity	NTU		
	Colour	TCU		
	pH#	-		
	Temperature	^{o}C		
	Conductivity	µS/cm		
	Total Dissolved Solids#	mg/l		
	Chloride	mg/l		
	Ammonia	mg/l		
	Nitrate#	mg/l		
	Iron#	mg/l		
	Fluoride	mg/l		
	Total Hardness	mg/l		
	Manganese	mg/l		
	COD	mg/l		
	Anionic Detergent (MBAS)	mg/l		
	BOD	mg/l		
	Nitrite	mg/l		
	Mercury	mg/l		
	Cadmium	mg/l		
	Arsenic	mg/l		
	Cyanide	mg/l		
	Lead	mg/l		
	Chromium	mg/l		
	Copper	mg/l		
	Zinc	mg/l		

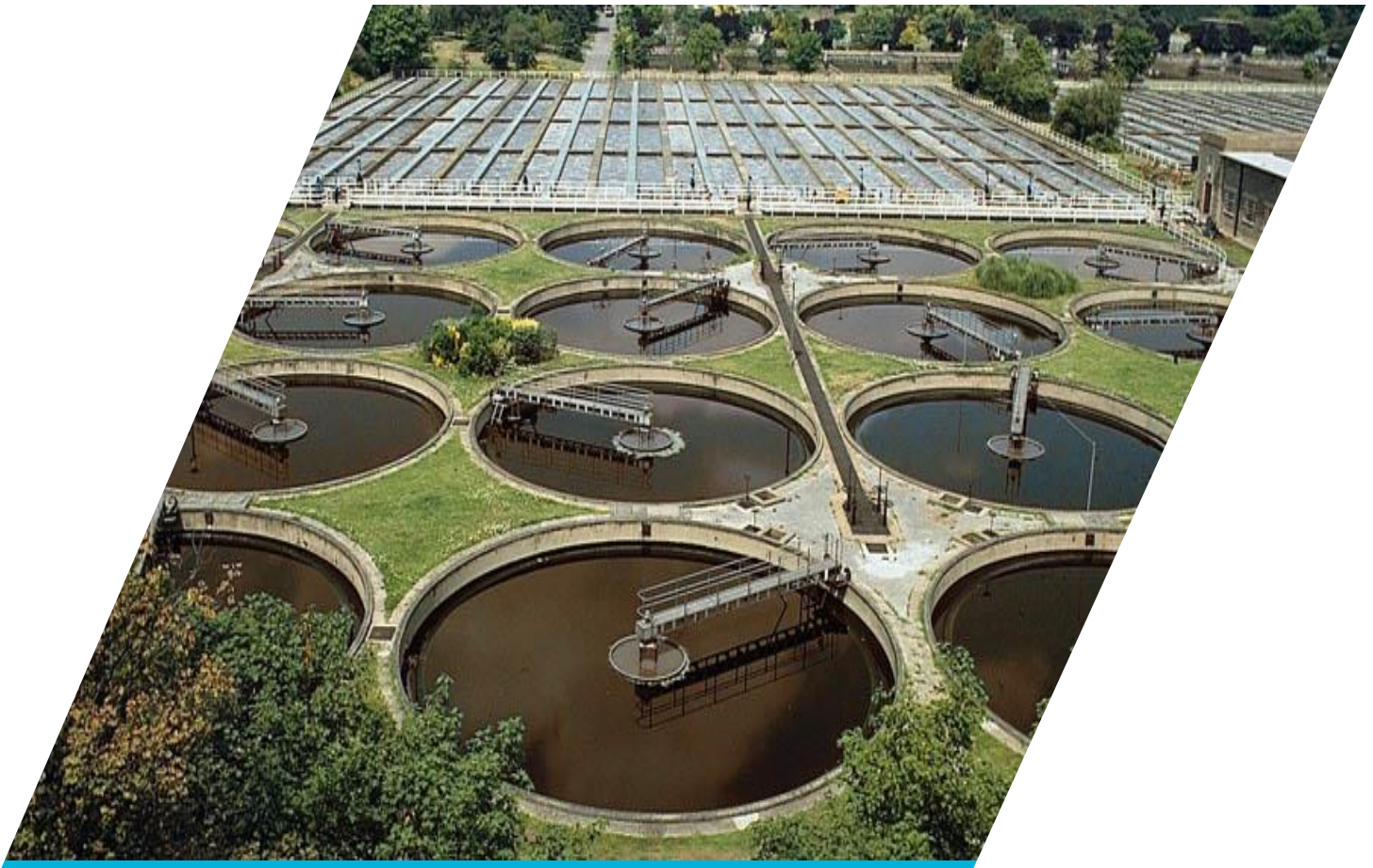
Environmental Components	Parameters	Unit	Criteria for Data Analysis	Remarks
	Sodium	mg/l		
	Sulphate#	mg/l		
	Selenium	mg/l		
	Silver	mg/l		
	Magnesium	mg/l		
	Oil	mg/l		
	Pesticides	mg/l		
	Phenol#	mg/l		
	Nickel	mg/l		
	Gross alpha	Bq/l		
	Gross beta	Bq/l		

Note: The list above is not exhaustive and there may be other parameters that may be relevant depending on the scale, nature and location of the project. The Qualified Persons shall determine other relevant requirements based on the project needs.

This page has been intentionally left blank.

EIA GUIDELINES

Waste Treatment and Disposal - Solid Waste



APPENDIX G
AIR MODELLING TOOLS

APPENDIX G – AIR QUALITY MODELLING TOOLS

Tools	SCREEN View	AERMOD View	AERSCREEN View	TSCREEN	CTSCREEN
Description	• User friendly interface for SCREEN3. • Preliminary modelling with SCREEN View can remove the need for more complicated modelling, saving time and resources.	• Complete and powerful air dispersion modelling package used extensively to assess pollution concentration and deposition from a wide variety of sources. • Incorporates building downwash algorithms, advanced depositional parameters, local terrain effects, and advanced meteorological calculations.	• User friendly interface for AERSCREEN screening-level air quality model and associated modelling programs. • Estimate worst-case impacts of ground level concentrations for a single source by interfacing with the screening mode of the AERMOD model.	• Toxics Screening Model (TSCREEN) is a Gaussian model that implements the procedures to correctly analyse toxic emissions and their subsequent dispersion from one of many different types of possible releases for superfund sites.	• CTSCREEN is a Gaussian plume dispersion model designed as a screening technique for regulatory application to plume impaction assessments in complex terrain. CTSCREEN is a screening version of the CTDMPLUS model.
Input Required	• Source type • Source parameters (emission rate, stack height and diameter, stack gas exit velocity and temperature, ambient air temperature)	• Source type • Source parameters (GPS coordinate, emission rate, stack height and diameter, stack gas exit velocity and temperature)	• Source type • Source parameters (emission rate, stack height and diameter, stack gas exit velocity and temperature, air temperature) • Building data	• Particulate matter emission type • Source parameters (emission rate, stack height and diameter, stack gas exit velocity and temperature) • Building parameters	• Terrain data • Wind speed • Terrain height • Wind directions

Tools	SCREEN View	AERMOD View	AERSCREEN View	TSCREEN	CTSCREEN
	• Dispersion coefficient • Receptor data (height above ground)		• Meteorological data • Terrain data • Receptors' distances	• Terrain type • Averaging time	
Output	• Distance vs concentration graph	• Maximum concentration by distances • 3D visualization of emission concentration	• Final maximum concentration and maximum concentration at the minimum ambient distance • Fumigation results • Maximum concentrations by distance • Meteorology associated with the maximum concentration	• Maximum concentration and the distance to the maximum • Dispersion characteristics and pollutant • Concentrations of the resulting plume	• Worst-case 1hour concentration
Price	Free	Paid (inquire from developer)	Paid (inquire from developer)	Free	Free

Source: Environmental. Essential for Siting of Industries in Malaysia 2013.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX H
QRA MODELLING TOOLS

APPENDIX H – QRA MODELLING TOOLS

Name	ALOHA™	PHAST™	EFFECTS	TEREX	WHAZAN
Sponsor	National Oceanic and Atmospheric Administration (NOAA) U.S. Environmental protection Agency (EPA)	DNV Technica	TNO Department of Industrial Safety, Netherlands	T-SOFT, Czech	DNV Technica
Application	➢ Rapid prediction of source strength and dispersion during emergency response ➢ Generates a variety of scenario-specific output, including threat zone pictures, threats at specific locations, and source strength graphs. ➢ Calculates how quickly chemicals are escaping from tanks, puddles, and gas pipelines – and predicts how those release rates change over time. ➢ Models many release scenarios: toxic gas clouds, BLEVEs, jet fires, vapor cloud explosions, and pool fires. ➢ Evaluates different types of hazard (depending on the release scenario): toxicity, flammability, thermal radiation, and overpressure. ➢ Models the atmospheric dispersion of chemical spills on	➢ Phast is the industry standard tool for process hazard analysis. ➢ It is used to estimate, understand and visualize the effects from loss of containment scenarios. ➢ Comprehensive hazard analysis facilities to examine the progress of a potential incident from the initial release to its far-field effects. ➢ Predict all possible complex	➢ Assess the physical effects of accidental releases of toxic or flammable chemicals. ➢ Detailed modelling and quantitative assessment of release rate pool evaporation, atmospheric dispersion, Vapour Cloud Explosion, Combustion, heat radiation effects from fires etc.	➢ Simulating concrete risk sources in industrial processes ➢ Civil crisis planning where the main threat is a terrorist attack ➢ Army modelling for an attack with hazardous substances, chemical and combat weapons for determining the area struck ➢ The rapid determination of the extent of the threat and the realization of subsequent measures for	➢ Explore the consequences of a set of release scenarios (outflow of chemical, behaviour immediately after release, dispersion in the atmosphere, fires and explosion, indoor gas build up etc.)

Name	ALOHA™	PHAST™	EFFECTS	TEREX	WHAZAN
	water.	consequences from possible release of hazardous material. ➢ PHAST includes a wide range of models for discharge and dispersion as well as flammable, explosive and toxic effects.		population protection, especially the area struck and the necessary evacuation. ➢ Basic modules to assess accident events: -Dangerous chemical substances (TOXI, UVCE, FLASH FIRE) -Explosive systems (TEROR) -Toxic agents (POISON)	
Limitation	➢ ALOHA's concentration estimates (Gaussian assumption) can be less accurate when any condition exists that reduces mixing in the atmosphere. ➢ Concentration patchiness, particularly near the source makes the estimate unreliable. ➢ ALOHA does not account for some effects such as: - Byproducts from fires, explosions, or chemical reactions - Particulates	➢ PHAST has limitations on the source term for maximum temperature and cannot deal with temperatures above 600^{o}C.			➢ Only 30 chemicals are available in the supplied database. ➢ Software does not produce consequence data for all situations (e.g. dust explosion) ➢ The program does not make estimates of the frequency of the scenarios or risk.

Name	ALOHA™	PHAST™	EFFECTS	TEREX	WHAZAN
	- Chemical mixtures - Wind shifts and terrain steering effects - Terrain - Hazardous fragments				
Input	➢ Scenario information (e.g. chemical, weather conditions, and the type of release)	➢ Basic information about storage or process conditions and material properties			➢ Quantities of hazardous substances and site conditions ➢ Physical and chemical Data from built in chemical database
Output	➢ Graphical outputs ➢ GIS-Compatible output (ALOHA's threat zones can be displayed on maps)	➢ Graphical or report outputs ➢ GIS-Compatible output	➢ Graphical outputs ➢ Reports ➢ Contours on map (incorporated GIS tool)	➢ Situation of modelling ➢ Characteristics of a danger ➢ Marking out a danger zone ➢ GIS-compatible	➢ Consequence calculation in both graphical and tabular form
Special Feature	➢ A part of CAMEO® software suite. ➢ Large chemical library (approximately 1,000 common hazardous chemicals) ➢ Pre-accident modelling	➢ Integrated material property database containing more than 1,600 pre-defined pure component chemicals	➢ Complete and industry standard chemical database, containing over 2200 toxic and flammable values and all thermodynamic properties. ➢ Pre accident modelling ➢ Modelling the effects of	➢ Post-accident modelling	➢ Process hazard screening tool

Name	ALOHA™	PHAST™	EFFECTS	TEREX	WHAZAN
			accidental release of hazardous substances		

Source: Environmental. Essential for Siting of Industries in Malaysia 2013.

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

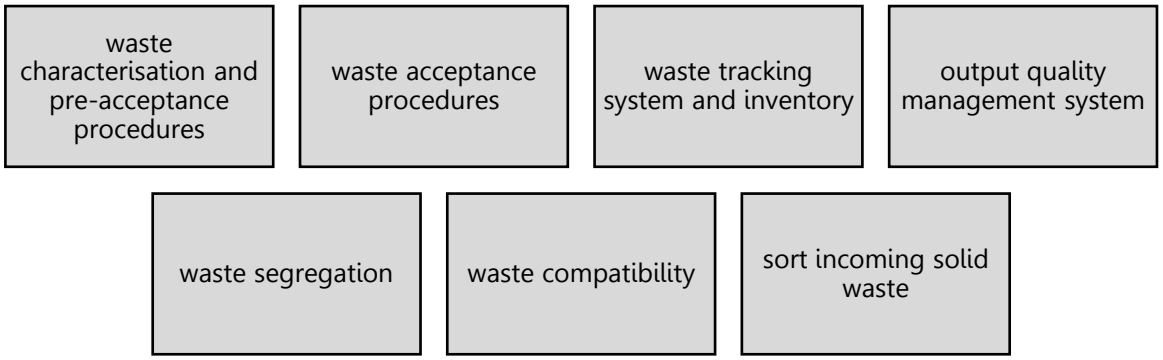
APPENDIX I
BAT AND BACT FOR SOLID WASTE TREATMENT AND DISPOSAL FACILITIES

APPENDIX I – BAT AND BACT FOR WASTE TREATMENT AND DISPOSAL FACILITIES

1. Waste Management

A. Waste Stream

Objective:
To improve the overall environmental performance of the plant, BAT is to use all of the techniques given below:



Technique	Description
Set up and implement waste characterisation and pre-acceptance procedures	To ensure the technical (and legal) suitability of waste treatment operations for a particular waste prior to the arrival of the waste at the plant. They include procedures to collect information about the waste input and may include waste sampling and characterisation to achieve sufficient knowledge of the waste composition.
Set up and implement waste acceptance procedures	Aim to confirm the characteristics of the waste, as identified in the pre-acceptance stage. These procedures define the elements to be verified upon the arrival of the waste at the plant as well as the waste acceptance and rejection criteria. They may include waste sampling, inspection and analysis.
Set up and implement a waste tracking system and inventory	Aim to track the location and quantity of waste in the plant. It holds all the information generated during waste pre-acceptance procedures (e.g. date of arrival at the plant and unique reference number of the waste, information on the previous waste holder(s), pre-acceptance and acceptance analysis results, intended treatment route, nature and quantity of the waste held on site including all identified hazards), acceptance, storage, treatment and/or transfer off site.
Set up and implement an output quality management system	Involves setting up and implementing an output quality management system, to ensure that the output of the waste treatment is in line with the expectations and standards. This management system also allows the performance of the waste treatment to be monitored and optimized, and for this purpose may include a material flow analysis of relevant components throughout the waste treatment.
Ensure waste segregation	Waste is kept separated depending on its properties in order to enable easier and environmentally safer storage and treatment. Waste segregation relies on the physical separation of waste and on procedures that identify when and where wastes are stored.

Technique	Description
Ensure waste compatibility prior to mixing or blending of waste	Compatibility is ensured by a set of verification measures and tests in order to detect any unwanted and/or potentially dangerous chemical reactions between wastes (e.g. polymerisation, gas evolution, exothermal reaction, decomposition, crystallisation, precipitation) when mixing, blending or carrying out other treatment operations.
Sort incoming solid waste	Sorting of incoming solid waste (1) aims to prevent unwanted material from entering subsequent waste treatment process(es). It may include: • manual separation by means of visual examinations; • ferrous metals, non-ferrous metals or all-metals separation; • optical separation, e.g. by near-infrared spectroscopy or X-ray systems; • density separation, e.g. by air classification, sink-float tanks, vibration tables; • size separation by screening/sieving.

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

B. Waste Storage

Objective:
To reduce the environmental risk associated with the storage of waste

Optimised storage location

- Storage is located as far as technically and economically possible from sensitive receptors, watercourses, etc.;
- Storage is located in such a way so as to eliminate or minimise the unnecessary handling of wastes within the plant (e.g. the same wastes are handled twice or more or the transport distances on site are unnecessarily long).

Adequate storage capacity

- Maximum waste storage capacity is clearly established and not exceeded taking into account the characteristics of the wastes (e.g. regarding the risk of fire) and the treatment capacity;
- Storage is located in such a way so as to eliminate or minimise the unnecessary handling of wastes within the plant (e.g. the same wastes are handled twice or more or the transport distances on site are unnecessarily long).
- Maximum residence time of waste is clearly established.

Safe Storage Operation

- Maximum residence time of waste is clearly established.
- Equipment used for loading, unloading and storing waste is clearly documented and labelled;
- Wastes known to be sensitive to heat, light, air, water, etc. are protected from such ambient conditions;
- Containers and drums are fit for purpose and stored securely.

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

C. Handling and Transfer of Waste

Objective:
To reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.

Handling and transfer procedures aim to ensure that wastes are safely handled and transferred to the respective storage or treatment. They include the following elements:

- Handling and transfer of waste are carried out by competent staff;
- Handling and transfer of waste are duly documented, validated prior to execution and verified after execution;
- Measures are taken to prevent, detect and mitigate spills;
- Operation and design precautions are taken when mixing or blending wastes (e.g. vacuuming dusty/powdery wastes).
- Handling and transfer procedures are risk-based considering the likelihood of accidents and incidents and their environmental impact.

2. Emission to Air

A. BACT to reduce channeled emissions to air from incineration plant

Reduction of Dust, Metals & Metalloids Emission	Reduction of Acid Gases (HCl, HF & SO_2) Emissions	Reduction of NOx, N_2O, CO & NH_3 Emissions	Reduction of PCDD/F & PCBs Emissions	Reduction of Mercury Emissions
• Bag filter • Electrostatic precipitator • Dry sorbent injection • Wet scrubber • Fixed or moving bed adsorption	• Wet scrubber • Semi-wet scrubber • Dry sorbent injection • Direct desulphurisation • Boiler sorbent injection	• Optimisation of the incineration process • Flue gas recirculation • Selective non-catalytic reduction (SNCR) • Selective catalytiv reduction (SCR) • Catalytic filter bags • Optimisation of the SNCR/SCR design and operation • Wet scrubber	• Optimisation of the incineration process • Control of waste feed • On-line and off-line boiler cleaning • Rapid flue gas cooling • Dry sorbent injection • Fixed or moving grate adsoprtion • SCR • Catalytic filter bags • Carbon sorbent in a wet scrubber	• Wet scrubber (low pH) • Dry sorbent injection • Injection of special highly reactive activated carbon • Boiler bromine addition • Fixed or moving bed adsorption

Source: Frederik Neuwahl, Gianluca Cusano, Jorge Gómez Benavides, Simon Holbrook, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste Incineration; EUR 29971 EN; doi:10.2760/761437.

B. Abatement of Pollutants based on Techniques

Technique	Typical Pollutant(s) Abated
Adsorption	Mercury, volatile organic compounds, hydrogen sulphide, odorous compounds
Biofilter	Ammonia, hydrogen sulphide, volatile organic compounds, odorous compounds
Condensation and cryogenic condensation	Volatile organic compounds
Cyclone	Dust
Electrostatic precipitator (ESP)	Dust
Fabric filter	Dust
HEPA filter	Dust
Thermal oxidation	Volatile organic compounds
Wet scrubbing	Dust, volatile organic compounds, gaseous acidic compounds (alkaline scrubber), gaseous alkaline compounds (acid scrubber)

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

C. BAT to reduce diffuse emissions to air, in particular of dust, organic compounds and odour

Technique	Description
Minimizing the number of potential diffuse emission sources	This includes techniques such as: • appropriate design of piping layout (e.g. minimising pipe run length, reducing the number of flanges and valves, using welded fittings and pipes); • favouring the use of gravity transfer rather than using pumps; • limiting the drop height of material; • limiting traffic speed; • using wind barriers.
Selection and use of high-integrity equipment	This includes techniques such as: • valves with double packing seals or equally efficient equipment; • high-integrity gaskets (such as spiral wound, ring joints) for critical applications; • pumps/compressors/agitators fitted with mechanical seals instead of packing; • magnetically driven pumps/compressors/agitators; • appropriate service hose access ports, piercing pliers, drill heads, e.g. when degassing WEEE containing VFCs and/or VHCs.
Containment, collection and treatment of diffuse emissions	This includes techniques such as: • storing, treating and handling waste and material that may generate diffuse emissions in enclosed buildings and/or enclosed equipment (e.g. conveyor belts); • maintaining the enclosed equipment or buildings under an adequate pressure; • collecting and directing the emissions to an appropriate abatement system (see Section 6.6.1) via an air extraction system and/or air suction systems close to the emission sources.
Dampening	Dampening potential sources of diffuse dust emissions (e.g. waste storage, traffic areas, and open handling processes) with water or fog.
Cleaning of waste treatment and storage areas	This includes techniques such as regularly cleaning the whole waste treatment area (halls, traffic areas, storage areas, etc.), conveyor belts, equipment and containers.

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution

Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

D. BAT to reduce diffuse emissions to air of dust, odour, and bioaerosols from open-air treatment steps

Technique	Description
Use of semipermeable membrane covers	Active composting windrows are covered by semipermeable membranes.
Adaptation of operations to the meteorological conditions	Adaptation of operations to the meteorological conditions: • Use of semipermeable membrane covers • Taking into account weather conditions and forecasts when undertaking major outdoor process activities. For instance, avoiding formation or turning of windrows or piles, screening or shredding in the case of adverse meteorological conditions in terms of emissions dispersion (e.g. the wind speed is too low or too high, or the wind blows in the direction of sensitive receptors). • Orientating windrows, so that the smallest possible area of composting mass is exposed to the prevailing wind, to reduce the dispersion of pollutants from the windrow surface. The windrows and piles are preferably located at the lowest elevation within the overall site layout.

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

3. Emission to Water

A. BAT to reduce the generation of waste water and to reduce water usage, use all of the techniques given below.

Techniques	Description
Water management	Water consumption is optimized by using measures which may include: • water-saving plans (e.g. establishment of water efficiency objectives, flow diagrams and water mass balances); • optimizing the use of washing water (e.g. dry cleaning instead of hosing down, using trigger control on all washing equipment); • reducing the use of water for vacuum generation (e.g. use of liquid ring pumps with high boiling point liquids).
Water recirculation	Water streams are recirculated within the plant, if necessary, after treatment. The degree of recirculation is limited by the water balance of the plant, the content of impurities (e.g. odorous compounds) and/or the characteristics of the water streams (e.g. nutrient content).
Impermeable surface	Depending on the risks posed by the waste in terms of soil and/or water contamination, the surface of the whole waste treatment area (e.g. waste reception, handling, storage, treatment and dispatch areas) is made impermeable to the liquids concerned.
Techniques to reduce the likelihood and impact of overflows and failures from tanks and vessels	Depending on the risks posed by the liquids contained in tanks and vessels in terms of soil and/or water contamination, this includes techniques such as: • overflow detectors; • overflow pipes that are directed to a contained drainage system (i.e. the relevant secondary containment or another vessel);

Techniques	Description
	• tanks for liquids that are located in a suitable secondary containment; the volume is normally sized to accommodate the loss of containment of the largest tank within the secondary containment; • isolation of tanks, vessels and secondary containment (e.g. closing of valves).
Roofing of waste storage and treatment areas	Depending on the risks posed by the waste in terms of soil and/or water contamination, waste is stored and treated in covered areas to prevent contact with rainwater and thus minimize the volume of contaminated run-off water.
Segregation of water streams	Each water stream (e.g. surface run-off water, process water) is collected and treated separately, based on the pollutant content and on the combination of treatment techniques. In particular, uncontaminated waste water streams are segregated from waste water streams that require treatment.
Adequate drainage infrastructure	The waste treatment area is connected to drainage infrastructure. Rainwater falling on the treatment and storage areas is collected in the drainage infrastructure along with washing water, occasional spillages, etc. and, depending on the pollutant content, recirculated or sent for further treatment.
Design and maintenance provisions to allow detection and repair of leaks	Regular monitoring for potential leakages is risk-based, and, when necessary, equipment is repaired. The use of underground components is minimized. When underground components are used, and depending on the risks posed by the waste contained in those components in terms of soil and/or water contamination, secondary containment of underground components is put in place.
Appropriate buffer storage capacity	Appropriate buffer storage capacity is provided for waste water generated during other than normal operating conditions using a risk-based approach (e.g. taking into account the nature of the pollutants, the effects of downstream waste water treatment, and the receiving environment). The discharge of waste water from this buffer storage is only possible after appropriate measures are taken (e.g. monitor, treat, reuse).

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

B. Best Available Control Technique to reduce emission to water by using appropriate combination of the techniques given below.

Technique	Typical Pollutant(s) Targeted
Preliminary and primary treatment	
Equalisation	All pollutants
Neutralisation	Acids, alkalis
Physical separation, e.g. screens, sieves, grit separators, grease separators, oil-water separation or primary settlement tanks	Gross solids, suspended solids, oil/grease
Physico-chemical treatment	
Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants, e.g. hydrocarbons, mercury, AOX
Distillation/rectification	Dissolved nonbiodegradable or inhibitory pollutants that can be distilled, e.g. some solvents
Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants, e.g. metals, phosphorus
Chemical oxidation	Oxidisable dissolved nonbiodegradable or inhibitory pollutants, e.g. nitrite, cyanide
Chemical reduction	Reducible dissolved nonbiodegradable or inhibitory pollutants, e.g. hexavalent chromium ((Cr(VI))
Evaporation	Soluble contaminants
Ion exchange	Ionic dissolved nonbiodegradable or inhibitory pollutants, e.g. metals
Stripping	Purgeable pollutants, e.g. hydrogen sulphide (H2S), ammonia (NH3), some adsorbable organically bound halogens (AOX), hydrocarbons
Biological treatment	
Activated sludge process	Biodegradable organic compounds
Membrane bioreactor	
Nitrification/denitrification when the treatment includes a biological treatment	Total nitrogen, ammonia
Solids Removal	
Coagulation and flocculation	Suspended solids and particulate-bound metals
Sedimentation	
Filtration (e.g. sand filtration, microfiltration, ultrafiltration)	
Flotation	

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

C. Best Available Techniques to Reduce Water Usage and to Prevent the Generation of Wastewater from the Incineration Plant.

Technique	Description	Applicability
Waste-water-free Flue Gas Cleaning (FGC) techniques	• Use of FGC techniques that do not generate waste water (e.g. dry sorbent injection or semi-wet absorber).	• May not be applicable to the incineration of hazardous waste with a high halogen content.
Injection of waste water from FGC	• Waste water from FGC is injected into the hotter parts of the FGC system.	• Only applicable to the incineration of municipal solid waste.
Water reuse/recycling	• Residual aqueous streams are reused or recycled. • The degree of reuse/ recycling is limited by the quality requirements of the process to which the water is directed.	• Generally applicable.
Dry bottom ash handling	• Dry, hot bottom ash falls from the grate onto a transport system and is cooled down by ambient air. No water is used in the process.	• Only applicable to grate furnaces. • There may be technical restrictions that prevent retrofitting to existing incineration plants.

Source: Frederik Neuwahl, Gianluca Cusano, Jorge Gómez Benavides, Simon Holbrook, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste Incineration; EUR 29971 EN; doi:10.2760/761437.

D. BACT for Leachate Treatment

Methods		Effectiveness of Treatment					
		BOD	**COD**	**Suspended Solids**	**Nitrogenous Compounds**	**Colour**	**Heavy Metal**
Leachate Recirculation		**++**	++	++	+	+	**+**
Biological Treatment	Activated Sludge	+++	++	+	+	+	**+**
	Contact Aeration	+++	++	+	+	+	**+**
	Rotating Disk Bioreactor	+++	++	+	+	+	**+**
	Trickling Filter	++	++	+	+	+	+
	Aeration Lagoon	++	++	+	+	+	+
	Biological Filtration	+++	++	+++	+	+	+
	Biological Denitrification	+++	++	+	+++	+	+
Physio-chemical Treatment	Coagulation Flocculation	++	**+++**	**+++**	+	**+++**	++
	Ozone Oxidation	**-**	++	**-**	**-**	**+++**	**-**
	Sand Filtration	+	+	**+++**	**-**	+	**-**
	Activated Carbon Adsorption	**+++**	**+++**	++	+	**+++**	++
	Chelating Adsorption	**-**	**-**	**-**	**-**	**-**	**+++**
Natural Attenuation	Stabilization Pond	**++**	++	+	+	+	+
	Hydrosphere Treatment	++	++	+	+	+	+
	Wetland Treatment	++	++	**++**	+	+	+

Notes: +++ highly effective; ++ effective; + slightly effective; - not effective

Source: The Study on The Safe Closure and Rehabilitation of Landfill Sites in Malaysia Final Report – Volume 5

4. BACT for Sludge Treatment

Process / Operation	Techniques
Preliminary Operations	• Grinding • Blending or mixing • Storage • Degritting
Sludge Thickening Operation	• Gravity thickening • Centrifugal thickening • Flotation thickening (DAF) • Gravity belt thickening • Rotary drum thickening
Sludge Stabilisation	• Chemical stabilization (lime) • Thermal stabilization • Anaerobic digestion • Aerobic biodegradation • Dual sludge stabilisation
Sludge Conditioning	• Chemical conditioning • Thermal conditioning
Sludge Dewatering Technique	• Centrifugal dewatering • Belt filter presses • Filter presses
Drying Operation	• Rotary drying • Spray-drying • Flash drying • Evaporation
Thermal sludge oxidation	• Fluidised-bed incineration, • Multiple hearth drying/incineration, • Wet air oxidation, • Deep shaft oxidation, • Incineration with other (e.g. solid) waste.

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

5. Greenhouse Gases (GHG) Emission from Landfill

A. BACT for GHG emission from sanitary landfill

Technique		Description	Applicability	CH_4 Reduction
LFG Collection Efficiency Improvement	Active system	• Active systems use mechanical blowers or compressors to create a vacuum that optimizes LFG collection • Collection efficiency depends primarily upon the design and maintenance of the collection system and the type of materials used to cover the Landfill (refer to Item 6B)	All landfills with gas collection systems	Varies
	Passive system	• Passive systems rely on the natural pressure gradient between the waste mass and the		

Technique		Description	Applicability	CH_4 Reduction
		atmosphere to move gas to collection systems.		
LFG Control Devices	Flares	• Open flares – collected gas is combusted in an elevated open burner • Enclosed flares – Collected gas is combusted using multiple burners within fire-resistant walls		99%
	Electricity Generation	• Turbine	For larger landfills with gas collection systems	99%
		• Engine		96-98%
		• Microturbine		99%
		• Small Engine		96-98%
	Cogeneration	• CHP engine		96-98%
		• CHP turbine		99%
		• CHP microturbine		99%
	Direct use	• Boilers • Direct thermal technologies (dryers, heaters, kilns) • Leachate evaporation		Varies by technology
	Alternate fuels	• Purification techniques can be used to convert LFG to pipeline-quality natural gas, compressed natural gas, or liquefied natural gas		
Increase CH_4 Oxidation	Biocovers	• Composed of two substrate layers: a gas dispersion layer and a CH4 oxidation layer. • The gas dispersion layer is an additional permeable layer of gravel, broken glass, or sand beneath the porous media of the CH4 metabolizing layer.	All landfill	Up to 32%
	Biofiltration	Gas capture system is constructed by digging a small area of space in the top cover soil, then, the space is filled with biomaterials for purposes of capturing the gases. • **Biowindows**, which are cells of spaces, cut into the cover soil and filled with support mediums • **Biofilters**, which differ from biowindows in that, they are contained in the cover layer of the landfill • **Biotarp cover**, which is a temporary system made of a thick film, infused with methanotrophic bacteria, and placed daily over an on-going operation of filling an active	Landfills with passive or no gas collection system	Up to 19%

Technique		Description	Applicability	CH_4 Reduction
		landfill site. The inducement of bacteria is done, so that the bio-tarp could immediately consume the escaped methane gas reaching the top soil, thereby, reducing fugitive gases while operating on the site.		

Source: United States Environmental Protection Agency (USEPA). 2011. Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Municipal Solid Waste Landfills

B. Type of Landfill Cover Material

Types	Gas Collection Efficiency
Clay final cover	85%
Geomembrane final cover	90%

Source: United States Environmental Protection Agency (USEPA). 2011. Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Municipal Solid Waste Landfills

6. Types of Daily Cover for Landfill

Waste Derived	Artificial/ Synthethic
Paper pulp	Geomembrane (refer to types of geomembrane below)
Shredded wood	Synthetic foams
Shredded tyres	Geotextile matting
Shredded tyres	Plastic film
Recycling process waste	Synthetic mesh
Shredded green waste	Hessian fabric
Pulverised household waste	Tarpaulins
Compost	

Source: International Solid Waste Association (ISWA). 2019. Landfill Operational Guidelines

Types of geomembranes include:

- **high-density polyethylene (HDPE) – most common type**
- medium-density polyethylene (MDPE),
- linear low-density polyethylene (LLDPE),
- polyvinyl chloride (PVC),
- chlorinated polyethylene (CPE),
- chlorosulphonated polyethylene (CSPE),
- ethylene propylene rubber (EPDM),
- polypropylene (PP),

7. Best Available Techniques to Reduce Noise and Vibration Emissions

Technique	Description	Applicability
Appropriate location of equipment and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating building exits or entrances.	• For existing plants, the relocation of equipment and building exits or entrances may be restricted by a lack of space or excessive costs.
Operational measures	This includes techniques such as: i. Inspection and maintenance of equipment; ii. Closing of doors and windows of enclosed areas, if possible; iii. Equipment operation by experienced staff; iv. Avoidance of noisy activities at night, if possible; v. Provisions for noise control during maintenance, traffic, handling and treatment activities.	• Generally applicable.
Low-noise equipment	This may include direct drive motors, compressors, pumps and flares.	• Generally applicable.
Noise and vibration control equipment	This includes techniques such as: i. Noise reducers; ii. Acoustic and vibrational insulation of equipment; iii. Enclosure of noisy equipment; iv. Soundproofing of buildings.	• Applicability may be restricted by a lack of space (for existing plants).
Noise attenuation	Noise propagation can be reduced by inserting obstacles between emitters and receivers (e.g. protection walls, embankments and buildings).	• Applicable only to existing plants, as the design of new plants should make this technique unnecessary. For existing plants, the insertion of obstacles may be restricted by a lack of space. • For mechanical treatment in shredders of metal wastes, it is applicable within the constraints associated with the risk of deflagration in shredders.

Source: Antoine Pinasseau, Benoit Zerger, Joze Roth, Michele Canova, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste treatment Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control); EUR 29362 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-94038-5, doi:10.2760/407967, JRC113018

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX J

EXAMPLES OF POLLUTION PREVENTION & MITIGATION MEASURES

APPENDIX J - EXAMPLE OF POLLUTION PREVENTION AND MITIGATION MEASURES

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
Pre-Construction		
• Soil Investigation • Site Survey • Land Acquisition	• Soil erosion and sedimentation	• Schedule to avoid rainy day or wet season
	• Socio-economic impact if relocation of local community	• Ensure relocation is planned and carried out in proper manner, provide some compensation for affected community
Construction		
• Site Clearance • Earthwork, site and cell preparation • Establishment of Access Road • Mobilisation of Machinery and Equipment • Civil and Structural Work • Mechanical and Electrical Installation	• Soil erosion and sedimentation	• Land-Disturbing Pollution Prevention and Mitigation Measures LD-P2M2 (refer to **Section 6.4**) • Preparation of ESCP (propose the construction of temporary silt fence, temporary silt trap, stockpile area, sandbag, wash trough, temporary earth drain) • Earthworks to carry out in phases. • Schedule to avoid rainy day or wet season • Vegetated buffer strip recommended to be established • Turf all bare grounds immediately • Planning and implementation of BMP
	• Generation of dust and deterioration of air quality	• Provision of temporary wash trough for wheel washing facility • Tyres of vehicles should be cleared of dirt and mud • Trucks carrying earth or other materials should be covered with canvas • Spray Project site with water by water browser especially during dry weather • Construction raw materials such as sand, gravel and cement should be stored neatly and covered properly • Prohibition of open burning
	• Deterioration in water quality	• Proper drainage system by construction of temporary drain at project site • Construction of check dam, silt traps or sediment basins for temporary retention of runoff from disturbance areas • Construction of silt fence • Construction of silt trap • Use of active treatment systems (if needed) such as flocculants, anionic polymers, etc. in constraint areas to accelerate entrapment and settlement of fine sediments.

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
		• Use of active treatment systems (if needed) such as flocculants, anionic polymers, etc. in constraint areas to accelerate entrapment and settlement of fine sediments. • Provision of toilet facility and maintenance in accordance to the National Water Services Commission (SPAN) requirements.
	• Noise and vibration	• Erection of hoarding along the perimeter of the Project Site • Periodical maintenance of all equipment and machinery • Restrict speed limit of vehicles • Schedule piling works during day time and week days
	• Solid waste generation (biomass, excess soil and domestic wastes)	• Proper management of waste by implementing 4R (Reduce, Reuse, Recover and Recycle). • Waste disposal must be transported to approved landfill • Strictly prohibit waste from being discharged into waterways • Have good housekeeping practices
	• Scheduled waste generation	• Scheduled waste must be safely stored and disposed following the Environmental Quality (Scheduled Waste) Regulations 2005 as follows: o Provision of suitable and adequate temporary scheduled waste storage area with containment facility and security. Containment facility shall be designed to contain 110% of the largest inventory of liquid scheduled waste. Containment facility shall be made from impermeable materials with spill recovery facility. o Competent person must conduct scheduled waste notification, labelling, inventory and consignment to track and control movement of scheduled wastes o Scheduled waste management and disposal at licensed facilities using licensed transporters.
	• Socio-economic impact if relocation of local community	• Ensure relocation is planned and carried out in proper manner, provide some compensation for affected community
	• Possible criminal case increment	• Contractor are expected to have all legal requirements for construction workers fulfilled

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
	• Possible social conflict between local community and workers	
	• Traffic increment	• Restrict movement of vehicles and machinery • Provision of road signage and traffic cones • Establish a Traffic Management Plan
Operation		
Waste Storage	Improper management and optimization of the storage of waste input, in terms of duration, location and size.	<u>Optimised storage location</u> • The storage is located as far as technically and economically possible from sensitive receptors, watercourses, etc.; • the storage is located in such a way so as to eliminate or minimise the unnecessary handling of wastes within the plant (e.g. the same wastes are handled twice or more or the transport distances on site are unnecessarily long). <u>Adequate storage capacity</u> • maximum waste storage capacity is clearly established and not exceeded taking into account the characteristics of the wastes (e.g. regarding the risk of fire) and the treatment capacity; • the storage is located in such a way so as to eliminate or minimise the unnecessary handling of wastes within the plant (e.g. the same wastes are handled twice or more or the transport distances on site are unnecessarily long). • the maximum residence time of waste is clearly established. <u>Safe storage operation</u> • the maximum residence time of waste is clearly established. • Equipment used for loading, unloading and storing waste is clearly documented and labelled; • wastes known to be sensitive to heat, light, air, water, etc. are protected from such ambient conditions; • containers and drums are fit for purpose and stored securely.

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
Air Quality	Emission of dust, odour and bioaerosols from open-air treatment such as windrow composting	• Use of semipermeable membrane covers <u>Adaptation of operations to the meteorological conditions:</u> • Use of semipermeable membrane covers • Taking into account weather conditions and forecasts when undertaking major outdoor process activities. For instance, avoiding formation or turning of windrows or piles, screening or shredding in the case of adverse meteorological conditions in terms of emissions dispersion (e.g. the wind speed is too low or too high, or the wind blows in the direction of sensitive receptors). • Orientating windrows, so that the smallest possible area of composting mass is exposed to the prevailing wind, to reduce the dispersion of pollutants from the windrow surface. The windrows and piles are preferably located at the lowest elevation within the overall site layout.
	Emission of dust / fine particulates (PM_{10} and $PM_{2.5}$) and bioaerosols	• High standard of construction, including enclosed waste handling and storage areas for waste with the potential to generate dust or particulate emissions, and cleanliness of site roads. • Pre-treatment of wastes, e.g., wetting, solidification, encapsulation. • Acceptance of bagged waste only. • Water sprinklers operated in relevant waste handling areas. • Regular sweeping of access roadways and areas of hard-standing and main transfer station area. • Transfer and loading of potentially dusty wastes within a building. • Use dust extraction system to remove dust and particulates from working areas/ buildings, where applicable.
	Emission of dust/fine particulates (PM10 and PM2.5) from landfill working area	• Use of semipermeable membrane covers • Prompt compaction after discharge from the vehicle delivering the waste, followed by covering with suitable material (natural or artificial cover materials) to sufficient depth. • Provision of spray equipment around active tipping area if dusty waste is a regular problem.

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
		• Use of paved site roads where appropriate. • Regular sweeping of surfaced site roads.
	Odour arise from the handling of waste	• The location of the facility with regard to off-site receptors should be considered during the design stage. • Vehicles delivering and removing waste should be enclosed or covered • Handling should be carried out in an enclosed area suitable for the capture, containment and treatment of odours. • At the design stage consideration should be given to the requirement for the capture, containment and treatment of odorous air. • All biodegradable wastes should be removed from the premises as soon as practicable and, in any case, within 48 hours of arrival or within 72 hours at public holiday weekends. • Use of appropriate odour abatement technique such as adsorption, wet scrubbing, alkaline oxidative scrubbing, alkaline oxidative scrubbing, thermal oxidation, catalytic oxidation.
	Odour risk at landfill from landfill gas or leachate	• Preparation and operation of odour management plan. • Minimisation of open tipping face area. • Prompt replacement, compaction and covering of wastes • Provision of landfill gas collection and management infrastructure prior to waste emplacement • Aeration of leachate storage areas. • Improvements in landfill gas collection, venting and combustion systems. • Monitoring and regular balancing of gas extraction wells. • Use of horizontal and vertical gas extraction wells. • Use of horizontal gas collection pipe work in active cell. • Use of gas extraction pipework to maintain negative air pressure within the body of gas producing waste. • Use of gas collection pipework at the top of the cell side slopes. • Regular balancing of gas fields and condensate management. • Use of auxiliary fuel in landfill gas flare systems to support gas combustion. • Covering of leachate lagoons. • Use of appropriate materials for daily, interim and final cover/capping.

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
		• Use of gas barrier layer along interface of filled cell and new cell (sacrificial). • During periods when the rate of landfill gas production alone is insufficient to allow the operation of landfill gas combustion equipment, the use of auxiliary fuels should be considered. • Covering or burial of waste excavated during the installation of leachate or landfill gas management systems. • Odour Management Plan including walk-over VOC survey (PID/FID, quarterly) • The use of odour neutralising sprays/aerosols at times when either climatic or waste acceptance site monitoring indicates heightened risk to identified receptors (for example inversions or calms). • Use of odour neutralising additives in wastes during transport from transfer station to landfill site.
	Dust emission to air	• Electrostatic precipitators • Wet electrostatic precipitators • Wet scrubber • Bag filters • Cyclones and multi cyclones
	Acid gas emission (HCl, HF, SO_2)	• Wet scrubber system • Semi-dry scrubber system • Flash dry system • Addition of alkaline reagents to the furnace
	Oxide of nitrogen emission	• Flue gas recirculation • Selective catalytic reduction (SCR) • Selective non-catalytic reduction (SNCR) • Air staging • Reduced air/ fuel ratio • Furnace insulation
	Methane emission to air	• Follow the hierarchy of landfill gas treatment options: (i) landfill gas utilisation for energy recovery, (ii) enclosed flaring, (iii) venting with open flaring as odour control measure.

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
		• Minimise landfill gas production potential by pre-treating the waste prior to acceptance for landfilling. • Prevent landfill gas from migrating through the ground in both gaseous and dissolved states and prevent emissions of methane to the atmosphere. • Manage odour risks/nuisance. • Prevent condensate build-up in gas collection network. • Use of horizontal and vertical gas collection pipework in the waste body. • Carry out regular balancing of gas wells. • Collect all landfill gas and, where feasible, utilise it to produce energy. • Where energy generation from landfill gas is not possible, it should be burned in an enclosed flare with a minimum temperature of 1,000oC and a retention time of 0.3 seconds. • Regularly monitor and balance gas extraction wells.
	Organic carbon compounds such as halogenated aromatic hydrocarbons; polycyclic aromatic hydrocarbons; benzene, toluene and xylene; PCDD/F emission to air from flue gas from waste incineration plant	• Adsorption on activated carbon reagents in an entrained flow system • Catalytic filter bags • Reburning of carbon adsorbents • Use of carbon-impregnated plastics for PCDD/F adsorption • Static or moving bed filters • Rapid cooling of flue gases
	PCDD / PCDF emission to air	• Presentation of re-formation • Selective catalyst reduction (SCR) • Destruction using catalytic filter bags • Absorption by carbon injection
	Dust emissions to air from the treatment of slags and bottom ashes	• Enclose and cover equipment • Limit height of discharge • Protect stockpiles against prevailing winds • Use water sprays • Optimise moisture content • Operate under subatmopsheric pressure
Water Quality	Water quality deterioration due to uncontrolled discharge of untreated leachate	• Leachate treatment plant must be periodically maintained to avoid breakdowns. Adequate spare parts must be readily available. • Operation and maintenance shall be operated by competent person.

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
		• Full process monitoring system using SCADA • Conduct monthly testing for the treated leachate discharge in order to maintain and improve the LTP performance
	Pre-treatment of sludge Dry sludge and biosolids generation	• Physical dewatering • Drying such as disk dryer, drum dryer, fluidised bed dryer, multi screw disk press • Dry sludge and biosolids generation • Storage of dry sludge should not exceed a period of five days • Proper disposal of sludge at sites which are approved by the Local Authority • Minimum technical and safety standards for vehicles transporting sludges shall be specified. • The schedule for sludge transportation should be planned to avoid using the main access road during morning peak and evening peak hours • Vehicles should have their loads adequately covered with canvas • Have good housekeeping practices
	Surface runoff of effluent / leachate from compost	• Run off and leachate should be collected in an engineered system and collected in a sump or lagoon with sufficient piping and drainage collection capacity to contain the maximum run-off anticipated. All sumps should be impermeable and resistant to the stored materials.
	Wastewater from the scrubber effluent of thermal treatment plant	• Physical dewatering • Recirculation of polluted waste water in wet or semi-wet flue gas cleaning systems (e.g. wet scrubbers), including effective process control to minimise waste water discharges; • Cooling of polluted waste water from wet flue gas cleaning systems which results in lower water losses to flue-gases and therefore reduced water consumption; this design can eliminate cooling water consumption; • Application of waste-water-free FGC technology (e.g. semi-dry or dry sorption systems); • Use of boiler drain water as water supply for the scrubber; • Treatment of laboratory waste water in the scrubber;

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
		• Application of a waste-water-free bottom ash discharger; • Use of leachate from open-air bottom ash storage areas as feed water to the bottom ash discharger; • Use of segregated drainage to enable direct discharge of clean rainwater from roofs and other clean surfaces; • Use of roofed enclosures to reduce the exposed surface areas used for waste storage and handling.
Soil Contamination	• Spills and other fugitive emissions into soil and groundwater • Seepage of leachate from the cell	• The use of good compaction, and daily and intermediate cover to reduce the level of water infiltration and hence the quantity/quality of leachate produced. • The applicant should put in place procedures to ensure that the capping system is not damaged by the placement of the soil restoration layers or the construction of environmental control systems, e.g., landfill gas or leachate pipework and associated manholes. • Leachate Recirculation. This engineering practice reduces the volume of effluent for treatment and assists in accelerating the degradation/stabilisation of the waste in the landfill however leachate recirculation may only be considered in engineered, lined cells where suitable leachate collection systems, leachate level monitoring is in place and the lined cell is capped/ • A comprehensive monitoring and repair programme should be initiated to ensure the integrity of the capping layers.
Noise & Vibration	<u>Sources of noise and vibration:</u> • Noise emission from flaring. • Noise caused by aeration and turning devices. • trucks for the transport of waste; • crane operations in the bunker;	<u>Appropriate location of equipment and buildings</u>: • noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating buildings' exits or entrances; <u>Operational measures</u> • inspection and maintenance of equipment;

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
	• mechanical pre-treatment of waste; • exhaust fans, extracting flue-gases from the incineration process and resulting in noise from the outlet of the stack; • noise related to the cooling system (for evaporation cooling and especially for air cooling); • noise related to transport and treatment of bottom ash; • noise from the turbo-generator set	• provisions for noise control during maintenance, traffic, handling and treatment activities • Low-noise equipment • This may include direct drive motors, compressors, pumps and flares • Noise and vibration control equipment • Noise reducers • Acoustic and vibrational insulation of equipment • Enclosure of noisy equipment • Soundproofing of buildings
Waste	Solid wastes generation (packaging wastes, domestic wastes)	• Proper management of waste by implementing 4R (Reduce, Reuse, Recover and Recycle). • Provision of a recycling centre to encourage recovery of reusable portions of packaging and domestic waste Placement of enough garbage bins
	Scheduled waste generation	Scheduled waste must be safely stored and disposed following the Environmental Quality (Scheduled Waste) Regulations 2005 as follows: • Provision of suitable and adequate temporary scheduled waste storage area with containment facility and security. Containment facility shall be designed to contain 110% of the largest inventory of liquid scheduled waste. Containment facility shall be made from impermeable materials with spill recovery facility. • Competent person must conduct scheduled waste notification, labelling, inventory and consignment to track and control movement of scheduled wastes • Scheduled waste management and disposal at licensed facilities using licensed transporters.
	Erosion and sedimentation	• Preparation of abandonment plan

Project Activity	Potential Significant Environmental Impact	Proposed Mitigation Measures
Abandonment of Site	Dust, particulate emission	• Proper removal and disposal of waste material from the site • Structures that are hazardous and pose safety issues to the public must be taken apart • Areas should be hoarded up to prevent trespassers • Land restored to its original land use where possible • Notify relevant authorities of intention of project abandonment
	Health risk due to possible breeding ground for vermins	
	Abandoned solid wastes	
	Undisposed scheduled wastes	
Abandonment of Plant / Facility	Deterioration of water and groundwater quality	
	Fire hazard from sewage gas	
	Health risk due to possible breeding ground for vermins	
	Odour generation	
	Damaged equipment / structures	
	Undisposed scheduled wastes	

EIA GUIDELINES

Waste Treatment and Disposal – Solid Waste

APPENDIX K
MONITORING PROGRAMME

APPENDIX K – PROPOSED MONITORING PROGRAMME

A) Construction Stage (Water Quality)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Compliance Limit	Reference
Water Quality						
Performance Monitoring (PM)	All P2M2 on-site: • Earth drains • Silt fence • Silt trap	Structural integrity, functionality, practicality and frequency of maintenance for all P2M2	Weekly After heavy rainfall	Quarterly	Design of P2M2 to comply with MSMA 2nd Edition specifications.	Urban Stormwater Management Manual Malaysia (MSMA 2nd Edition
Compliance Monitoring (CM)	Silt trap discharge	Total suspended solids (TSS)	Monthly		50 mg/l	-
		Turbidity			250 NTU	
	Septic tank discharge	pH			Limit values depends on the location of the project (upstream or downstream of the water intake point)	Environmental Quality (Sewage) Regulations 2009
		COD				
		BOD				
		TSS				
		NH_3-N				
		E. coli				
Impact Monitoring (IM)	Beneficial users along the river within the ZOI.	TSS	Monthly		Limit values based on the river water class	National Water Quality Standards (NWQS)
		Turbidity				
		Temperature				
		pH				
		DO				
		BOD				
		NH_3-N				
		E. coli				

Note: The list is not exhaustive and not all of the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

B) Construction Stage (Air Quality)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Compliance Limit	Reference
Air Quality						
Impact Monitoring (IM)	Nearby residential areas within ZOI	Particulate Matter < 10µm (PM_{10})	Monthly/ Quarterly	Quarterly	100 µg/m^3 (24-hr)	Standard 2020 of the Malaysia Ambient Air Quality Standard (MAAQS) 2013

Note: The list is not exhaustive and not all of the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

C) Construction Stage (Noise)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Compliance Limit	Reference
Noise						
Impact Monitoring (IM)	Nearby residential areas and noise sensitive receptors within ZOI	L_{10} (Day time 12-hr)	Monthly/ Quarterly	Quarterly	75 dBA (daytime) 70 dBA (evening)	Guidelines for Environmental Noise Limits and Control Third Edition, 2019.

Note: The list is not exhaustive and not all of the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

D) Construction Stage (Vibration)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Compliance Limit	Reference
Vibration						
Impact Monitoring (IM)	Nearby residential areas and vibration sensitive areas within ZOI	Peak particle velocity (measured in three orthogonal x, y, z axes)	Monthly/ Quarterly	Quarterly	Limits based on the receiving land use category in the guideline	The Planning Guidelines For Vibration Limits and Control in the Environment, 2007

Note: The list is not exhaustive and not all of the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

D) Operation Stage (Air Quality)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Limit	Reference
Air Quality						
Performance Monitoring (PM)	Bag filter	Pressure	Daily	Quarterly	Design specification	Technical Guidance on Performance Monitoring of Air Pollution Control Systems (APCS)
		Flowrate	Daily			
		Stack condition	Daily			
		Hopper condition	Daily			
	Wet scrubber	Gas flow	Daily			
		Pressure	Daily			
		Temperature	Daily			
		pH of liquor	Daily			
		Wet scrubber spray flowrate	Daily			
		Opacity/stack condition	Daily			
Compliance Monitoring (CM)	Stack emission	Total PM	Continuous*	Quarterly	100 mg/m^3	Item K, Waste Incinerators in All Sizes of the Environmental Quality (Clean Air) Regulations 2014
		NMVOC as total organic carbon	Continuous*		10 mg/m^3	
		Hydrogen chloride (HCl)	Continuous*		40 mg/m^3	
		Hydrogen fluoride (HF)	Continuous*		1 mg/m^3	
		Sum of SO_2 and SO_3 expressed as SO_2	Continuous*		50 mg/m^3	
		Sum of NO and NO_2 expressed as NO_2	Continuous*		200 mg/m^3	
		Carbon monoxide (CO)	Continuous*		50 mg/m^3	
		Cadmium and its compound, expressed as cadmium (Cd)	Quarterly		Total 0.05 mg/m^3	
		Thallium and its compound, expressed as thallium (Th)	Quarterly		Total 0.05 mg/m^3	
		Mercury and its compound, expressed as mercury (Hg)	Quarterly		0.05 mg/m^3	

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Limit	Reference
Air Quality						
Compliance Monitoring (CM)	Stack emission	Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), Vanadium (V), and their compounds expressed as the element	Quarterly	Quarterly	Total 0.5 mg/m^3	Item K, Waste Incinerators in All Sizes of the Environmental Quality (Clean Air) Regulations 2014
		PCCD/PCDF	Bi-annually	Bi-annually	0.1 ng TEQ/m^3	
Impact Monitoring (IM)	Sensitive receptors (residential within ZOI)	Odour	Monthly/ Quarterly	Quarterly	-	-
		Particulate Matter < 10µm (PM_{10})	Monthly/ Quarterly	Quarterly	100 $\mu g/m^3$ (24-hr)	Standard 2020 of the Malaysia Ambient Air Quality Standard (MAAQS) 2013
		Particulate Matter < 2.5µm ($PM_{2.5}$)	Monthly/ Quarterly	Quarterly	35 $\mu g/m^3$ (24-hr)	
		Sulphur Dioxide (SO_2)	Monthly/ Quarterly	Quarterly	80 $\mu g/m^3$ (24-hr)	
		Nitrogen Dioxide (NO_2)	Monthly/ Quarterly	Quarterly	70 $\mu g/m^3$ (24-hr)	
		Ground Level Ozone (O_3)	Monthly/ Quarterly	Quarterly	180 $\mu g/m^3$ (1-hr)	
		Carbon Monoxide (CO)	Monthly/ Quarterly	Quarterly	30 mg/m^3 (1-hr)	

Note: The list is not exhaustive and not all the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

E) Operation Stage (Water Quality)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Limit	Reference
Water Quality						
Performance Monitoring (PM)	✓ Leachate Treatment Plant (LTP) discharge ✓ Industrial Effluent Treatment System (IETS) discharge	pH Turbidity DO Pressure	Daily	Quarterly	Design specification	Technical Guidance on Performance Monitoring of Industrial Effluent Treatment Systems (IETS)
		MLSS TSS	Weekly			
Type of Monitoring	**Description**	**Proposed Parameter**	**Proposed Monitoring Frequency**	**Proposed Reporting Frequency**	**Limit**	**Reference**
Water Quality						
Compliance Monitoring (CM)	✓ Leachate Treatment Plant (LTP) discharge ✓ Industrial Effluent Treatment System (IETS) discharge	Temperature	Monthly/ Quarterly	Quarterly	LTP: Discharge shall comply to the limits prescribed by the Director General of Environmental Quality. IETS: Limit values depends on the location of the project (upstream or downstream of the water intake point)	LTP: Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009 IETS: Environmental Quality (Industrial Effluent) Regulations 2009
		pH Value				
		Biochemical Oxygen Demand (BOD5) at 20°C				
		Chemical Oxygen Demand (COD)				
		Suspended Solids				
		Ammoniacal Nitrogen				
		Mercury				
		Cadmium	Monthly / Quarterly			
		Chromium Hexavalent				
		Chromium Trivalent				
		Arsenic				
		Cyanide				
		Lead				
		Copper				
		Manganese				
		Nickel				
		Tin				
		Zinc				

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Limit	Reference
Water Quality						
Compliance Monitoring (CM)	✓ Leachate Treatment Plant (LTP) discharge ✓ Industrial Effluent Treatment System (IETS) discharge	Boron Iron Silver Selenium Barium Fluoride Formaldehyde Phenol Sulphide Oil and Grease Colour	Monthly / Quarterly	Quarterly	LTP: Discharge shall comply to the limits prescribed by the Director General of Environmental Quality. IETS: Limit values depends on the location of the project (upstream or downstream of the water intake point)	LTP: Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009 IETS: Environmental Quality (Industrial Effluent) Regulations 2009
Impact Monitoring (IM)	Beneficial users along the river within the ZOI.	Ammoniacal Nitrogen Biochemical Oxygen Demand (BOD) Chemical Oxygen Demand (COD) Dissolved Oxygen (DO) pH Temperature Total Suspended Solid (TSS) Oil & Grease Cadmium (Cd) Arsenic (As) Lead (Pb) Chromium (Cr) Zinc (Zn) E. coli	Monthly / Quarterly	Quarterly	Limit values based on the river water class	National Water Quality Standards (NWQS)

Note: The list is not exhaustive and not all the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

F) Operation Stage (Noise)

Type of Monitoring	Description	Proposed Parameter	Proposed Monitoring Frequency	Proposed Reporting Frequency	Compliance Limit	Reference
Noise						
Performance Monitoring (PM)	-	-	-	-	-	-
Compliance Monitoring (CM)	Noise at plant boundary	L_{Aeq}	Monthly/ Quarterly	Quarterly	70 dBA (daytime) 65 dBA (night time)	Guidelines for Environmental Noise Limits and Control Third Edition, 2019.
Impact Monitoring (IM)	Nearby residential areas and sensitive receptors within ZOI	L_{Aeq}	Monthly/ Quarterly	Quarterly	Limits based on the receiving land use category in the guideline	

Note: The list is not exhaustive and not all of the above may be relevant to the project depending on the scale, nature and location of the project. The proposed monitoring frequency is subjected to the significance of the impact.

ISBN 978-983-9795-44-8