ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR PETROCHEMICAL INDUSTRIES

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PREFACE

This is the first edition of the **Environmental Impact Assessment Guidelines For Petrochemical Industries** following the amendments to the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 of the Environmental Quality Act (EQA) 1974 on 28 August 2015.

In Malaysia, an **Environmental Impact Assessment (EIA)** is a statutory requirement for activities, which have been prescribed under Section 34A of the EQA 1974. These prescribed activities have been categorised under the new Order into the **First** and **Second Schedules**.

The Guidelines aim to protect the quality of the environment in the development of Petrochemical Industries by:

Defining environmental requirements for the prescribed activity.

Providing a range of tools and methods to avoid and/or to reduce and minimise the sources of environmental pollution to an acceptable level.

Guiding the selection and application of these tools and methods to maintain a healthy environment during different phases of project implementation, including abandonment / decommissioning phase.

Guiding towards environmental excellence by self-regulating and implementing 5S concept in environmental management.

The Guidelines shall provide guidance to the Project Proponents, Qualified Person (i.e. DOE-registered EIA Consultants), and other EIA-related practitioners in the preparation and submission of EIA reports for activities related to the development of **Petrochemical Industries** as stated in the Order.

The Guidelines shall only be used within the framework of the EQA 1974 including its future updates, and its subsidiary regulations.

(DATO' DR. HAJI AHMAD KAMARULNAJUIB BIN CHE IBRAHIM)

Director General of Environmental Quality

Malaysia

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ABBREVIATIONS

AELB	Atomic Energy Licensing Board
AI	appointed individuals
APCS	air pollution control system
AS/NZS	Australian / New Zealand Standard
BAT	best available technologies
BMP	best management practices
BOD	Biochemical Oxygen Demand
BPEO	Best Practical Environmental Option
CEMS	Continuous Emission Monitoring System
CEO	Chief Executive Officer
CO	Carbon Monoxide
COA	conditions of approval
COD	Chemical Oxygen Demand
DID	Department of Irrigation and Drainage
DOE	Department of Environment
DOF	Department of Fisheries
e.g.	Example
EGIM	Environmental Impact Assessment Guideline in Malaysia
EIA	Environmental Impact Assessment
EIATRC	EIA Technical Review Committee
EM	Environmental Manager
EMT	Environmental Management Teams

EO	Environmental Officer
EPMC	Environmental Performance Monitoring Committee
ERCMC	Environmental Regulatory Compliance Monitoring Committee
ESCP	Erosion and Sediment Control Plan
ESI	Environmental Scoping Information
ESI	Environmental Screening Information
ESM	Environmental Scoping Matrix
ETA	Event Tree Analysis
etc.	Et cetera
FGD	Focal Group Discussions
FTA	Fault Tree Analysis
GA	Government Agencies
H_2S	Hydrogen Sulphide
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
HIA	Health Impact Assessment
IETS	Industrial Effluent Treatment System
IFC	International Finance Corporation
IPPC	Integrated Pollution Prevention and Control
JKPTG	Department of Director General of Land and Mines
JKR	Public Works Department
JPSM	Forestry Department Peninsular Malaysia
KSAS	*Kawasan Sensitif Alam Sekitar*
L10	Ten percentile level
L50	Fifty percentile level
L90	Ninety percentile level
LAC	Limit of Acceptable Change

LAeq	Equivalent A-Weighted Continuous Sound Level
LD-P2M2	Land Disturbing Pollution Prevention And Mitigation Measures
LMax	Maximum A-Weighted Continuous Sound Level
LMin	Minimum A-Weighted Continuous Sound Level
MESTECC	Ministry of Energy, Science, Technology, Environment and Climate Change
METMalaysia	Malaysian Meteorological Department
MIDA	Malaysian Investment Development Authority
MOH	Ministry of Health
MOM	minutes of meetings
MOSTI	Ministry of Science, Technology and Innovation
MPFN	National Physical Planning Council of Malaysia
MSMA	Storm water management
MTRA	Marine Traffic Risk Assessment
NH_3	Ammonia
NO_2	Nitrogen Dioxides
NPCZP	National Physical Coastal Zone Plan
NPP-3	National Physical Plan-3
O_3	Ozone
P2M2	Pollution Preventions and Mitigation Measures
PBT	Local Authority
PEMS	Predictive Emission Monitoring System
PERHILITAN	Department of Wildlife and National Parks Peninsular Malaysia
PLANMalaysia (JPBD)	Department of Town and Country Planning of Peninsular Malaysia

PM_{10}	Particulate Matter 10 Micron
$PM_{2.5}$	Particulate Matter 2.5 Micron
PTD	District and Land Office
PTG	Land and Mines Office
QRA	Quantitative Risk Assessment
RIA	Radiological Impact Assessment
RQSAT	Report Quality Self-Assessment Tool
SI	Soil investigations
SIA	Social Impact Assessment
SO_2	Sulphur Dioxide
SPAN	National Water Services Commission
SPC	State Planning Committee
SSA	Site Suitability Assessment
SSL	Site Screening Levels
STS	sewage treatment systems
TIA	Traffic Impact Assessment
TOR	Terms of Reference
TORAC	TOR Adequacy Check
VOC	Volatile Organic Compounds
ZOI	Zone of Impact
ZOS	Zone of Study

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

The **'Environmental Impact Assessment (EIA) Guidelines for the Petrochemical Industries'** (hereinafter referred to as the 'Guidelines') is newly issued to align with the latest amendments in the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015, of the Environmental Quality Act 1974 (Act 127).

The amended Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 was gazette on 28 August 2015. It superseded the previous Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987, with a revised list of Prescribed Activities, which are now divided into the **First Schedule** (21 Prescribed Activities) and **Second Schedule** (17 Prescribed Activities).

Inter alia to the above, 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 Environmental Management Strategic Plan, focusing on **self-regulation** by implementing the environmental mainstreaming tools as well as the application of **5S concept** in compliance with latest environmental requirement and improvement of environmental management.

The Guidelines are complementary to and shall be referred together with the Environmental Impact Assessment Guideline in Malaysia (EGIM) (DOE, 2016).

Compliance with the requirements set out in this Guidelines and EGIM (DOE, 2016) is the obligations of the Project Proponent as stated under Section 34A (2C) of the EQA 1974, and/or any amendments thereafter.

1.2 GUIDELINES OBJECTIVES

The objectives of the Guidelines are to:

(a) Provide a clear and concise guidance document on EIA preparation to the stakeholders, Project Proponents, Qualified Persons (i.e. DOE registered Environmental Consultants), Government Agencies (GAs), Enforcement Officers and other EIA related practitioners.

(b) Facilitate integration of the EIA into the overall project planning and development cycle, to ensure compliance with and adherence to the legal requirements within the framework of environmental sustainability.

(c) Provide a detailed step-by-step guidance with explanations of the EIA procedures and submissions, comprising:

(i) Environmental Scoping Information (ESI).

(ii) Terms of Reference (TOR).

(iii) EIA Reporting.

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

(e) Provide a succinct framework for the DOE to assess the EIA reports.

1.3 SCOPE OF THE GUIDELINES

The scope of the Guidelines covers the development of petrochemical industry, which may fall within the criteria provided in the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015.

The activity of construction of a low capacity (below 50 tonnes of product or combined product) a petrochemical plant is a prescribed activity listed under activity 6 (d) in the **First Schedule** of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015; as follows:

6. INDUSTRY

(d). Petrochemicals:

Production capacity of each product or combined product of less than 50 tonnes per day.

Meanwhile higher production capacity petrochemical plant (equivalent or above 50 tonnes of product or combined product), it is a prescribed activity listed under item 6 (d) in the **Second Schedule** of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 as follows:

6. INDUSTRY

(d). Petrochemicals:

Production capacity of each product or combined product of 50 tonnes or more per day.

1.4 STRUCTURE OF THE GUIDELINES

The Guideline is structured according to the step-by-step procedures highlighted in **Section 1.4**, divided into eight Chapters with their respective supporting sections below:

Chapter	Details
Chapter 1: Introduction	Provides an introduction to the Guidelines covering the objectives, scope and structure. Provides an overview on environmental project planning and approaches to integrate the EIA process. Provides a concise review of legislations, policies and guidelines, and how they relate to the EIA process. Provides definitions for associated key terms.
Chapter 2: Terms of Reference (TOR)	Provides the procedures to conduct environmental screening and scoping the significant issues to prepare the TOR from the ESI. Presents the structure and content for TOR reporting, including an overview of the review and endorsement process. Provides stakeholders engagement requirements.
Chapter 3: Environmental Impact Assessment: Baseline Conditions	Provides an outline of the relevant baseline information required for incorporation into the EIA report.
Chapter 4: Environmental Impact Assessment: Evaluation of Impacts	Provides the methodology and tools to identify, predict, evaluate and assess the significant environmental impacts.
Chapter 5: Environmental Impact Assessment: Mitigation Measures	Identifies appropriate Pollution Preventions and Mitigation Measures (P2M2) to minimise any negative impacts arising from the development of the project; and the types of measures to manage any residual impacts.

Chapter	Details
Chapter 6: Environmental Impact Assessment: Environmental Management Plan	Provides an EMP framework for post EIA. Details out self-regulation requirement by implementing the Environmental Mainstreaming Tools. Provides the environmental monitoring and audit programmes for post-EIA.
Chapter 7: Environmental Impact Assessment: Abandonment Plan	Provides an Abandonment Plan framework. Provides the environmental monitoring and audit programmes for post-abandonment activity.
Chapter 8: EIA Reporting and Review	Presents the structure and content for EIA reporting, including an overview of the review and approval process.

1.5 ENVIRONMENTAL PROJECT PLANNING

An Environmental Impact Assessment (EIA) is an integral part of an overall project development. Incorporation of the EIA during planning stage for the project provides significant benefits and value add to the project (see **Box 1**).

Box 1

Benefits of Incorporating EIA into Project Planning

(i) Ensures compliance to environmental and development policies, facilitating project approval and avoid instances where changes need to be made later.

(ii) Assist in Site Suitability Assessment (SSA) by identifying environmental constraints and limitations to ensure the best site is chosen, in tandem with other technical and financial considerations by the Project Proponent.

(iii) Complements other planning considerations to provide feedback towards technical and management deliberations by the Project Proponent.

(iv) Reduce the adverse impacts from a project and make it more environmentally and socially acceptable among the stakeholders. It can even become a positive selling point for the Project Proponent, e.g. adoption of green technology.

(v) Allows for the adoption of best available technologies (BATs) and best management practices (BMPs) in the project which would improve the overall quality of the project.

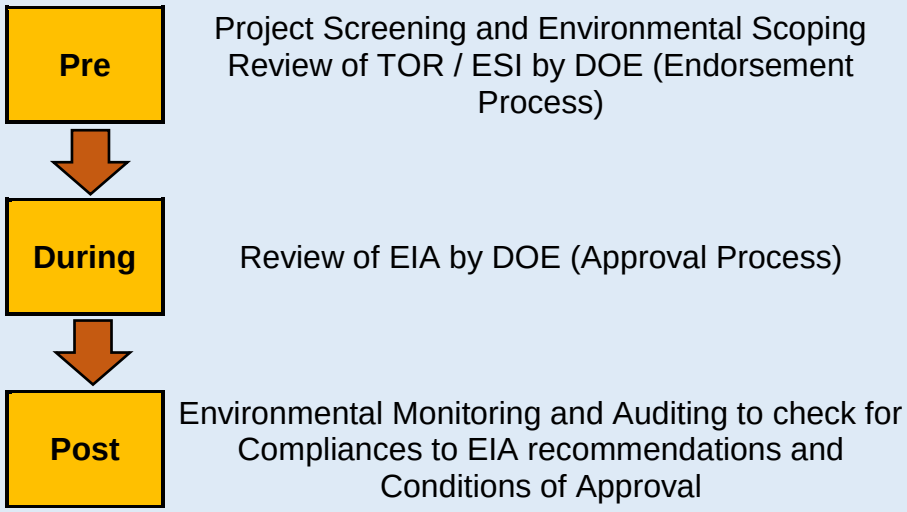
An EIA identifies the key areas of environmental significance and provides a means to decide, by the Project Proponent and the Qualified Person, on the types of mitigation measures to avert or minimise any adverse impacts at an early stage.

At the same time, the EIA can also enhance the project needs and the environmental conservation and protections with the correct use of the EIA tools.

The whole EIA review and approval processes are guided by the EGIM (DOE, 2016). **Box 2** illustrates the stages in the EIA processes.

Box 2

Stages in EIA Processes



1.6 OVERVIEW OF ENVIRONMENTAL ASSESSMENT PROCESS

An EIA report should contain important information for:

(i) The Project Proponent to implement the mitigation measures in an environmentally and socially responsible manner.

(ii) The DOE and other authorities to make an informed decision on the project, including preparation of the conditions of approval (COA).

(iii) The public to understand the project and its potential impacts on the environment.

Good practices in EIA preparation are shown in **Box 3**.

Box 3

Good Practices for EIA

(i) Purposive: The EIA should meet its aims of informing decision making and ensuring an appropriate level of environmental protection and human health.

(ii) Focused: EIA should concentrate on significant environmental effects, taking into account the issues that matter.

(iii) Adaptive: EIA should be adjusted to the realities, issues and circumstances of the proposals under review.

(iv) Participative: EIA study should provide appropriate opportunities to inform and involve the interested and affected publics, and their inputs and concerns should be addressed explicitly.

(v) Transparent: EIA process should be a clear, easily understood and open process, with early notification procedure, access to documentation, and a public record of decisions taken and reasons for them.

(vi) Rigorous: EIA should apply the 'best practicable' methodologies to address the impacts and issues being investigated.

(vii) Practical: EIA should identify measures for impact mitigation that work and can be implemented.

(viii) Credible: EIA study should be carried out with professionalism, rigor, fairness, objectivity, impartiality and balance.

(ix) Efficient: EIA process should impose the minimum cost burden on proponents consistent with meeting process requirements and objectives.

Source: EIA Training Resource Manual Second Edition (UNEP, 2002).

This Section provides an overview of the step-by-step guide to the environmental assessment of a petrochemical project:

Step 1: Provide the Project Brief

When a Project Proponent wants to develop a petrochemical project, some basic information regarding the project will be needed to enable the Qualified Person to understand the intent, objectives and scope of the proposed project.

Table 1.6.1: Examples on Requirement of Project Brief

Information	Details
Project Information	• Project title. • Details of Project Proponent [Company, address, contact person(s) and contact details]. • Project concept and description. • Project layout plan and components. • Details on activities in flow charts, mass balances, etc. Refer **Appendix A** for samples of Process Descriptions. • Sources of materials and material storage areas. • Transport route and temporary access. • Project implementation schedule. • List of infrastructure, utilities and amenities.
Project Location	• Project location including boundary coordinates. • Maps (topographic, aerial, satellite, etc.) the locations of the site in relation to surrounding land use, sensitive receptors and landmarks. • Future land use map (e.g. structure and local plans). • Zoning and land use policies related to the project. • Identification of sensitive receptors (affected communities, areas of ecological importance, heritage and archaeological significance, etc.). • Buffer and setback requirements, if any.

Step 2: Identify the Legal Requirements

The Project Proponent undertaking the project shall comply with all legal requirements before developing the project and before carrying out the EIA (refer to the sections):

(i) **Section 1.7:** Environmental legislative requirement.

(ii) **Section 1.8:** Terms and definitions relevant to the Guidelines.

(iii) **Section 2.2:** Environmental screening procedure.

Step 3: Check if Project Aligns to Existing Policies and Guidelines

The Project Proponent shall clear all policy and administrative matters relating to the project prior to submitting the EIA report to DOE. **Section 1.9** of this Guidelines lists the potential policies and guidelines to be met by the Project Proponent.

Step 4: Stakeholder Engagement

It is prudent to carry out stakeholder engagements early, before the start of the project and the EIA. Constant engagement with the DOE is advisable, including the relevant GAs when preparing the TOR and EIA. **Section 2.12** provides details of stakeholder engagements approaches.

Step 5: Preparation of the TOR and ESI

Hence, TOR and ESI shall be prepared. At this point of the study, qualitative data will suffice (see **Chapter 2** for details). However, if quantitative data is available, it should be included in the TOR.

Step 6: Submission of the TOR

All data and information obtained during scoping shall be reviewed for preparation of the TOR report based on DOE requirements stated in the EGIM (DOE, 2016), and in this Guidelines. The TOR shall be submitted to DOE for review and endorsement as detailed in **Chapter 2** of this Guidelines.

Step 7: Baseline Data Collection for EIA

After endorsement of the TOR by DOE, baseline data collection (primary and/or secondary) shall be carried out to obtain information of the project environment and its surrounding areas. **Chapter 3** provides the types of baseline data required for the EIA.

Step 8: Carry Out the EIA Studies

The major studies and components of the EIA shall cover the followings:

(i) **Chapter 4:** Impact assessment on the significant environmental issues.

(ii) **Chapter 5:** Identification of suitable P2M2s to avert and/or to minimise the significant environmental issues arising from implementation of the project and identification of residual impacts.

(iii) **Chapter 6:** Provision of the Environmental Management Plan (EMP) framework.

(iv) **Chapter 7:** Provision of the Abandonment Plan framework.

(v) Conclusion to the EIA.

Step 9: Drafting EIA Report

The format of the EIA report is detailed in **Chapter 8** of this Guidelines.

The results of assessments and studies required by other GAs have to be incorporated into the EIA report. However, the whole of other GAs' individual reports need not be fully incorporated in the EIA Report; but they must be reviewed and approved by the respective GAs.

Step 10: Carry Out Public Engagement

The main objective of these public engagements is to brief the stakeholders regarding the project, the potential environmental issues and the proposed mitigation measures, to address their concerns and to seek any further required feedbacks. Some small scale projects may not need this session since there is already a stakeholders' engagement prior to carrying out the TOR.

A Second Schedule EIA requires public engagements with the relevant stakeholders who are likely to be affected by the project directly or indirectly (e.g. communities or institutions, businesses and the general public), upon completion of the Draft EIA report.

All findings from any public engagements shall be incorporated into the final EIA report (refer to **Chapter 2.12** for further details).

Step 11: Submission of the EIA report

The completed EIA report shall be submitted to DOE for review as per procedure defined in the EGIM (DOE, 2016). Details of the EIA submission and review process are detailed in **Chapter 8** of this Guidelines.

1.7 ENVIRONMENTAL LEGISLATIVE REQUIREMENTS

The Environmental Quality Act 1974 (Act 127) is the main legislation governing environmental management in Malaysia.

Amendments to this main legislation and new subsidiary legislations or regulations may be enacted from time to time, pertinent and relevant to changing circumstances. The Project Proponent and Qualified Person are required to refer to and adopt any latest amendments for their project.

The DOE under the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) is the main agency tasked to implement the Act 127. It has overall functions and responsibilities on environmental management and enforcement as prescribed under the said legislation and its subsidiary legislations and regulations.

The Project Proponent is responsible to comply with all prevailing and/or any new laws that were enforced or to be enforced in Malaysia.

1.7.1 Environmental Quality Act 1976 (Act 127)

EIA is a mandatory requirement under the provision of Section 34A (2) of the Environmental Quality Act 1974 for activities prescribed in the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015.

Section 34A(2) stipulates "Any person intending to carry out any prescribed activities shall appoint a qualified person to conduct an environmental impact assessment and to submit a report thereof to the Director General in the manner as the Director General may prescribed, before any approval for the carrying out of such activities is granted by the relevant approving authority, submit a report to the Director General. The report shall be in accordance with the guidelines prescribed by the Director General and shall contain an assessment of the impact such activity will have or is likely to have or is likely to have on the environment and the proposed measures that shall be undertaken to prevent, reduce or control the adverse impact on the environment."

Section 34A(2A) stipulates "The Director General shall maintain a list of qualified persons who may carry out an environmental impact assessment and submit a report thereof."

Section 34A(2B): The qualified person who submits the report shall:-

(a) be responsible for the environmental impact assessment and the recommendations of the environmental impact assessment;

(b) ensure that the report and the recommendation do not contain any false or misleading information;

(c) take a professional indemnity insurance for any liability arising from the environmental impact assessment and the recommendations of the environmental impact assessment;

Section 34A(2C): The report shall be in accordance with the guidelines as the Director General may prescribed and shall contain:-

(a) An assessment of the impact such activity will have or is likely to have on the environment; and

(b) The proposed measures that shall be undertaken to prevent, reduce or control the adverse impact on the environment.

1.7.2 Environmental Quality (Clean Air) Regulations, 2014

The regulations in the Environmental Quality (Clean Air) Regulations 2014 are applicable for the petrochemical industries.

A petrochemical industry may requires boilers, furnaces or any fuel burning equipment used for the purposes of heat and power generation where the emission limits are as stipulated in the **Third Schedule, under Item A: Heat and Power Generation**. Other emission limit apart for heat and power generation purposes shall comply with the Third Schedule, under **Item I: Chemical and Petrochemical Industry in All Sizes.**

1.7.3 Environmental Quality (Industrial Effluents) Regulations, 2009

During operation of the petrochemical plant, any industrial effluents generations in the facility shall need to comply with the Environmental Quality (Industrial Effluents) Regulations 2009.

The following regulations are to be considered during the EIA:

Design and construction of industrial effluent treatment system

5(1) An owner or occupier of a premises shall conduct any design and construction of the industrial effluent treatment system to collect and treat the industrial effluent or mixed effluent generated within the premises in strict compliance with the specifications as specified in the Guidance Document of the Design and Operation of Industrial Effluent Treatment System issued by the Department of Environment.

Compliance with Specifications of Industrial Effluent Treatment System

6 (1) No person shall operate any industrial effluent treatment system unless it complies with the specifications as specified in sub-regulation 5(1).

Specifically, the treated industrial effluents quality from the premise shall comply with the **Fifth, Seventh, Eighth and Ninth Schedules** of the Regulations.

1.7.4 Environmental Quality (Sewage) Regulations, 2009

This regulations applied to any premises which discharge sewage onto or into any soil, or into any inland waters or Malaysian waters, other than any housing or commercial development or both having a population equivalent of less than one hundred and fifty.

Where applicable, the sewage from a petrochemical plant is expected to be treated to meet the **Second Schedule** of the Regulations.

1.7.5 Environmental Quality (Scheduled Wastes) Regulations, 2005

The Environmental Quality (Scheduled Wastes) Regulations 2005 regulates the handling, movement, disposal and treatment of scheduled wastes in Malaysia. The petrochemical industry is known to generate several types of scheduled waste in its processes. During the EIA preparation stage, this regulation shall be considered, in particular:

Responsibility of Waste Generator

8(1) Every waste generator shall ensure that scheduled wastes generated by him are properly stored, treated on-site, recovered on-site for material or product from such scheduled wastes or delivered to and received at prescribed premises for treatment, disposal or recovery of material or product from scheduled wastes.

8(2) Every waste generator shall ensure that scheduled wastes that are subjected to movement or transfer be packaged, labelled ad transported in accordance with the guidelines prescribed by the Director General.

Storage of Scheduled Wastes

9(1) Scheduled wastes shall be stored in containers which are compatible with the scheduled wastes to be stored, durable and which are able to prevent spillage or leakage of the scheduled wastes into the environment.

9(2) Incompatible scheduled wastes shall be stored in separate containers, and such containers shall be placed in separate secondary containment areas.

9(3) Containers containing scheduled wastes shall always be closed during storage except when it is necessary to add or remove the scheduled wastes.

9(4) Areas for the storage of the containers shall be designed, constructed and maintained adequately in accordance with the guidelines prescribed by the Director General to prevent spillage or leakage of schedule wastes into the environment.

9(5) Any person may store scheduled wastes generated by him for 180 days or less after its generation provided that:-

(a) The quantity of scheduled wastes accumulated on site shall not exceed 20 metric tonnes; and

(b) The Director General may at any time, direct the waste generator to send any scheduled wastes for treatment, disposal or recovery of material or product from the scheduled wastes up to such quantity as he deems necessary.

1.8 TERMS AND DEFINITIONS

The common terms and definitions adopted for this Guidelines are provided in the Glossary while the key terms and definitions are described in this Section. In case of doubt and uncertainty of the terms, clarification with DOE shall be carried out.

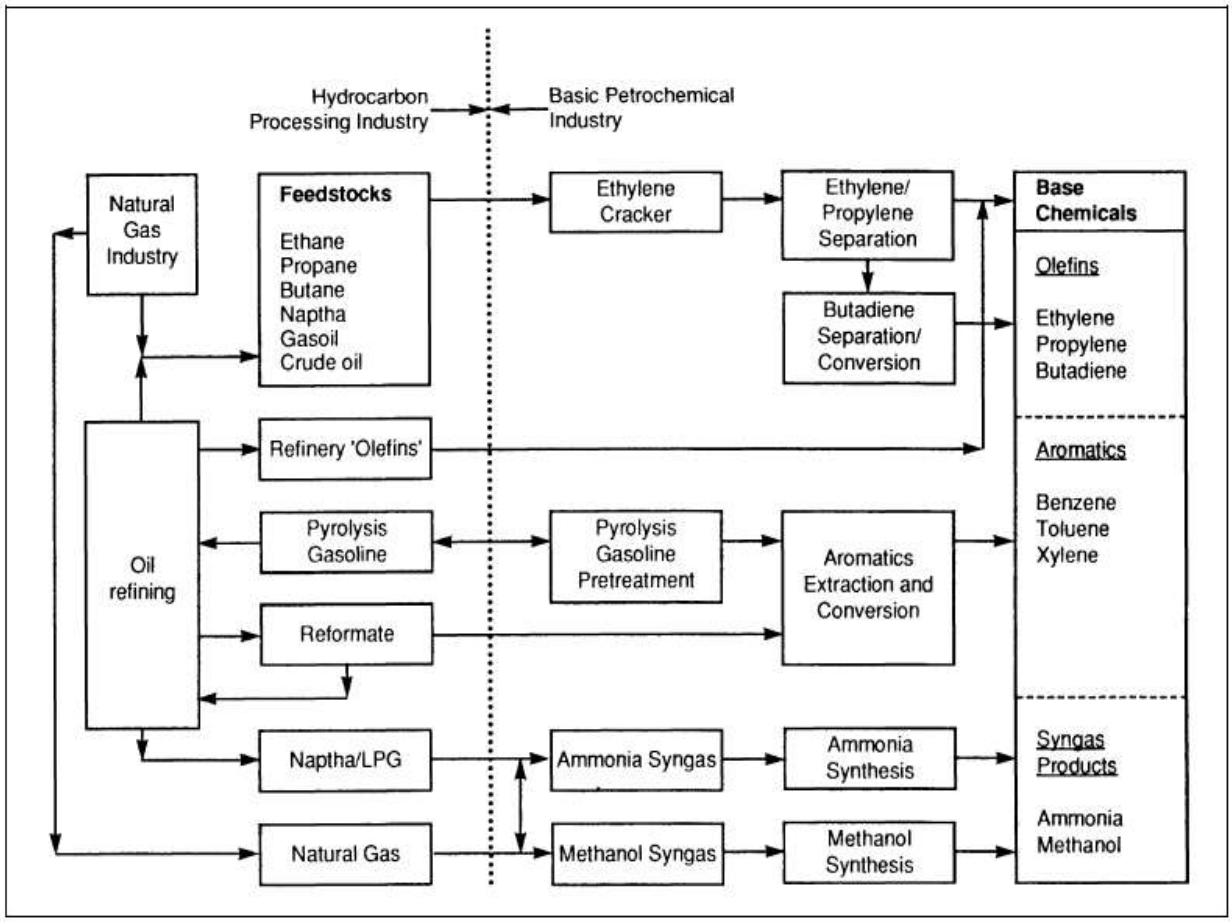
1.8.1 Petrochemicals Industries

The Petrochemical industry is defined as a branch of heavy industry encompassing the production of synthetic materials and items mainly from products derived from the refining of petroleum and natural fuel gases. The products are mainly produced from natural gas, natural-gas liquids, or refinery products derived from crude oil distillation, or cracking. These compounds are made up of entirely or almost entirely of hydrocarbons (petroleum or natural gas).

The upstream interface of petrochemical plants and hydrocarbon refining is often blurred since the sectors usually occupy the same site and have common products (e.g. olefins and aromatics). However based on the definitions of IPPC BAT, 2003 [1] document for Organic Chemicals differentiates the hydrocarbon refineries to only produce fractions (made up of groups of hydrocarbons) that are primarily used as fuels (or fuel modifiers) whilst the petrochemical industry produces specific hydrocarbons for use as basic building blocks in the wider chemical industry. This is illustrated in the **Figure 1.8.1**.

[1] Integrated Pollution Prevention and Control (IPPC) Ref Document on Best Available Techniques in the Large Volume Organic Chemical Industry Feb, 2003 published by the European Commission.

Figure 1.8.1: The Interface / Separation Between Petrochemical and Hydrocarbon Industries



Source: IPPC, BAT for LVOC, Feb 2003.

Primary petrochemicals are divided into 3 main groups depending on their chemical structure:

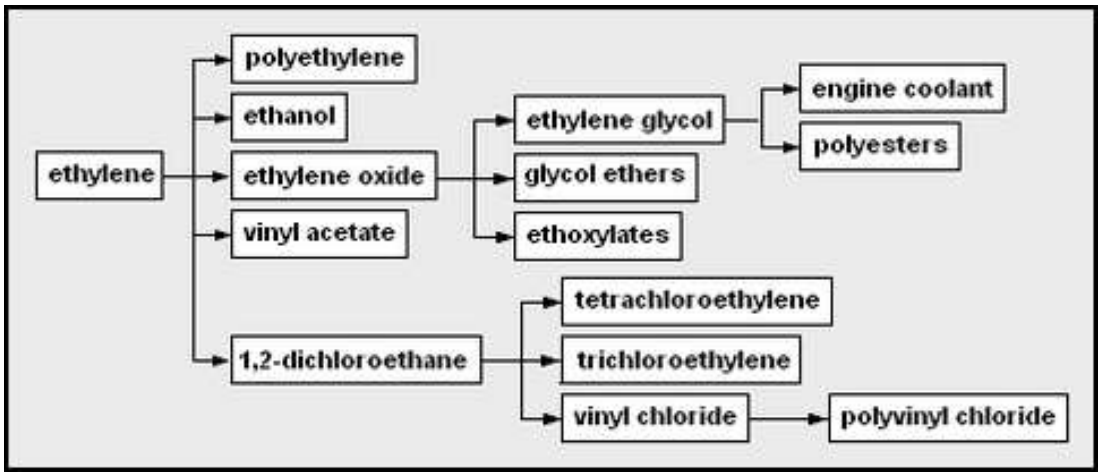
(i) **Olefins** includes **ethylene, propylene and butadiene**. Ethylene and propylene are important sources of industrial chemicals and plastics products while butadiene is used in making synthetic rubber.

(ii) **Aromatics** includes **benzene, toluene and xylene**. Benzene is a raw materials for dyes and synthetic detergents, and benzene and toluene for isocyanates MDI and TDI used in making polyurethanes. Manufacturers use xylene to produce plastics and synthetic fibres.

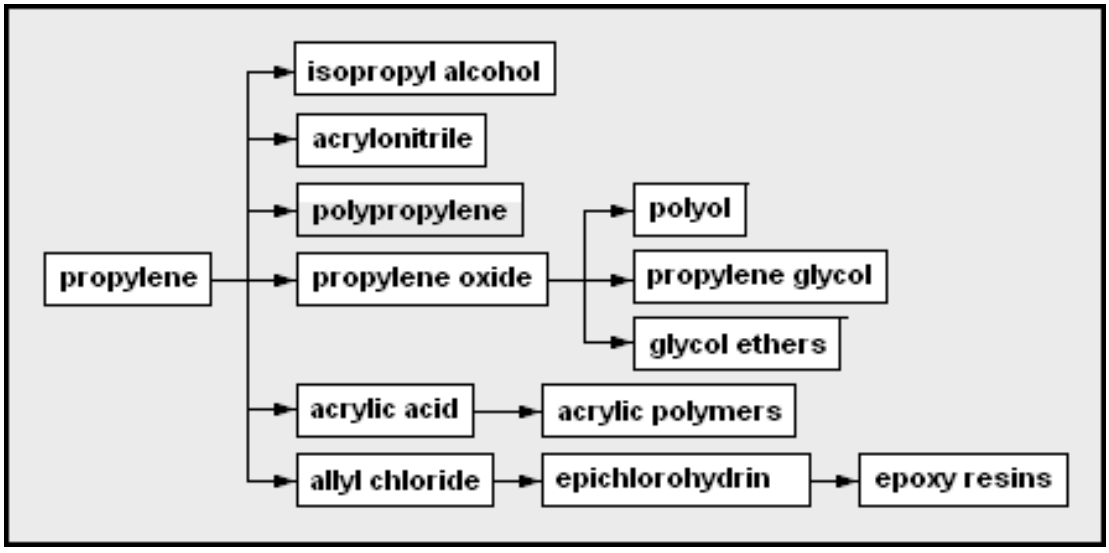
(iii) **Synthesis gas** is a mixture of carbon monoxide and hydrogen used to make ammonia and methanol. Ammonia is used to make the fertilizer urea and methanol is used as a solvent and chemical intermediate.

The followings are samples of major commercial petrochemicals and their derivatives:

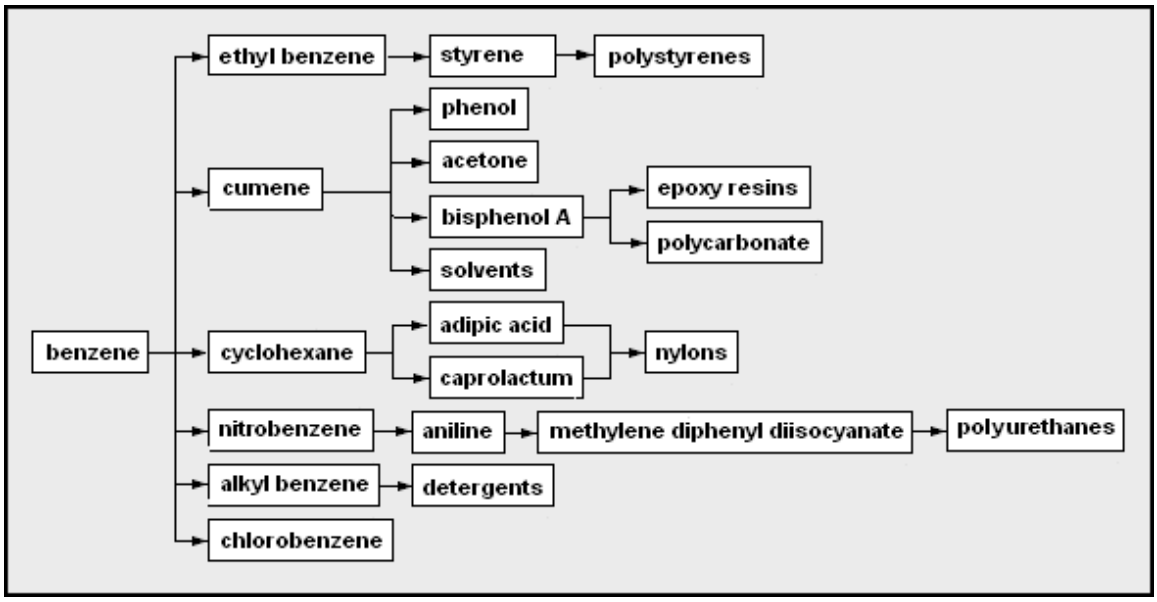
Chemicals produced from ethylene:



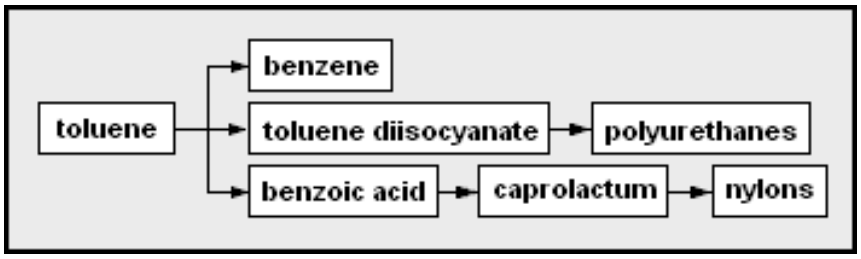
Chemicals produced from propylene:



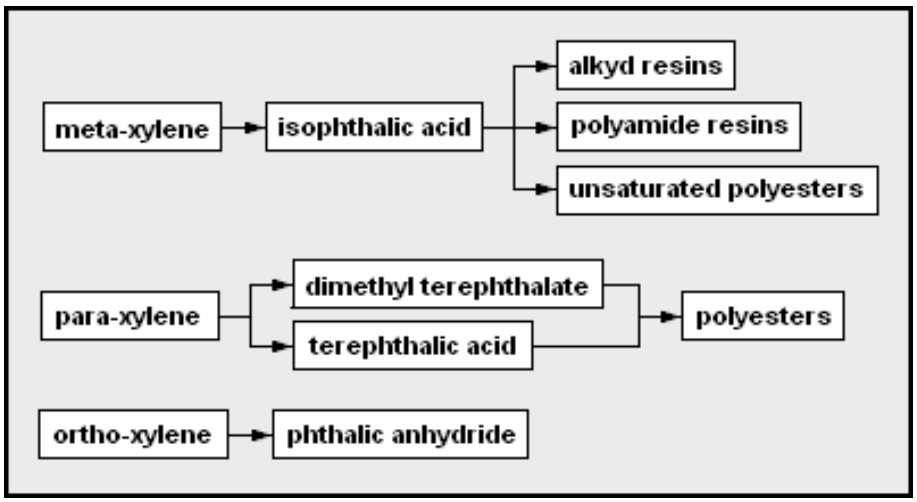
Chemicals produced from benzene:



Chemicals produced from toluene:



Chemicals produced from xylenes:



Some of the petrochemicals products are listed as below:

Basic Feedstock:

Benzene
Butadiene
Ethylene
p-Xylene
Propylene

Intermediates:

2-Ethyhexanol
Acetic acid
Acrylonitrile
Ammonia
Bis(2-ethylexyl_phthalate (dioctyle phthalate)
n-Butene
Cyclohexane
Dimethyl terephthalate
Dodecylbenzene
Ethanol
Ethanolamine
Ethoxylate
1,2-Dichloroethane (ethylene dichloride)
Ethylene glycol
Ethylene oxide
Formaldehyde Moulding Compound
n-Hexene
Linear alkyl benzene
Methanol
Methyl tert-butyl ether
Phenol
Propylene oxide Purified terephthalic acid
Styrene monomer
Thermosetting Resin (Urea/Melamine)
Vinyl acetate monomer
Vinyl chloride monomer

1.8.2 Development

Under the Town and Country Planning Act 1976 (Act 172) and amendment thereof in 2006, "development" means the carrying out of any building, engineering, mining, industrial, or other similar operations in, on, over, or under land, the making of any material change in the use of any land or building or any part thereof, or the subdivision or amalgamation of lands; and "develop" shall be construed accordingly.

1.9 POLICY AND GUIDELINES COMPLIANCE

Any proposed development shall comply with and adhere to the requirements enabled in the national and state legislations and enactments, policies, local regulations, procedures and guidelines published by the national and state governments, agencies and local authorities, where applicable.

The requirements can be either statutory or non-statutory and from one or more national or state agencies and authorities. Adherence to the policies and legislations will ensure that the development is in line with the requirements of the authorities to avoid complications in the project approval process.

1.9.1 Other Policy and Legislation Requirements

The project shall comply with all legal requirements (statutory and non-statutory) and procedures of Malaysia. The project shall be in line with and not contradict the current national and state development policies and plans, especially for high impact projects.

Due diligence shall be undertaken in regards to policy compliance and study with the relevant agencies and government departments.

The Project Proponent and his team shall be required to engage with all the relevant national requirements and state agencies during the project planning stage.

The Project Proponent and Qualified Person are to determine the specific compliance requirements, based on the scope and nature of the project.

Common requirements by other GAs may be shown in **Table 1.9.1** and **Table 1.9.2**. Proof of compliance in the form of, but not limited to, GAs approvals, support letters and minutes of meetings (MOM), among others, shall be included as part of the TOR and EIA.

All policy and administrative matters and GA requirements at the national and state levels shall be cleared before proceeding with the EIA Report submission.

Table 1.9.1: Associated or Other Requirements Prior to EIA Submission

Agencies	Legal Requirements	Outputs
Malaysian Investment Development Authority (MIDA)	Malaysian Investment Development Authority (Incorporation) Act 1965 (Act 397)	Approvals and/or supporting documents
National Physical Planning Council of Malaysia (MPFN) Regional/Land Development Authority State Planning Committee (SPC) Local Authority (PBT)	Town and Country Planning Act 1976 (Act 172) and subsidiary regulations, order and guidelines	Approvals and/or supporting documents : • National and state development policies National Physical Plan • State Structural Plan • Local Plan • Adherence to land use compatibility

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 project compliance.

Table 1.9.2: Associated or Other Requirements During or Post EIA

Agencies	Legal Requirements	Outputs
PLANMalaysia (JPBD)	Town and Country Planning Act 1976 (Act 172) and subsidiary regulations, order and guidelines *Manual Penilaian Impak Sosial Bagi Projek Pembangunan Edisi Ke-2 2017*	To ensure that the project is in line with the structure/local plans and compatible with the surrounding land use. Approval for Social Impact Assessment (SIA), where applicable Approval of any project and activities within the ESA or limits by *Jawatankuasa Teknikal Pembangunan Kawasan Sensitif Alam Sekitar* (KSAS)
Department of Director General of Land and Mines (JKPTG) Land and Mines Office (PTG) District and Land Office (PTD)	National Land Code 1965 (Act 56) Territorial Seas Act 2012 (Act 750)	To ensure Project Proponent owns the land and land status is correct with its intended development type. To ensure no constraints on the land that may prohibit it from being developed (minerals, sand resources etc.).
Public Works Department (JKR)	Road Transport Act 1987 (Act 333)	Approval for Traffic Impact Assessment (TIA) and Road Safety Audit
Forestry Department of Peninsular Malaysia	Forestry Act 1984 (Act 313)	Development requirements in permanent reserved forests
Department of Wildlife and National Parks Peninsular Malaysia (PERHILITAN)	Wildlife Conservation Act 2010 (Act 716)	Development requirements in/near wildlife sanctuaries and other protected areas. Requirement for relocation plan, conservation, etc. Wildlife management plan

Agencies	Legal Requirements	Outputs
Department of Fisheries (DOF)	Fisheries Act 1985 (Act 317)	Approvals and/or supporting documents: • Development in fishery zones. • Impacts on jetties, fish landing areas, artificial reefs, etc. • Impacts on fishermen livelihood. • Conservation of turtles, terrapins, etc.
Department of Irrigation and Drainage (DID) State Water Authority	Street, Drainage and Building Act 1974 (Act 133) State enactments on water resources, river basins and coastal areas	Approvals and/or supporting documents: • Hydraulic study • Coastal protection works. • Permission for river diversion. • Requirement for river reserves and coastal setbacks. • Storm water management (MSMA). • Erosion and Sediment Control Plan (ESCP). • Shoreline monitoring.
Marine Department of Peninsular Malaysia	Merchant Shipping (Amendment and Extension) Act 2007 (Act 1316)	Approval / permits / supporting documents for: • Marine Traffic Risk Assessment (MTRA) • marine navigation • vessel registration • issuance of notice to mariners • navigational aid • marine pollution control, etc.

Agencies	Legal Requirements	Outputs
Atomic Energy Licensing Board (AELB)	Atomic Energy Licensing Act 1984 (Act 304)	Approvals and/or supporting documents: • Radiological Impact Assessment (RIA), where applicable • Operation license
Local Authority (PBT)	Town and Country Planning Act 1976 (Act 172) and subsidiary regulations, order and guidelines	Approvals and/or supporting documents : • Development order • Earthwork plans • Building plans

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.

1.9.2 National and State Policies and Plans

The relevant policies and plans for new development are listed in **Table 1.9.3**. They serve as references for the Project Proponent and the Qualified Person when undertaking the project. Any change or amendment to existing policies and plans (i.e. updating, revision, new edition, etc.) shall be taken into account in the EIA by the Qualified Person.

1.9.3 Guidelines and Guidance Documents

The EIA report shall also refer to the relevant guidelines and guidance documents issued by DOE and other Government Agencies (GAs) pertaining to environment-related system and management, and any other documents and notices issued from time to time, related to the EIA process and procedures.

The list of relevant Guidelines and Guidance Documents are appended as **Appendix B**.

Table 1.9.3: List of Policies and Plans Potentially Relevant to Petrochemical Industries

Policies and Plans	Details and Scope
National Physical Plan-3 (NPP-3) (JPBD, 2016)	National spatial planning guidelines: covers national and state parks.
National Physical Coastal Zone Plan (NPCZP) (JPBD, 2012)	National spatial planning guidelines for coastal zones and associated activities.
State Structure and Local Plans (Various Local Authorities and publishing dates)	State and local level planning guidelines for national and state parks, including development controls.
National Policy on the Environment [Ministry of Science, Technology and Innovation (MOSTI), 2002]	Specifies eight principles to harmonise economic development goals with environmental imperatives. It seeks to integrate environmental considerations into development activities and in all related decision-making processes; foster long-term economic growth and human development; and protect and enhance the environment.

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.

CHAPTER 2

TERMS OF REFERENCE

2.1 INTRODUCTION

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

This Chapter, comprising 10 Sections, provides the steps in detail to prepare the TOR for submission and endorsement by the Department of Environment (DOE). These steps are as follows:

Section 2.2: Environmental Screening.

Section 2.3: Environmental Scoping.

Section 2.4: Site Suitability Assessment (SSA).

Section 2.5: Study Boundary.

Section 2.6: Baseline Data Review.

Section 2.7: Determination of Key Project Activities.

Section 2.8: Identification of Significant Impacts and Priority Setting.

Section 2.9: Establishment of Study Requirements for EIA.

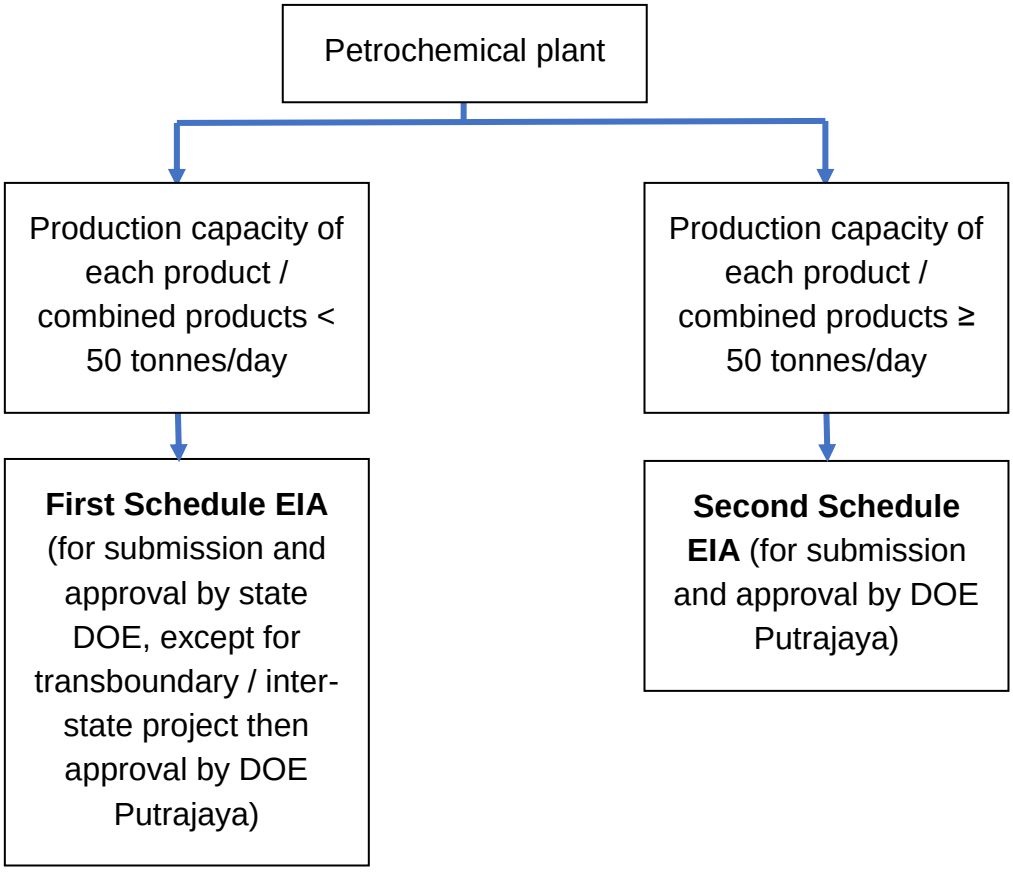
Section 2.10: Outlining of Mitigation Measures.

Section 2.11: Preparation and Submission of TOR/Environmental Screening Information (ESI).

2.2 ENVIRONMENTAL SCREENING

Environmental Screening is carried out to determine whether or not a proposed project is a prescribed activity under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 (refer to **Figure 2.2.1**). Potential outcome criteria of project screening are shown in **Box 4**.

Figure 2.2.1: Criteria for Screening of Petrochemical Industries



Box 4:

Potential Outcomes from Project Screening

(i) No EIA is required: If the project does not fall within any prescribed activities under the First or Second Schedule, and/or has insignificant impacts on the environment.

(ii) EIA is required: If the project will have potentially significant environmental impacts and/or falls within the prescribed activity under the First or Second Schedule.

(iii) Further studies and clarification from DOE: If the potential impacts from the project are uncertain, indeterminate, ambiguous or may not fall neatly within any prescribed activities, i.e. involving new technologies, DOE shall be consulted upon on the need for an EIA.

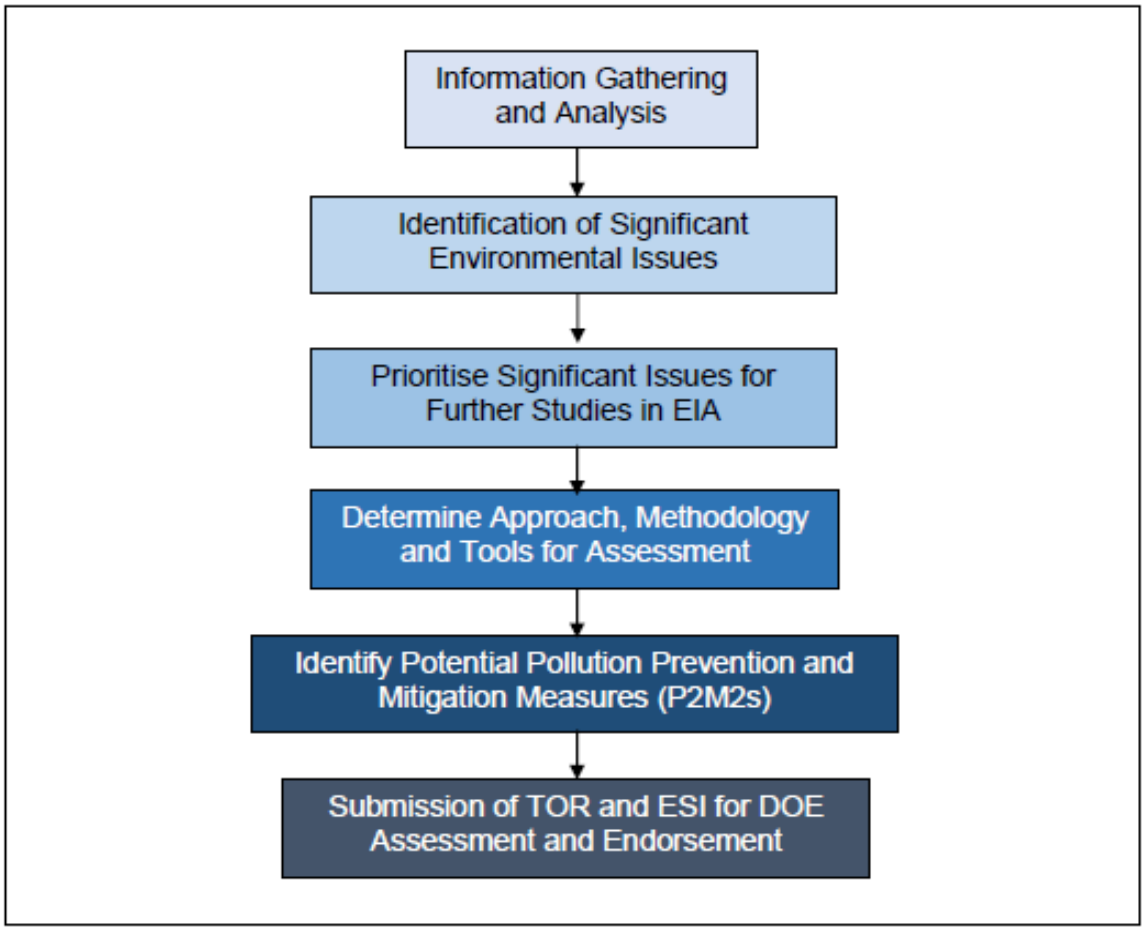
2.3 ENVIRONMENTAL SCOPING

The main objective of environmental scoping is to identify the environmental attributes and issues to determine the focus, depth, spatial and temporal boundaries of the EIA that are deemed significant and requiring assessment. Scoping shall be carried out in the early stage of the project cycle. It enables the EIA to focus only on the significant issues, impacts and sensitive receptors.

Scoping shall encompass all environmental aspects (physico-chemical, biological and human) to enable an overall preliminary evaluation of the significant impacts. At the start of the scoping exercise, no attempt shall be made to exclude, pre-empt and pre-judge any issues of concern.

The scoping exercise (also refer to **Figure 2.3.1**) comprises the following steps, which are elaborated on in the accompanying sections:

Figure 2.3.1: Flow Path for Environmental Scoping



(i) Site Suitability Assessment (SSA): The SSA shall consider all alternatives or options to refine and improve upon the original concept design (refer to **Section 2.4**).

(ii) Determination of Study Boundary: The Qualified Person shall determine the extent of the Zone of Study (ZOS) and Zone of Impact (ZOI) based on site conditions and environmental sensitivity (refer to **Section 2.5**).

(iii) Baseline Data Review: The Qualified Person shall carry out qualitative assessment based on desktop study and literature review. These may be supplemented by initial site investigations and stakeholder engagements (refer to **Section 2.6**). Quantitative assessment can be provided where necessary and available.

(iv) Determination of Key Project Activities: The Qualified Person and / or Competent Person(s) shall outline the key project activities at various phases of project implementation (pre-construction, construction and operations) (refer to **Section 2.7**).

(v) Identification of Significant Impacts and Priority Setting: This step will involve preliminary identification of significant issues for further detailed assessment in the EIA. Non-significant issues shall also be addressed accordingly in the EIA study but through general/qualitative impact prediction and evaluation (refer to **Section 2.8**).

(vi) Establishment of Study Requirements for EIA: Identify and detail out the methodologies and assessment tools to be carried out in the EIA for identified significant impacts (refer to **Section 2.9**).

(vii) Outlining of Mitigation Measures: Based on the identified significant impacts, the Qualified Person shall determine and select suitable mitigation measures to abate the impacts (refer to **Section 2.10**).

(viii) Preparation and Submission of ESI and TOR: Findings from the scoping exercise shall be compiled, collated and analysed to prepare the TOR for submission to DOE (refer to **Section 2.11**).

2.4 SITE SUITABILITY ASSESSMENT

The Site Suitability Assessment (SSA) is detailed in the EGIM (DOE, 2016). Generally, this is carried out at the feasibility stage where alternatives and options to the proposed concept and layout will be amended and finalised, which will form the basis in the scoping exercise (refer to **Table 2.4.1** for examples).

The scoping exercise will value add to this SSA through recommendations of pragmatic mitigation measures, such as P2M2s and best management practices (BMPs), where potential environmental degradation is anticipated when developing the proposed project.

Table 2.4.1: Considerations in Project Alternatives and Options

Options	Considerations
Project Siting	• Adherence to national and state policies and guidelines. • Site constraints to the project and *vice versa*. • Location and proximity to sensitive receptors. • Land use zonings. • Any alternative sites proposed for the project.
Terrain and Topography	• Availability of land for buffers. • Possibility of avoidance of unsuitable terrain. • Visual/aesthetic impacts.
Accessibility	• Availability of access. • Proximity to construction/source materials. • Strategic locational advantages.

Options	Considerations
Technology Options Project Component and Design	• Availability of Best available technology (BAT) to minimise impacts. • Green technology adoption. • Ecological protection requirements. • Adaptive design to suit terrain/sensitive areas. • Layout consideration – safety risk, process flows. • Choice of construction methods. • Location within or close to existing communities. • Need for land acquisition and relocation.
Economy and Finance	• Potential employment and business. • Cost and benefit considerations. • Supply and demand scenarios.
Operations	• Carrying capacity. • Allowable activities and zoning. • Adoption of best practices and green development concepts. • Resources management.

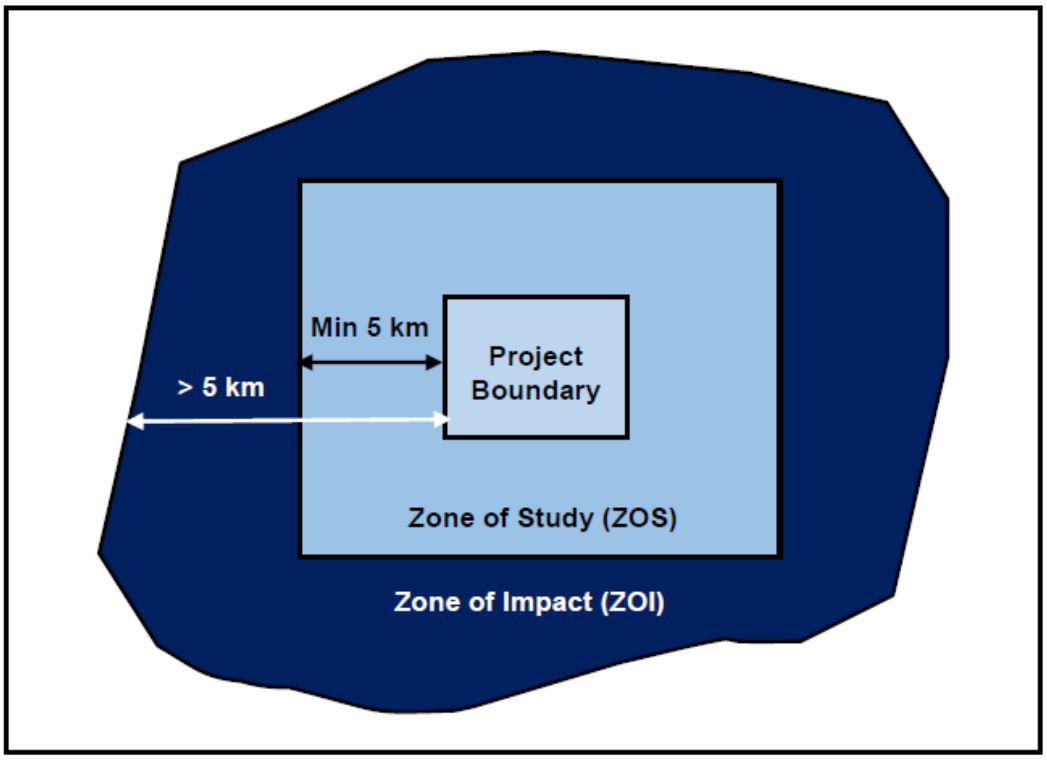
2.5 STUDY BOUNDARY

The study boundary is an important component in the EIA study. Two types of study boundaries shall be used:

(i) The study boundary, which defines the ZOS. In terms of criteria, the ZOS is the study area generally encompassing a 5-km radial zone from the project boundary (refer to **Figure 2.5.1**). In terms of criteria, the ZOS is left to the Qualified Person to define the limits of the spatial boundary.

(ii) The impact boundary, which defines the spatial area of the potential impacts to extend beyond the ZOS, and hence, this impact area is termed the ZOI. 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.

Figure 2.5.1: Diagram Showing the Difference between ZOS and ZOI



2.6 BASELINE CONDITIONS

A description of the existing environment where the proposed project is to be located (termed as "baseline conditions") shall be presented. Typically these are described as physico-chemical environment, biological environment and human environment. **Chapter 3** of this Guidelines describes the approaches to document the baseline conditions.

The level of details shall be based on factors such as area, size, types of activities and potential impacts to the surrounding sensitive environments. The criteria to decide on the priority of relevant information shall be based on the levels of significance.

If any of the information is not available at the time of scoping, but is important for the EIA study, it shall be recorded as baseline information to be addressed at the EIA stage. Irrelevant or insignificant information to the project should be omitted during environmental scoping.

2.7 DETERMINATION OF KEY PROJECT ACTIVITIES

Project activities are the basis for assessing the potential impacts. **Table 2.7.1** provide a summary list of activities in a typical petrochemical development project by phases. The list is not exhaustive and the Qualified Person shall add to the list whenever necessary.

Table 2.7.1: List of Typical Project Activities for a Petrochemical Project

Project Stage	Project Activities	Key Environmental Impacts
Pre-construction	Topographical Survey	Socio economic Change of land use
	Land Acquisition	
	Detailed Design	
	Government agencies (GAs) Approval	
Construction	Influx of construction workers / setting up works camp	Socio economic Creation of spin off businesses Conflicts with local cultures Water quality (sewage) Waste generation (solid waste)
	Site Clearing / biomass removal	Effect on flora and fauna / endangered species Habitat removal / Contamination of habitat Erosion risk Waste generation (biomass)
	Site preparation and earthworks	Alteration of local hydraulic regime Water Quality (sediment in surface runoff) Air Quality (fugitives) Noise Pollution Waste generation (unsuitable materials)

Project Stage	Project Activities	Key Environmental Impacts
Construction	Civil works such as building of structures / plant proper	Soil contamination Water quality (sediment in surface runoff, spills) Air Quality (fugitives, emissions) Noise Pollution Waste generation (scheduled waste, solid waste)
	Transportation of materials to site	Noise Pollution Air Quality Traffic congestion Road safety
	Mechanical and Electrical Works	Noise Pollution Air Quality Waste generation (scheduled waste, solid waste)
	Testing and Commissioning Works	Noise Pollution Air Quality (emissions) Water Quality (effluent) Safety
Operation	Normal Operation	Air Quality (emissions) Water Quality (industrial effluents, sewage) Noise Pollution Waste generation (scheduled waste, solid waste) Safety Public Health
	Maintenance Works Outage Period	Waste generation (scheduled waste, solid waste) Safety

Project Stage	Project Activities	Key Environmental Impacts
	Abnormal Operation	Air Quality (uncontrolled emissions) Water Quality (untreated industrial effluents, sewage) Noise Pollution Waste generation (scheduled waste, solid waste) Safety Public Health
	Materials handling and storage	Land and groundwater contamination (leaks and spills) Safety Traffic congestion
Abandonment	Decommissioning Rehabilitation	Waste generation (scheduled waste, solid waste) Land and groundwater contamination (leaks and spills) Water quality (effluent, sewage)

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.

2.8 IDENTIFICATION OF SIGNIFICANT IMPACTS AND PRIORITY SETTING

There are many methods and tools to conduct the scoping exercise. These include checklists, matrices, or any other accepted methods, to assist in systematically organising, collating and analysing the data for the project. At the TOR stage, qualitative assessment is adequate but quantitative data can be provided to support the assessment. **Table 2.8.1** lists the advantages and disadvantages of the various common methods used. The list given is not exhaustive and any other suitable method can be used if relevant.

A useful tool is the Environmental Scoping Matrix (ESM) to amalgamate the scores from a series of criteria; ranging them from major to minor negative and positive formats of environmental impacts (see **Appendix C** for an example of the matrix used).

The Qualified Person and the Project Proponent's input is vital at this stage as their knowledge and experience would ensure appropriate weightage is given to the issues under assessment (see **Box 5**). From the scoping outputs, a priority list of environmental impacts shall be determined for in-depth studies and assessments in the EIA.

Table 2.8.1: Advantages and Disadvantages of Impact Identification Methods

Method	Advantages	Disadvantages
Checklists	• Easy to understand and use. • Good for site selection and priority setting. • Simple ranking and weightages.	• Do not distinguish between • direct and indirect impacts. • Do not link action and impact. • The process of incorporation of values can be controversial.
Matrices	• Link action to impacts. • Good method for displaying EIA results.	• Difficult to distinguish direct and indirect impacts. • Have potential for double-counting of impacts.
Networks Overlays	• Link actions to impacts. • Useful in simplified form to check for second order impacts. • Handles direct and indirect impacts. • Easy to understand. • Focus and display spatial impacts. • Good siting tool.	• Can be very complex if used beyond simplified version. • Can be cumbersome. • Poorly suited to address impact duration or probability.

Method	Advantages	Disadvantages
GIS and Computer Expert Systems	• Good for impact identification and spatial analysis. • Good for experimenting.	• Heavy reliance on knowledge and data. • Often complex and expensive.

Source: EIA Training Resource Manual Second Edition (UNEP, 2002).

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 best method to adopt for their study.

Box 5:

Criteria for Determining Significance of Environmental Impacts

(i) Magnitude: Defined as the degree and scale of an impact (may be detrimental or beneficial) towards sensitive receptors due to a proposed activity.

(ii) Permanence: Defined as to whether the effects are temporary in nature (e.g. only during certain work activities or only during the construction stage), or may result in permanent effects (e.g. landform alteration due to cut and fill).

(iii) Reversibility: A measure of whether mitigation measures can be implemented in rehabilitating the site back to its original state or better.

(iv) Cumulative Effects: A measure of whether the effects will be accumulative singly or in combination with other effects from nearby sites/activities (that may be detrimental or beneficial) over a time period.

2.9 ESTABLISHMENT OF STUDY REQUIREMENTS

Once the key environmental impacts have been identified and prioritised, the subsequent step is to establish the appropriate study requirements to address these significant impacts.

The scope of the EIA studies are dependent on the scale and extent of the development, its relationship to adjacent land uses and nearby sensitive receptors, the type of planning and study approvals as required by the relevant GAs, which will be generally determined in consultation and engagement with these agencies (refer to **Section 2.6**), and other relevant criteria.

The Qualified Person shall provide the methodologies, assessment / modelling tools, and expected outputs derived from the assessment of the significant impacts, as part of the TOR. **Table 2.9.1** provides a list of applicable studies. This list is only indicative and non-exhaustive as site conditions can vary from project to project. Hence, it is the responsibility of the Qualified Person to check and verify the applicability and extent of the relevant studies to be conducted for a specific project.

The EIA Technical Review Committee (EIATRC) shall later assess the adequacy of the proposed studies and may recommend additional studies to be incorporated into the TOR.

Table 2.9.1: List of Potential Studies to be Considered in the EIA

Type of Studies	Government Agencies	Prescribed Activities	
		First Schedule Activity 6 (d)	Second Schedule Activity 6 (d)
Air Dispersion Modelling	DOE	√	√
Water Dispersion Modelling	DOE / DID	√	√
Noise Prediction Modelling	DOE	√	√
Quantitative Risk Assessment (QRA)	DOE / DOSH	√	√
Health Impact Assessment (HIA)	DOE / MOH	√	√
Soil investigations (SI)	JMG / JKR	√	√
Geotechnical Report	JMG / JKR	√	√
Land use Compatibility	PLANMalaysia	√	√
Social Impact Assessment (SIA)	PLANMalaysia	√	√
Traffic Impact Assessment (TIA)	JKR	√	√
Heritage Impact Assessment	Department of National Heritage	When applicable	When applicable

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.

2.10 OUTLINING OF MITIGATION MEASURES

The Qualified Person with the assistance of the technical consultants and specialists shall assess the BATs, BMPs and options for P2M2 to address the identified key environmental issues. At this point in the TOR/ESI, the identified measures shall be qualitative and descriptive only, to be further detailed in the EIA stage.

Table 2.10.1: Typical Project Alternatives and P2M2 Considerations For A Petrochemical Plant

Options	P2M2 Considerations
Project siting	Consider alternative siting with better suitability of the below: • Locations and proximity of sensitive receptors • Buffer zones / setback • Compatibility with the local land uses / neighbours • Risk consideration • Existing infrastructure tie-in / availability • Proximity to human settlement / sensitive receptors • Proximity to any cultural heritage
Terrain / Topography	Consider alternatives of: • To maximise usage of the existing terrain to minimize earthworks on site and import of soil / minimize land reclamation. • Avoidance of unsuitable terrain.
Socio Economic	Consider options to minimize: • Land acquisition. • Pressure on the existing infrastructure

Options	P2M2 Considerations
Existing Environment	Consider alternatives of: • Minimize impact to the existing carrying capacity of receiving water bodies (if there is industrial effluent discharge) • Minimize impact to the existing air shed (if there is emission discharge) • Minimize disturbance to any natural ecosystem nearby the project site.
Technology option – process and pollution control / treatment systems	Consider alternatives of: • Available technology options of higher efficiency • Clean technology option • Best Available Technology (BAT) options • Options to minimize plant resources – electricity / water / natural gas consumption. Recycling of resources. • Technology options to reduce pollution to the environment
No Project Option	Consider the benefits of no project and also the loss of potential benefits including socio economic and other development benefits brought by the project.

2.11 PREPARATION AND SUBMISSION OF TOR

Findings from the scoping exercise shall be incorporated into the ESI as information to develop the TOR. The TOR shall be submitted to DOE for review and endorsement before proceeding to the EIA stage.

2.11.1 Content of TOR

The TOR report shall be prepared in accordance with the format detailed under the Guidance Document for Preparing TOR under Appendix 8 of the EGIM (DOE, 2016).

The TOR shall contain, but not limited to, the following:

(i) Introduction: Include the title to the project and a brief introduction to the project details.

(ii) List of Consultants/Study Team: Include the list of Consultants and Study Team (DOE registration number, academic background, experience, area of study and declaration). The EIA consultant team shall be led by a Team/Project Leader/Manager who shall be responsible for the EIA report.

(iii) Project Scope: Detail out the legal requirements to carry out the project. Provide description on the project, project activities and implementation schedule.

(iv) Alternatives Consideration: Provide the assessment of the various alternatives/options considered for the project and detail out the justifications and reasons for selection of the final project layout, components and/or details.

(v) Significant Environmental Impacts to be Studied: Include the findings from the environmental scoping and detail out the significant impacts which will result from the project activities that are required to be included in the EIA.

(vi) Study Boundary: Delineate the study boundaries and identify the environmentally sensitive areas (ESAs) within the zone of study/zone of impacts.

(vii) Assessment Standards: List the standards, criteria, acceptable limits, etc. that will be used to assess the environmental impacts.

(viii) Timeline of Study: Detail our all studies/investigations to be carried out, including indicative dates.

(ix) Consideration of Concurrent Projects: List potential concurrent or planned projects that may result in cumulative impacts.

(x) Description of Modelling Tools and Assessment Methodologies: List the modelling tools and methodologies to undertake the impact assessment and evaluation of significance.

(xi) Possible Mitigation Measures: Outline the mitigation measures or BMPs from similar projects that may be used to address the environmental impacts from the project.

The ESI shall be appended as part of the TOR as a supporting document. The format for the ESI is as detailed in Appendix 8 of the EGIM (DOE, 2016).

2.11.2 TOR Adequacy Check Process

A review shall be carried out by the EIATRC comprising the DOE officers and appointed individuals (AIs) and/or GAs. The TOR Adequacy Check (TORAC) requirements and procedures shall follow the requirements as detailed out in the EGIM (DOE, 2016) or any future amendments to it.

The adequacy of the scoping exercise and the TOR shall be decided in a TORAC meeting, chaired by the DOE (refer to **Box 6** for possible outcomes).

Box 6:

Outcomes from TORAC Review

At the end of the process, the TORAC meeting can decide the following:

(i) Endorse the report.

(ii) Endorse the report with revisions, where a Revised TOR shall be submitted.

(iii) Reject the report with reasons (a fresh TOR can still be submitted).

When the TOR Report is endorsed, the Project Proponent shall proceed to the EIA stage.

2.12 STAKEHOLDERS ENGAGEMENT

Stakeholders engagement is an important process and shall be continuous from the project planning stage.

Additional engagements: While it is mandatory for the Second Schedule EIA to have public engagement, the Project Proponent is encouraged to carry out public engagement voluntarily even for the First Schedule EIA.

The mechanisms for stakeholders engagement in the EIA process can be direct, indirect and formal or informal. EGIM (DOE, 2016) has succinctly highlighted this as follows:

…*"EIA is a multi-disciplinary study on the environmental components such as water quality, air quality, waste management, environmentally sensitive areas and natural resources. It involves the participation of government agencies, non-governmental agencies (NGOs), academicians, experts and environmental practitioners including qualified and competent persons, industries and public at large. Hence, the EIA process should provide adequate opportunities to all stakeholders including the affected public to express their concerns and provide inputs for decision making process by relevant approving authority."*

Engaging with stakeholders can have general benefits to a project as shown in **Box 7**.

Box 7

Aims of the Stakeholder Engagement

(i) To understand the GA's key requirements, especially approvals process, and guidelines to be cleared for the project.

(ii) To convey the aims and scope of the development to the affected stakeholders, inform of potential impacts from the development and mitigation measures put in place to address them. This builds public trust and confidence towards the project.

(iii) To obtain feedbacks from the stakeholders on their concerns so that adjustments can be made for incorporation into the project designs and EIA for project implementation.

(iv) To allow early resolution of any conflicts and impasses, avoiding costly delays.

Box 8 provides some examples of good practices when engaging with the stakeholders.

Box 8

Good Practices in Stakeholder Engagement

(i) Stakeholder Identification: Selection of stakeholders should be inclusive, encompassing and without bias. The focus should be those that are directly affected by the project within the ZOI but may include any other relevant stakeholders.

(ii) Transparency: The stakeholder engagement process shall be carried out in a transparent and inclusive manner, with ample opportunities for the relevant stakeholders to obtain information, provide comments and submit feedbacks.

(iii) Information Disclosure: Information provided should be adequate and relevant to allow for stakeholders to understand the project and make informed decisions. Sufficient time should be allowed for information assessment and feedback.

(iv) Communication Tools: Communication can be in many forms – reports, formal meetings, focal group discussions (FGDs), townhall meeting, dialogues, information sheets, surveys, websites, etc. The method should best be suited to the target audience, with information communicated in simple to understand language and none too technical.

(v) Notification: All stakeholders should be informed and notified appropriately of any meetings or discussions to be held and given ample time to make arrangements. All efforts shall be made to ensure representative attendance by the stakeholders.

(vi) Selection of Venue: Meeting locations should be in a venue close by, convenient and accessible to the stakeholders. This would ideally be near the project site. For public display of EIA reports, these shall be at locations open and accessible to the public, e.g. public library, police station, local authority office, etc.

(vii) Documentation: All engagements shall be properly documented and reported in the EIA. Actions taken to address the issues brought up shall be clearly spelled out and mitigation measures incorporated as part of the project design. It is a good practice to follow up with the stakeholders on actions taken.

(viii) Accountability and Continuity: All comments and feedbacks from stakeholders shall be assessed and reviewed objectively. Actions shall be taken by the Project Proponent to address legitimate concerns. Stakeholder management should be throughout the project lifespan. Provision of platforms for stakeholders' engagement post-EIA is a best practice that should be adopted.

2.12.1 Identification of Stakeholders

A project's stakeholders can be grouped into four main groups as shown in **Table 2.12.1**.

Table 2.12.1: Key Stakeholders and their Roles and Responsibilities

Stakeholder	Role and Responsibilities
Department of Environment	Decision on the EIA report, environmental regulatory body to ensure project complies with the environmental requirement. Issue environmental license or permits to the Project Proponent.
Project Proponent and his Other Consultants	Initiate project proposal. Initiate and comply with the EIA process and its terms and conditions. Publicly release all relevant information on the project proposal and EIA. Manage and be fully responsible for their development activities and associated social and environmental impacts.

Stakeholder	Role and Responsibilities
Government Agencies, NGOs, Trade Associations	Contribute technical knowledge and expertise to EIA process. Disseminate information about project proposals and EIA process. Assist Project Proponents and other stakeholders to understand concepts and participate in EIA processes.
Affected Communities – residentials, business groups, neighbouring industries	Be aware of and read/consider about project proposals in areas of influence. Engaged, as much as practicable, with project proponents and environmental agencies regarding project proposals. Help to identify potential risks and impacts of project proposals, as well as project alternatives and impact avoidance strategies. Identify and communicate community needs, desires and expectations from 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 identify the relevant stakeholders.

2.12.2 Methods of Engagement

At the start of the proposed project, the Project Proponent and/or the Qualified Persons should pre-consult with DOE, the planning approval authorities and GAs to confirm their study requirements and the approval process to be followed, and to obtain their feedbacks regarding the proposed project.

Consultations with other stakeholders, besides the GAs and approving authorities, are also needed and it is the Project Proponent and Qualified Person’s responsibility to identify the key stakeholders to engage with at this early stage to assist in the preparation of the TOR and ESI.

During the EIA phase, stakeholder engagement is essential for the Project Proponent to brief the stakeholders about the project and the potential impacts, and to obtain their feedback on the suggested mitigation measures.

Methods of engagements are provided in **Table 2.12.2**.

Table 2.12.2: Methods of Engagement and Expected Outputs

Stakeholder	Methods of Engagement	Expected Outputs
Department of Environment	Meetings Interviews	Comments on TOR/ESI and EIA process and requirements
Project Proponent and his other Consultants	Meetings Emails	Project's detailed information Consultation on changes in project design and requirement Incorporation of P2M2s
Relevant Government Agencies	Meetings Interviews Focal group discussion (FGD) Official correspondence – letters, emails	Brief on project information Agency requirements such as key elements of policies, regulations and guidelines to adhere to Methods to address those key elements and approval procedures Information for EIA study Endorsement or approval of applicable studies, where relevant
NGOs, Trade Associations	Meetings Interviews FGD Official correspondence – letters, emails	Brief on project information Concerns and inputs on project Information for EIA study
Affected Communities – residentials, business groups, neighbouring industries	Questionnaire surveys. Interviews (formal and informal) FGD, Dialogue Townhall meeting Media, Website Roadshows	Brief on project information Concerns and inputs on project Information for EIA study Establish community feedback mechanism

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 and select the best method of engagements.

2.12.3 Documentation and Reporting

Initial stakeholders engagement and expectations from the stakeholders shall be incorporated into the TOR, especially in regards to policy compliance and regulatory adherence.

Proof of engagement can be in the form of written reports, official response letters from the GAs, meeting notes, photos, etc.

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

(i) Details of the programme (dates, venue, itinerary).

(ii) Attendance list of participants.

(iii) Copies of survey forms.

(iv) Brief summary of findings from the event, e.g. reports, minutes of meeting, list of questions and responses, photograph of event.

(v) Video or voice recordings (optional and only as reference).

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

CHAPTER 3

ENVIRONMENTAL IMPACT ASSESSMENT: BASELINE CONDITIONS

3.1 INTRODUCTION

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

During the EIA study, the baseline conditions should be used to determine the type mitigation measures being put in place in order to ensure the quality of environment remains within acceptable criteria and risks.

During project implementation stage, the baseline data should be used for reference or comparison against the project’s monitoring data to verify the performance of the mitigation measures.

Box 9

Objectives for Description on Baseline Conditions

(i) Identify existing environmental conditions which may influence project design decisions (e.g. site layout, structural or operational characteristics).

(ii) Identify sensitive issues or areas requiring mitigation or compensation.

(iii) Provide input data to analytical models for prediction of impacts.

(iv) Provide baseline reference for comparison during project implementation stage.

3.2 ENVIRONMENTAL BASELINE

The baseline conditions may be described based on primarily surveys from the ZOS or from validated secondary sources.

3.2.1 Secondary Data Collection

Secondary data includes information and statistical data from various sources but mainly from official published reports, census, publications and research papers. They are collected to form the basic information brief for the project.

All sources of information and statistics have to be clearly referenced and acknowledged alongside the date of publications in the EIA. References for all maps, photos and diagrams will also need to be included in the EIA.

3.2.2 Primary Data Collection

Primary data is collected to fill in gaps in information or to obtain first hand data for detailed assessment. Common methodologies include site surveys and sampling programmes at site and off site.

The survey area shall be bounded by the ZOS. However, if the predicted impact is much further away, then the ZOI shall be part of the survey and assessment area. This has to be clearly defined in the EIA.

3.2.3 Environmental Components and Indicators

Table 3.2.1 lists the likely environmental components and indicators to be described for baseline conditions. Sources to obtained the required information are also indicated in **Table 3.2.1**.

The baseline conditions may be described qualitatively but shall be sufficiently adequate to assess the potential impacts on the sensitive receptors. Quantitative data wherever available, should be provided to support the impact assessment.

Table 3.2.1: Environmental Components and Indicators

Components	Descriptions	Sources of Information
Physico-chemical Environment		
Topography / Bathymetry	Topography and slopes Bathymetry, coastal areas and landforms Description of accreting or erosional areas	Topography maps by JUPEM Nautical charts from National Hydrographic Centre National Coastal Erosion Study 2015 Field surveys
Soil	Type and characteristics Porosity and permeability Runoff rate and infiltration capacity Effective depth Inherent fertility	Soil map by Department of Agriculture Soil investigation (SI) report
Geology	Local and regional geology Underlying rock type, texture Geological structures (fault lines, shear zones, etc.) Geological resources (minerals)	Geological maps by JMG Geology investigation report
Drainage	Natural drainage patterns and network Rainfall runoff relationships Hydrogeology patterns and network Groundwater characteristics Floodplains	Topography maps by JUPEM Hydrology maps by DID Hydrogeology reports from JMG Field survey

Components	Descriptions	Sources of Information
Climate	Rainfall data and patterns Ambient temperature data and patterns Relative humidity data and patterns Wind data and patterns Extreme events (floods, droughts) Climate change projections Stability conditions and mixing height	Malaysian Meteorological Department (METMalaysia)
Water Quality	Surface water quality (rivers, lakes, ponds), water depths., flow rates Groundwater quality, water table, local aquifer storage capacity, specific yield, specific retention, water level depths and fluctuations, etc. Marine water quality, water depths, flow rates Existing sources of water pollutions Existing drinking water intake points and water treatment plants	Published reports by DOE and DID State's water resources department State's potable water provider Field surveys
Ambient Air Quality	Trending of ambient air quality Existing sources of air pollutions	Published reports by DOE Field surveys
Ambient Noise	Locations of high noise generators	Published reports by DOE Field surveys
Ambient Vibration	Locations of high vibration generators	Field surveys

Components	Descriptions	Sources of Information
Biological Environment		
Ecosystem	Description of existing ecology and habitats Identification of ESAs and conservation areas (forest reserves, wetlands, mangroves, wildlife reserves, etc.) Presence of endemic, rare, threatened, endangered and near extinct species Species composition Flora – type, density, exploitation etc. Fauna – distribution, abundance, rarity, migratory, species diversity, habitat requirements and resilience, economic significance, commercial value, etc. Fisheries – migratory species, species with commercial / recreational value	Published literatures Research papers, publications and inventory data from PERHILITAN, Department of Fisheries (DOF) and Forestry Department Peninsular Malaysia (JPSM). *Buku Kawasan Sensitif Alam Sekitar* (DOE) Field observations
Human Environment		
Land use	Land use maps (within 500m radius, 1km radius, 3km radius and 5km or beyond) and photos Identification of ESAs Future land use map	Topography maps Aerial or satellite imagery National Physical Plan, structure and local plans by PLANMalaysia and PBT Field surveys
Public Health	Morbidity and mortality statistics Chronic and infectious disease indicators Availability of public health facilities	Data from Ministry of Health (MOH) Field surveys

Components	Descriptions	Sources of Information
Socio Economic	Details of demographics Local economic profile Feedback from stakeholders engagement	Census date from Department of Statistics Local plans from PBT Local profile reports from community leaders Reports on stakeholders engagements Field surveys
Heritage, Culture and Archaeology	Locations of historical and cultural sites Description of heritage and cultural practices	Published literatures Research papers, publications and data from Department of Museums, National Heritage Department, JAKOA, etc. Local plans from PBT Local profile reports from community leaders Reports on stakeholders engagements Field surveys
Road Network and Traffic	Access to project site Condition of access roads Traffic data	Published traffic data by the Public Works Department (JKR) Road maps Field surveys
Infrastructure, Utilities and Amenities	Water, steam and electricity sources and capacity Sewerage and waste management facility and capacity Telecommunication provider and capacity	Information from utility providers Local plans from PBT

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.

3.3 BASELINE MONITORING

The development of a petrochemical plant shall require adequate primary baseline data collection for ambient air quality, water quality and ambient noise and vibration.

Generally, primary baseline data collected during the EIA study should be acceptable as relevant references for two (2) years from the date of field monitoring, unless the Qualified Person is able to prove that there is no significant changes to the surrounding physical, biological and human environments within the zone of impact of the project site within or after 2 years.

The following sections describe typical test parameters, test methods, monitoring locations and criteria for comparison for ambient air quality, water quality, ambient noise and vibration for a petrochemical plant.

3.3.1 Ambient Air Quality

Petrochemical plant has the potential to emit air pollutants from various sources and activities, such as its processes and storage facilities.

Test Parameters and Methods

The sampling and testing methods to determine the concentrations of ambient air pollutants shall be based on standard methods acceptable to DOE. Typical examples of ambient air test parameters and sources of test methods are tabulated as **Table 3.3.1**.

Monitoring Locations

A minimum of three (3) locations with the following justifications are recommended. Additional monitoring locations should be considered if there are more of sensitive receptors nearby.

(i) At project site

(ii) Upwind of the project site based on reference to long term wind rose data

(iii) Downwind of the project site

Other considerations for additional ambient air monitoring locations and frequencies, are season and climatic changes (dry and wet seasons), and pollution sources from other current activities surrounding the area.

Table 3.3.1: Examples of Ambient Air Test Parameters and Methods

Test Parameters	Sources of Test Methods
Particulate Matter 2.5 Micron ($PM_{2.5}$) (for project with combustion processes)	Australian / New Zealand Standard (AS/NZS) Method US EPA Method
Particulate Matter 10 Micron (PM_{10})	
Nitrogen Dioxides (NO_2)	
Sulphur Dioxide (SO_2)	
Ozone (O_3)	
Carbon Monoxide (CO)	
Hydrogen Chloride (HCl)	
Ammonia (NH_3)	
Chlorine	
Mercury	
Hydrogen Sulphide (H_2S)	
Volatile Organic Compounds (VOC)	

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.

Criteria for Comparison

The measured concentrations of air pollutants shall then be compared and evaluated against the New Malaysia Ambient Air Quality Standard (**Appendix D**).

For ambient air parameters that are not listed in the New Malaysia Ambient Air Quality Standard, references should be made to other applicable standards or guideline limits prescribed internationally (e.g. International Finance Corporation (IFC) and Arizona Ambient Air Quality Guidelines).

3.3.2 Water Quality

During the construction stage, activities such as earthworks and civil construction works may contribute to increase of sediment in the runoff water due to soil erosion, generation of sewage and accidental spills during petroleum or chemical handling. Meanwhile during the operation stage, process effluent, wash water, generation of sewage and accidental spills are potential sources of water pollutants.

Uncontrolled water pollutants may contaminate the surface water, groundwater and / or ultimately the marine water.

Test Parameters and Methods

The sampling and testing methods to determine the concentrations of water pollutants shall be based on standard methods acceptable to DOE. Typical examples of surface water test parameters and sources of test methods are tabulated as **Table 3.3.2**.

Table 3.3.2: Examples of Water Test Parameters and Methods

Test Parameters	Sources of Test Methods
Surface Water	
Temperature, pH, Conductivity, Dissolved Oxygen, Total Suspended Solids, BOD_5, COD, Oil and Grease, Total Organic Carbon, Ammoniacal Nitrogen, Nitrate, Phosphorus, Mercury, Cadmium, Lead, Chromium, Copper, Nickel, Zinc, Arsenic, Silver, Cyanide Total Coliform, Faecal Coliform	Standard Methods for the Examination of Water and Wastewater by APHA US EPA Method

Test Parameters	Sources of Test Methods
Groundwater	
Water level, Temperature, pH, Conductivity, Dissolved Oxygen, Oxidation Reduction Potential, LNAPL Detection, Oil and Grease, Total Organic Carbon, Total Petroleum Hydrocarbon, Aromatic Volatile Organic Compounds (BTEX), Chlorinated Hydrocarbon, Polycyclic Aromatic Hydrocarbon, Ammoniacal Nitrogen, Nitrate, Phosphorus, Mercury, Cadmium, Lead, Chromium, Copper, Nickel, Zinc, Arsenic, Silver, Cyanide	Standard Methods for the Examination of Water and Wastewater by APHA US EPA Method
Marine Water	
Temperature, pH, Conductivity, Dissolved Oxygen, Total Suspended Solids, Oil and Grease, Total Organic Carbon, Polycyclic Aromatic Hydrocarbon, Ammonia (unionised), Nitrate, Nitrite, Nitrogen, Phosphate, Phenol, Mercury, Cadmium, Lead, Chromium VI, Zinc, Arsenic (III), Cyanide, Tributyltin, Faecal Coliform	Standard Methods for the Examination of Water and Wastewater by APHA US EPA Method

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.

Monitoring Locations

Sampling locations should cover the potential waterbodies that will be receiving discharges from the project site. Selection of sampling locations should include sensitive receptors such as water intake point, agricultural and aquaculture farming, and residential area where villagers may use water from the affected waterway for their daily uses, including groundwater.

A minimum of three (3) locations with the following justifications are recommended and additional monitoring locations should be added for water sensitive receptors downstream, where applicable.

(i) Upstream of the project site or point of interest (e.g. location of tank farm for groundwater sampling): minimum 1 sample point

(ii) At the receiving point of project's discharge or location of interest (e.g. tank farm location): 1 sample point

(iii) Downstream of the project site or point of interest: minimum 1 sample point

(iv) At any other water sensitive receptor locations

Where waterbodies are influenced by tides, sampling during flood tide and ebb tide should be carried out. In this case, water monitoring at water sensitive receptors upstream of the project site should be considered as well.

Other considerations for water monitoring locations and frequencies, are season and climatic changes (dry and wet seasons), monsoon changes, spring and neap tides, other natural changes such as sedimentation and ecological succession, and pollution sources from other current activities surrounding the area.

Criteria for Comparison

Water quality analysis results should be compared and evaluated against the national standards and guideline levels where available.

References for surface water quality and marine water quality are the Malaysia National Water Quality Standard and Malaysia Marine Water Quality Criteria and Standard as presented in **Appendices E** and **F** respectively. Groundwater quality should be evaluated against the Site Screening Levels (SSLs) as presented in the Contaminated Land Management and Control Guidelines No. 1: Malaysian Recommended Site Screening Levels for Contaminated Land, Nov 2015 by DOE Malaysia.

3.3.3 Ambient Noise and Vibration

Noise is defined as unpleasant and unwanted sound that may annoy human and high noise level may damage human's hearing or cause mental stress.

Vibration normally arises from rotating machineries such as fans and turbines, impact activities such as piling as well as from vehicular movement. High vibration level may annoy human or cause mental stress, and damage structures.

Test Parameters and Methods

The measurement methods to determine the ambient noise and vibration levels shall be based on methods acceptable to DOE. Noise and vibration parameters and requirement of test meters are as tabulated as **Table 3.3.3**.

Table 3.3.3: Examples of Noise and Vibration Parameters and Methods

Test Parameters	Sources of Test Methods
Ambient Noise: L_{eq}, L_{min}, L_{max}, L_{90}, L_{10} in dBA	ISO 1996
Vibration: Peak particle velocity be measured simultaneously in the three orthogonal x, y, z axes, computed vectorial sum	ISO 2631 BS 6472 DIN 4150

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.

Monitoring Locations

Common noise monitoring locations are:

(i) Plant or project boundaries

(ii) Noise sensitive receptors such as resident areas, hospitals, institutions / schools etc.

Vibration monitoring should be conducted at the nearest building to the vibration source and the best position should be on the floor slab or foundation. However, baseline vibration monitoring locations are commonly at:

(i) Plant or project boundaries

(ii) Vibration sensitive receptors such as resident areas, heritage building / sites, hospitals, institutions / schools etc.

Criteria for Comparison

Water quality analysis results should be compared and evaluated against the national standards and guideline levels where available.

Measured baseline noise and vibration levels should be compared and evaluated against guideline limits specified by DOE in the followings:

- The Planning Guidelines For Environmental Noise Limits and Control (Book 1 of 3), Schedule 1 to Schedule 9 of Annex A: Schedule of Permissible Sound Levels.

- 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.

CHAPTER 4

ENVIRONMENTAL IMPACT ASSESSMENT: EVALUATION OF IMPACTS

4.1 INTRODUCTION

This section presents the impact assessment approaches and prediction methodologies / tools for potentially key environmental impacts that may arise from the development of a petrochemical plant

There are many methods to assess the environmental impacts. Generally, all methods of impact assessment seek to compare the existing environment against a predicted future environment caused by activities during different phases of project implementation.

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

(i) Established and proven methods and models.

(ii) Adequate, accurate and up-to-date data for assessment.

(iii) Results can be replicated and is reproducible by independent evaluators.

(iv) Cost-effective and for any software, it can be purchased (propriety software and tools can also be used). Widely accepted freeware is acceptable.

The Qualified Person shall select the best method to conduct the assessments and / or generate practical scenarios from reliable datasets to ascertain the magnitude, extent and significance of impacts from the project.

4.2 PREDICTION AND EVALUATION OF IMPACTS

Only significant issues shall be assessed in detail in the EIA. Issues that are not significant shall only be addressed qualitatively.

The level of details in the impact identification shall commensurate with the following factors:

(i) Scale of the project (land area, total disturbed areas, etc.).

(ii) 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 project on adjacent land areas and *vice versa*).

(vii) Sensitivity of nearby receptors (e.g. Environmentally Sensitive Areas).

Key assessments for a petrochemical plant include, but are not limited to, the following:

- Air Quality
- Water Quality
- Noise and Vibration
- Risk Assessment
- Public Health
- Waste Generation
- Socio Economic

4.3 AIR QUALITY

4.3.1 Sources of Pollutions

Construction Stage

Contribution of air pollutants during the construction are primarily related to dust and combustion gases from vehicles and machineries and fugitive dust from exposed soil surfaces at the project site.

Operation Stage

Atmospheric emissions from a petrochemical processes can be broadly categorized into point sources and fugitive emissions. Point source emissions can be routed to a pollution control device for treatment. For diffuse and fugitive emissions, the objective of controls are through prevention and / or minimization (e.g. improved process equipment with least fugitive emissions, and by capturing in ducted system). **Table 4.3.1** gives typical air pollutants from petrochemical processes.

Table 4.3.1: Air Pollutants and Their Potential Sources

Air Pollutants	Sources
VOC	Process vents Storage and transfer of liquids and gases Fugitive sources and intermittent vents Processes / distillation units
Particulate matters	Conditioning of solid raw materials Drying of solid products Catalyst regeneration Waste handling
Combustion gases: NOx, CO, SOx, HC, metals, dust	Furnaces Steam boilers Incinerators Flares
Acid gases (HCl, HF)	Halogenation reactions
Dioxins	Production processes that use chlorine Incinerators

Example 1:

Sources of Emissions from Ethylene Cracker Plant

Sources of emissions in ethylene cracking process are:

- **Furnace area (steady state operation):** Furnace area is part of the process comprising pyrolysis heaters, complete with heat exchange equipment for generating high pressure steam, and any separately fired steam superheaters. The most significant emissions are from the combustion of fuels in the pyrolysis cracking furnaces. Operating conditions of cracking furnaces frequently changed to provide the desired product distribution and this may affect optimal control of the combustion process.

- **Furnace area (decoke operation):** All cracking furnaces require periodic de-coking to remove carbon build-up on the radiant coils. The carbon layer acts as an insulator, and requires the use of higher tube metal temperatures to maintain desired feedstock conversion. Periodically, the furnace shall be de-coked to restore its performance and carbon is burned to carbon dioxide. Number of cycles varies significantly with different feedstock, coil configurations and operating severity, typically in 14- 100 days.

- **VOCs from point source:** During normal operation there are very few VOC emissions from the cracking process as they are recycled into process, used as a fuel or routed to associated processes on an integrated site. Elevated VOC emissions from ethylene plants are intermittent, but occur during plant start-up and shutdown, process upsets and emergencies. VOCs may be emitted from pressure relief devices, intentional venting of off-specification materials or depressurizing and purging of equipment for maintenance. Generally, intermittent emissions, all pressure relief devices, and emergency vents are routed to flare. The relief valve from de-methaniser usually vents to atmosphere, but the valve is not operated very frequently and results in emissions of hydrogen and methane.

- **Flaring**: all crackers are provided with flare gas systems for safe disposal of any hydrocarbons or hydrogen that cannot be recovered in the process. This is particularly the case during unplanned shutdowns, and during start-ups, when the intermediate streams have not reached the compositions required to enable the production of full-specification products.

- **Fugitive emissions:** Stream crackers are large complex units that have a high number of components with potential to give rise to fugitive emissions. Fugitive emissions may arise from valve glands, pipeline flanges, open-ended (non-blanked) lines, pressure relief valves and other piping components, in addition to the pump/compressor seals and sample points, many of the process streams are light (containing at least 20% of substances with vapour pressure greater than 300 Pa at 20^{o}C) and at high pressure (1500 – 3000 kPa). Fugitive losses can therefore constitute a significant proportion of overall steam cracking process emissions. Hydrocarbons from steam cracking unit are mostly emitted due to leakage and flaring of the residual gases. VOC emissions from steam cracking are compose of paraffins, ethylene, olefins (including propylene) and other hydrocarbons.

4.3.2 Impact Assessment

It is suggested that the followings are considered for air quality impact assessment of a petrochemical plant:

(i) The significant pollutants emitted from the petrochemical plant. Continuous, large volume with high concentration emissions point sources should be given priority.

(ii) Ambient air prediction and assessment scenarios. Examples of scenarios: normal operation conditions (with air pollution control system to specified guaranteed performance limits), worst case scenario (no treatment of flue gas during worst atmospheric conditions) and emergency bypass scenario (emergency shutdown due to power outage or plant upset or air pollution control system failure).

(iii) Meteorological data should be sourced from the nearest Meteorological Station.

(iv) Sensitivity of the receiving environment or sensitive receptors, should there be any locally specified tolerance levels, such as exposure dosage levels to plant or human.

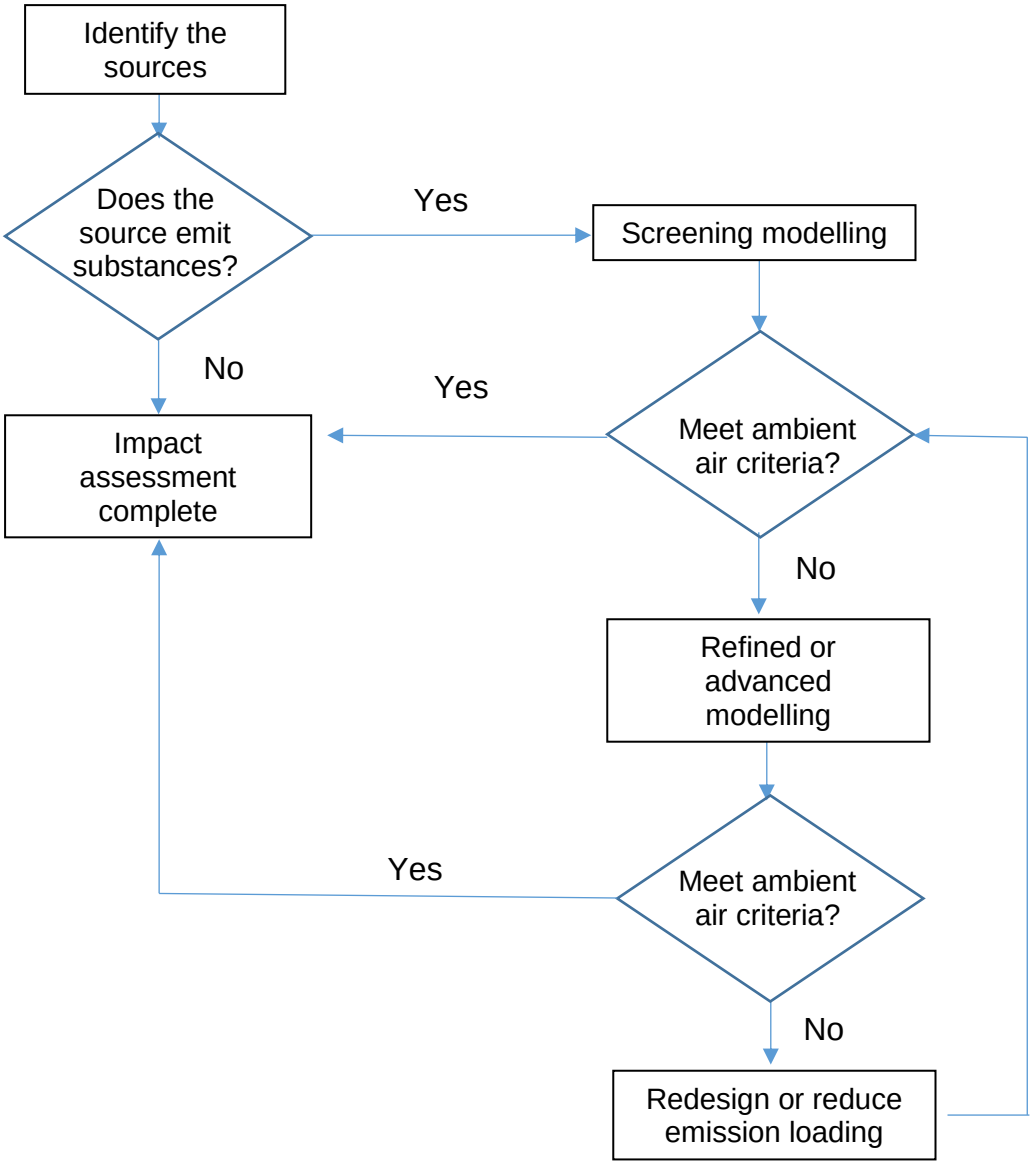
(v) Reference to assessment criteria such as the New Malaysia Ambient Air Quality Standard, baseline conditions or any relevant standards / guideline limits.

In order to assess whether an emission meets the ambient air quality objective, it is necessary to determine the ground-level concentrations that may arise at various distances from the source.

Air dispersion modelling is often used to determine the ambient ground-level concentrations of an emitted pollutant, given information about the emissions and the nature of the atmosphere. Model predictions are useful in a wide variety of air quality decisions, including determining appropriateness of facility location, monitoring-network design and stack design. Models also provide information on the areas most influenced by emissions from a source, the contribution of weather to observed trends and the air quality expected under various scenarios.

Figure 4.3.1 shows the flow in determining the level of air quality impact. The initial air quality assessment is conducted qualitatively and once it is identified as significant emission sources, the assessment should progress to quantitative assessment by either screening modelling or refined / advanced modelling to predict the pollutants' ground-level concentrations. Refined air dispersion model provides detailed analysis of the parameters and caters for multiple emission sources, thus gives a more accurate estimate of the pollutants' concentrations at receptors. However, a refined model demands for more specific input data which can include topography, better receptor grid resolution, downwash or other plume adjustment and pollutant decay or deposition algorithm. Refer to **Section 4.10** of this Guidelines for examples of prediction tools.

Figure 4.3.1: Flow Chart to Determine the Level of Air Quality Impact Assessment



4.3.3 Outputs

The main objective of a modelling study is to determine the significance of the effects of pollutants being discharged from a particular source and its Zone of Impact. Some of the key information to be included in reporting modelling results are:

(i) Information about the input data and how variations may affect the results.

(ii) Discussion on the accuracy of the modelling results.

(iii) Identification of the receptors that are most highly impacted and those are the most sensitive.

(iv) Tabulate the model output in predicted pollutants concentrations at respective sensitive receptors and evaluate the significances. **Table 4.3.2** shows sample of this tabulation.

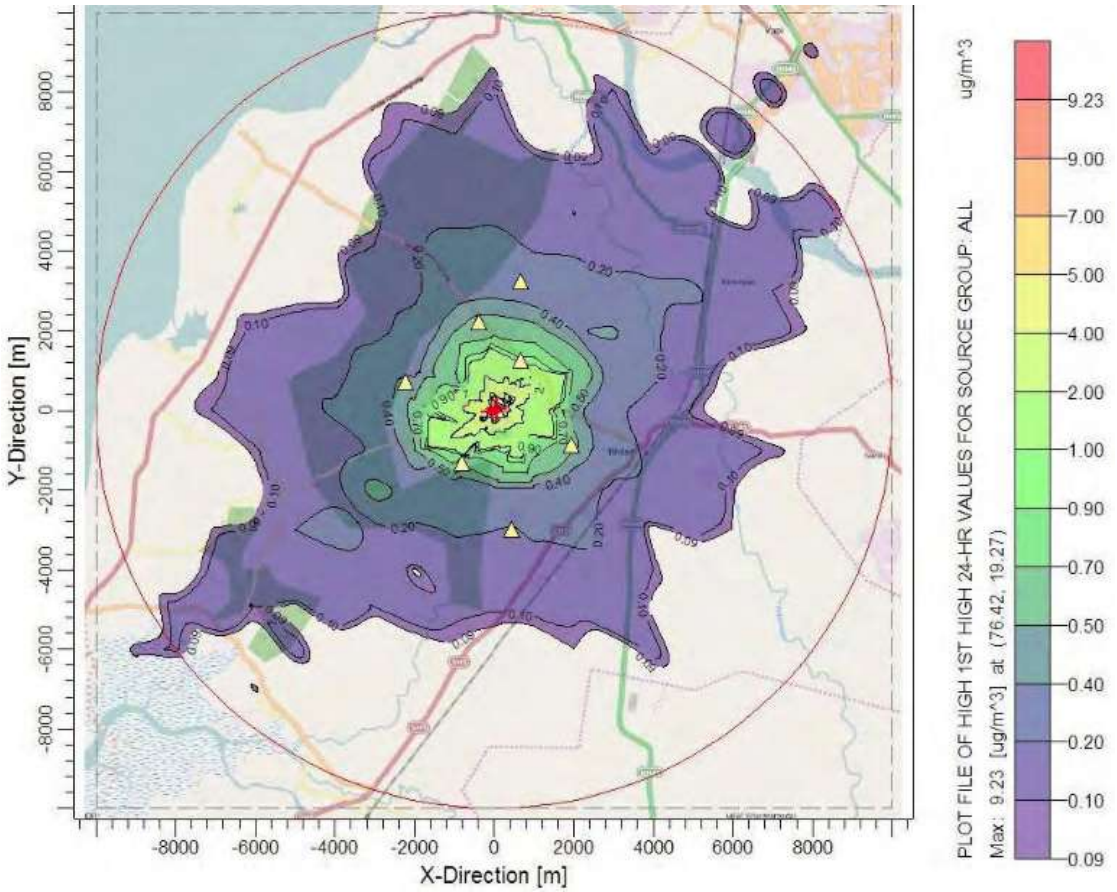
Maps of the pollutants' dispersion contours overlay on a land use map surrounding the project site. A sample of this contour map is illustrated in **Figure 4.3.2**

(v) .

Table 4.3.2: Sample of Tabulated Predicted Maximum of 24-Hours Average and Annual Average PM10 Without Control Measures

Receptor	Baseline, PM_{10} ($\mu g/m^3$ at 24-hour average)	Incremental PM_{10} ($\mu g/m^3$ at 24-hour average)	Ambient PM_{10} ($\mu g/m^3$ at 24-hour average)
A1 : Project site	17	810	827
A2 : Sensitive Receptor A	8	101	109
A3 : Sensitive Receptor B	9	112	121
New Malaysia Ambient Air Quality Standard	100		

Figure 4.3.2: Sample of Air Dispersion Contour Map



4.4 WATER QUALITY

4.4.1 Sources of Pollutions

Construction Stage

Site clearing and earthworks activities, involve removal of vegetation and soil movement. These could result in the increase of surface runoff, soil erosion and sedimentation in waterbodies.

During peak construction period, the presence of large number of workers at site will translate to a significant amount of sewage generation.

During the testing and commissioning, large amount of water may be used for hydrostatic pressure test on storage tanks, vessels and transfer pipelines. These waters sometimes contains corrosion inhibitors, antifreeze compounds, biocide or other chemical additives. At this stage, effluent may be generated and its characteristics may be fluctuating in accordance to the processes being tested.

Nearby water resources are also at risk of accidental spillage or leak of fuel and hazardous materials including chemicals, during handling and storage.

Operation Stage

A petrochemical plant is known to generate process effluent and / or wash waters periodically. These waters usually contain high organic matters as indicated by COD concentrations. Depending on the type of raw materials or additives or catalyst being used in the process, other unique water parameters may be observed.

Example 2:

Effluent from Ethylene Crackers Plant

There are three effluent streams that are specific to the steam cracking process, namely process water, spent caustic and decoke drum spray water. In addition, cooling or boiler water blowdown, surface or maintenance water may also be generated. Major water pollutants are:

- Inorganic sulphide
- Cyanide
- Heavy oils
- Coke
- Spent caustic
- Particulates
- Water borne waste containing BOD, COD Suspended Solids and Oil (oily water is the main source of liquid effluent from cracker plant)
- Liquid effluents like pygas, pyrolysis fuel oil quench water, process water stripper bottom may give peculiar odour

Meanwhile, other common effluent streams includes:

First flush pits: These waters are largely stormwater but may contain spilled chemicals or oily water from process areas, utility areas or storage areas .

Boiler blowdown: These waters will be non-oily but high in dissolved solids. It may also be contaminated with heavy metals and anti-scaling agents.

Cooling water: A process plant may employ once-through cooling water or circulating cooling water systems (or perhaps both may be used in large plants). If the cooling water is once through, then the cooling water discharge is low in dissolved solids but will contribute to elevation of temperature in discharge water. If the cooling water is circulated in a closed system with a cooling tower, then the blowdown from the system will be high in dissolved solids, heavy metals and to certain extend some anti-scaling agents too.

4.4.2 Impact Assessment

Selection of methodology for water quality impact assessment may vary, depending on the quality of effluent discharges and the location of discharge point.

It is suggested that the followings are considered for water quality impact assessment of a petrochemical plant:

(i) The significant pollutants emitted from the petrochemical plant. Continuous, large volume and high concentration of water sources and parameters should be given priority.

(ii) Water quality prediction and assessment scenarios. Examples: normal operation conditions (with Industrial Effluent Treatment System (IETS) to the specified guaranteed performance limits), worst case scenario (no effluent treatment).

(iii) Hydrology data should be sourced from the nearest DID Monitoring Station.

(iv) Sensitivity of the receiving environment or sensitive receptors, should there be any locally specified tolerance levels, such as drinking water intake, recreational requirement, agricultural or aquaculture requirement, ecological requirement, other downstream industrial needs, navigation etc.

(v) Reference to assessment criteria such as the national river and marine water guidelines, baseline conditions or any other relevant standards / guideline limits.

Impact assessment shall rely on the concept of assimilative capacity of the receiving waterbody and water quality objectives. Quantification of the assimilative capacity of the receiving environment shall take into account physical processes, as well as all chemical, biochemical and biological processes.

The prediction exercise or modelling should provide information as the basis for determining whether the aquatic resources and beneficial users are at risk, or that the assimilative capacity may be exceeded as a result of the project implementation.

When the prediction shows the water quality of the received waterbodies may have been significant compromised due to the discharges from the project, then suitable mitigation measures shall be considered to alleviate the concern so as to either remove or mitigate the impacts to the receiving waterbodies.

4.4.3 Outputs

The main objective of an impact assessment is to determine the significance of the effects of pollutants being discharged from a particular source and its Zone of Impact, and key information to be reported include:

(i) Information about the input data and how variations may affect the results.

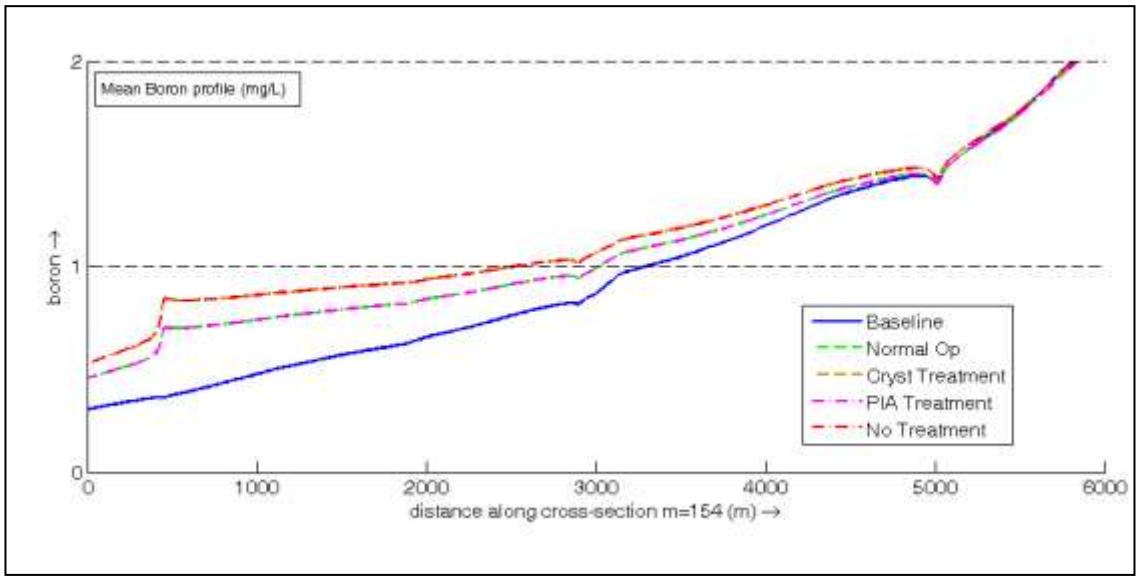
(ii) Discussion on the accuracy of the predictions.

(iii) Identification of the receptors that are most highly impacted and those are the most sensitive.

Presentation of predicted pollutants concentrations in tabulation or maps of the pollutants' dispersion contours. A sample of this contour map is illustrated in **Figure 4.4.1**

(iv) .

Figure 4.4.1: Sample of Water Quality Dispersion Contour



4.5 NOISE AND VIBRATION

4.5.1 Sources of Pollutions

Construction Stage

Construction activities involve the use of machinery and equipment and generate noise typically as shown in **Table 4.5.1**.

Operational Stage

Similarly a petrochemical plant may have machinery and equipment and activities that generate noise and vibration as presented in **Table 4.5.2**. Specific sound power levels, its noise spectrum and respective characteristics for each operating equipment may be sourced from the suppliers for better understanding on the level of concerns on noise and vibration.

Table 4.5.1: Typical Sound Power Levels from Construction Equipment and Activities

Equipment	Operating Condition	Sound Power Level @ 15 m
Bulldozer (e.g. CAT D10)	Clearing vegetation	~ 84 dBA
Backhoe	Digging	78 - 80 dBA
Excavator	Operation	81-85 dBA
Crawler Crane	Lifting	81-85 dBA
Compressor	Operating	78-80 dBA
Concrete Batching Plant	Operation	83 dBA
Generator set	Operation	80-82 dBA
Impact Pile Driver	Operation	95-101 dBA

Table 4.5.2: Typical Sound Levels from Operating Equipment and Activities

Equipment	Sound Pressure Level
Transfer / Delivery Pump	89 - 100 dBA @ 1m
Exchanger / Exhaust Fan	90 - 100 dBA @ 5m
Air compressor	80 dBA @ 1m
Boiler	85 dBA @ 1m
Chiller	85 dBA @ 1m
Flare Combustion	~ 100 dBA @ 120m from flare
Burner Combustion	90 – 85 dBA
Conveyor Belt (line source)	82 – 103 dBA @ 1 m

4.5.2 Impact Assessment

Approaches to environmental noise and vibration assessment are guided by The Planning Guidelines for Environmental Noise Limits and Control and The Planning Guidelines for Vibration Limits and Control, published by the DOE Malaysia in 2007.

It is suggested that the followings are considered for noise and vibration impact assessment of a petrochemical plant:

(i) List of significant sources from the petrochemical plant. Continuous and high noise or vibration levels should be given priority.

(ii) Noise and vibration prediction and assessment scenarios. Examples of scenarios: normal operation conditions without control measures and with control measures.

(iii) Sensitivity of the receiving environment or sensitive receptors, should there be any locally specified tolerance levels, such as exposure levels to residential, institutions, heritage buildings etc.

(iv) Reference to assessment criteria such as the national guideline limits, baseline conditions or any relevant standards / guideline limits.

Where multiple significant sources from a petrochemical plant have been identified, prediction of impact using modelling software normally ease the assessment tasks. These modelling tools could incorporate specific characteristics of the sources as well as attenuation features (noise barriers, buildings, terrain etc.) to generate more accurate predictions.

4.5.3 Outputs

The main objective of this impact assessment is to determine the compliances of anticipated noise and vibration levels at the plant boundaries and to determine the significance of the effects from the project at the identified receptors. The report should include:

(i) Information about the input data and how variations may affect the results.

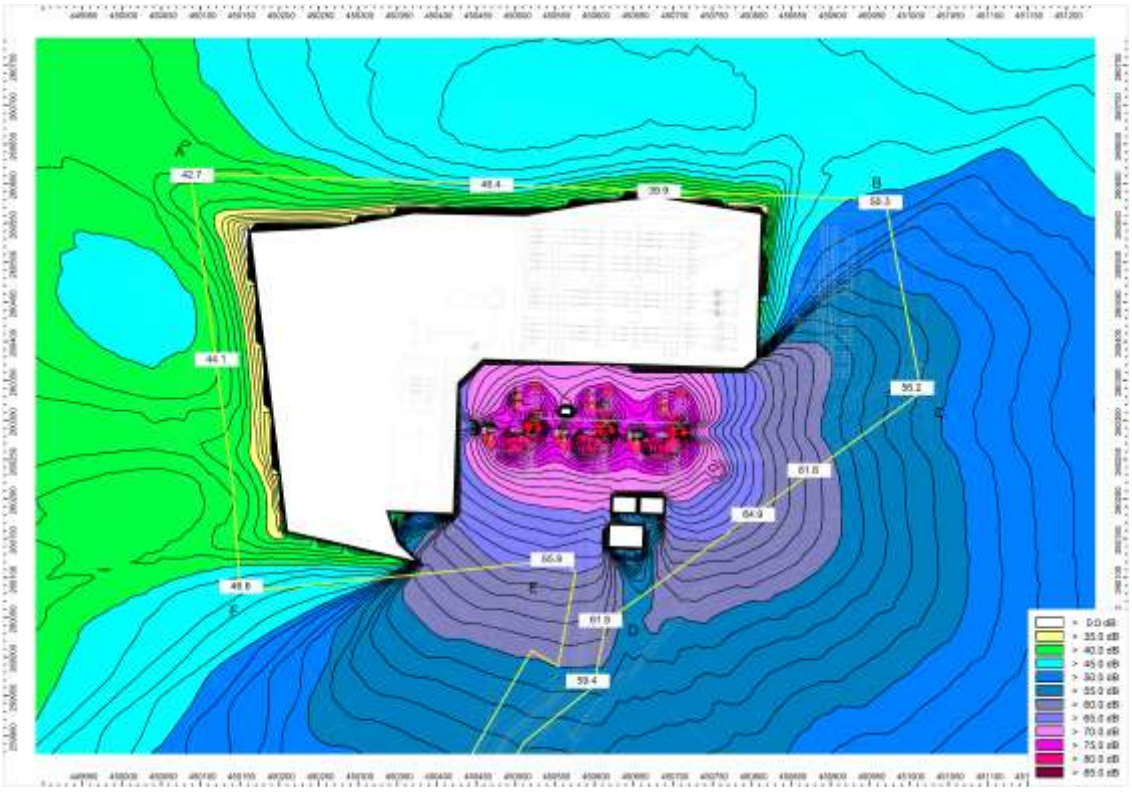
(ii) Discussion on the accuracy of the prediction calculations and / or modelling software.

(iii) Identification of the receptors that are most highly impacted and those are the most sensitive.

Presentation of predicted levels in tabulation or contours maps. A sample of this contour map is illustrated in **Figure 4.5.1**

(iv) .

Figure 4.5.1: Example of A Noise Contour Map



4.6 RISK ASSESSMENT

4.6.1 Sources of Hazards

A petrochemical installation normally handles and uses large amounts of hazardous substances. The Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996 defines "major hazard installation" as an industrial activity which produces, processes, handles, uses, disposes of or stores, whether permanently or temporarily, one or more hazardous substances or a category or categories of hazardous substances in a quantity or quantities which is or are equal to or exceed the threshold quantity stipulated in its regulations.

The operational hazards of which the risk assessment will focus on, are:

- Fires
- Explosions
- Thermal decomposition
- Chemical leakage

Table 4.6.1 indicates the different sources and types of hazards potentially present in a petrochemical plant.

Table 4.6.1: Typical Sources and Type of Hazards

Source of Hazards	Hazards Type
Pipelines, pump station or compressor station	Fire or explosion, pipeline failure
Storage (no light hydrocarbons)	Tank fire, bund fire, boil-over
Storage (with light hydrocarbons)	Boiling liquid expanding vapour explosion (BLEVE)
Simple gas plants (no light hydrocarbons)	Jet fires
Simple refineries (no light hydrocarbons)	Liquid pool fires, flash fires, furnace fire
Ammonia plants / Methanol plants	Jet fire, internal vessel disintegration, furnace explosion
Complex Gas Plants / Refineries / Petrochemical Plants	Above plus vapour cloud explosions

Source:
http://www.swissre.com/china/Alarming_risks_in_the_petrochemical_industry.html

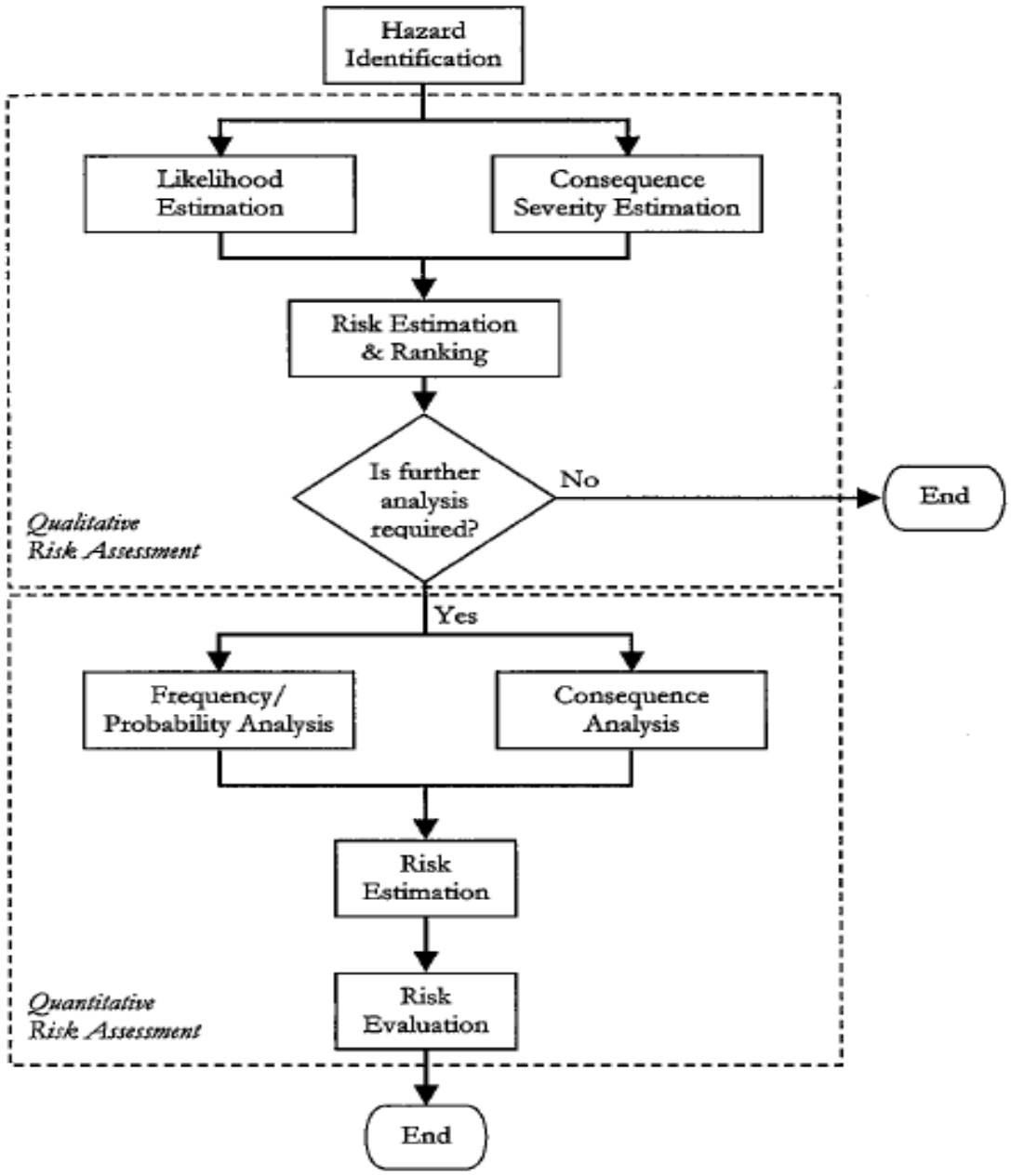
4.6.2 Impact Assessment

The objectives of a risk assessment are to identify and quantify the probability and consequences of the possible emergency events that may escalate from the project site to the surrounding areas offsite and potentially cause undesirable outcome such as human injury, fatality or

destruction of property, to calculate the risk level, and to suggest measures to reduce the level of risk if higher than the risk acceptance criteria.

Risk assessment for EIA reporting is guided by EIA Guidelines for Risk Assessment by DOE Malaysia (2004). The flow of the risk assessment of a petrochemical plant shall follow **Figure 4.6.1.**

Figure 4.6.1: Risk Assessment Flow



Source: Environmental Impact Assessment Guidelines for Risk Assessment (DOE, 2004)

Qualitative Assessment

This risk assessment is a screening exercise and the outcome is the risk ranking of the identified hazards. If the qualitative risk assessment indicates that the risk is insignificant or acceptable with specific risk control measures, then there is no need to carry out further quantitative risk assessment. Some of the method for qualitative risk assessment include:

- Risk matrix.
- Risk calculator.

Quantitative Assessment

Quantitative risk assessment involves:

(i) Frequency / Probability Analysis

This is a method to determine the probability of occurrence of a hazardous event by the Event Tree Analysis (ETA) or Fault Tree Analysis (FTA). They should reveal the outcomes of the root cause of failure and help identify further hazardous events. The root causes can be component failures, human errors or other pertinent events that can lead to hazardous event.

Figure 4.6.2: Sample of ETA Diagram of Unloading Line Rupture of Ammonia

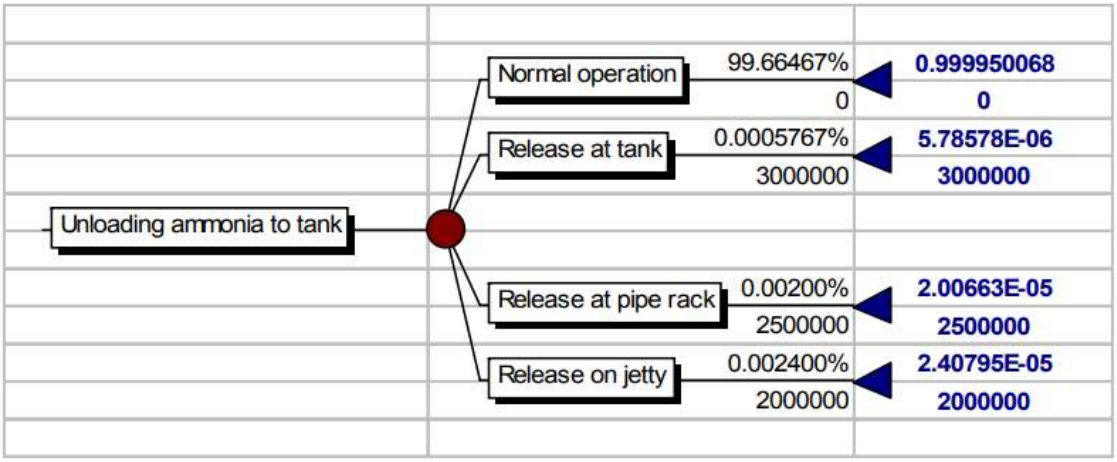
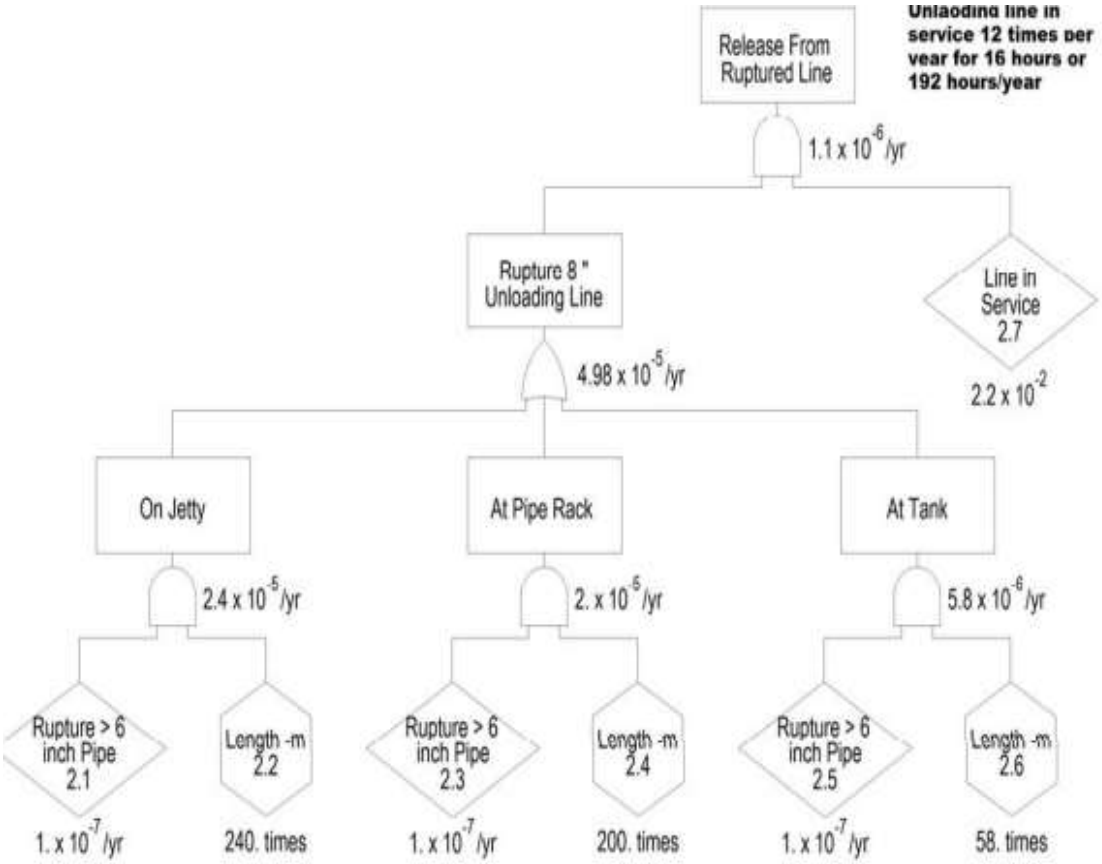


Figure 4.6.3: Sample of FTA Diagram For Unloading Line Rupture of Ammonia



(ii) Consequence Analysis

This is a method to determine the chance of the vulnerable resource, usually human beings, to attain the harmful effects of the identified hazard. The worst case of the harmful effect is fatality. Consequence analysis can be divided into 3 steps namely:

- Source analysis
- Exposure analysis
- Dose analysis

(iii) Risk Estimation

The three principal factors that determine the risk posed by an industrial activity are:

- The chance of attaining serious harm due to the occurrence of the major hazards such as fire, explosion and / or toxic release;
- The probability of occurrence of the hazard;
- The population within the affected region where the effects of the occurrence of the major hazards can be felt.

Combination of the first two factors in the risk estimation will result in individual risk values and combining all the three factors will result in societal risk values. Where relevant, the triggering of secondary events or domino effects shall be assessed too.

4.6.3 Outputs

The main objective of this risk assessment is to determine the individual and societal risks values and to determine the acceptability of these risks.

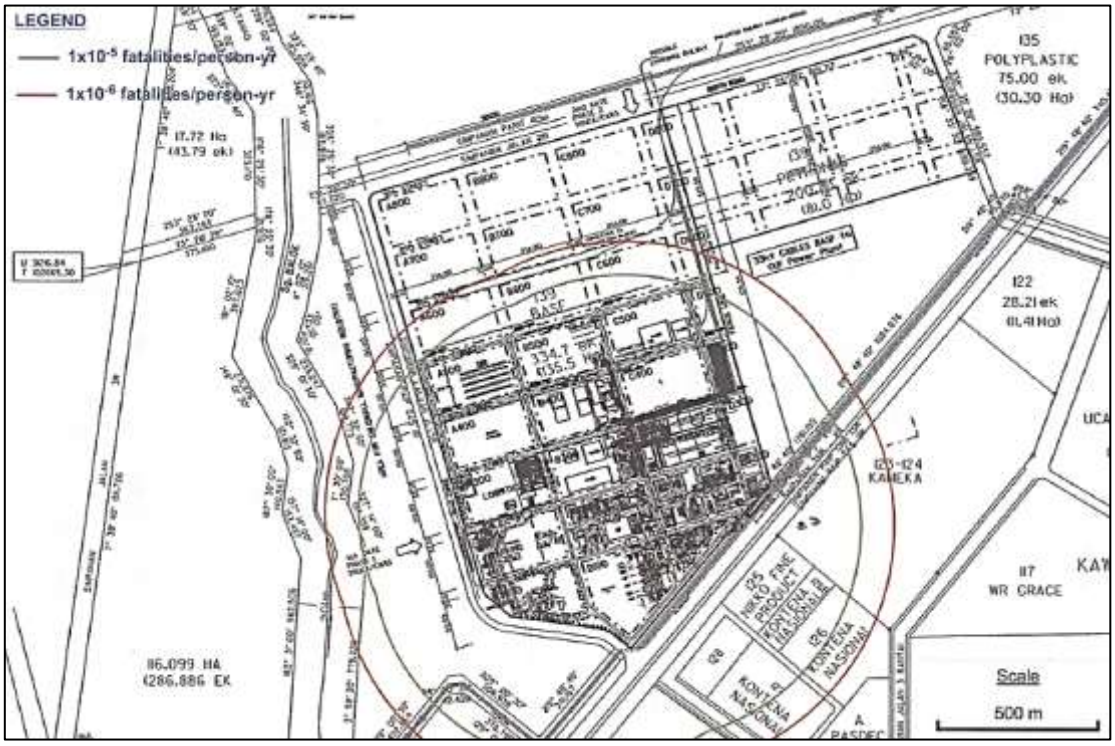
(i) Individual risk

Individual risk represents the frequency or probability of an individual dying due to the occurrence of the hazardous event. The individual is assumed to be unprotected and to be present during the total exposure time. The individual risk is usually presented as a contour lines on a map as illustrated in **Figure 4.6.4**.

(ii) Societal Risk

Societal risk represents the frequency or probability of having an accident with N or more people being killed simultaneously. The people involved are assumed to have some means of protection. The societal risk is presented as an F-N curve, where N is the number of deaths and F is the cumulative frequency of accidents with N or more deaths.

Figure 4.6.4: Sample of Individual Risk Contours



(iii) Risk Tolerability

Outcome from the risk assessment is usually compared to the risk tolerability criteria so that a decision can be made whether the risk is broadly acceptable or tolerable or if it is unacceptable. The risk tolerability criteria recommended in the EIA Guidelines for Risk Assessment by DOE Malaysia (2004) are:

- The 1 x 10^{-6} fatalities / person per year individual risk contour should not encompass involuntary recipients of industrial risks such as residential areas, schools, hospitals and places of continuous occupancy, etc.
- The 1 x 10^{-5} fatalities / person per year individual risk contour should not extend beyond industrial boundaries.

4.7 PUBLIC HEALTH

4.7.1 Sources of Health Hazards

A health hazard may be biological, chemical or physical in nature.

Construction Stage

Among the common health hazards during construction stage are:

- Respiratory effects from exposure to gaseous and particulate pollutants such as particulate matters below 10 microns (PM_{10}), SO_2, NO_2 from fuel combustion machinery on sites.
- Vector-borne diseases (dengue fever, malaria which are caused by the unhygienic construction sites or living workers quarters). Water-borne and food-borne disease like cholera, typhoid and hepatitis A due to improper sewage and solid waste disposal in the workers' camp area.
- Physical injuries due to work accidents, road traffic accidents, noise-induced hearing impairment from exposure to vehicle or machinery noises.
- Accidents and explosion hazards from handling highly flammable materials on site (pipelines, storage tanks etc.).

Operation Stage

Among the common health hazards during the operation of a petrochemical plant are:

- Respiratory effects due to air borne pollutants which originate from the operation of a petrochemical plant as outlined in **Section 4.3** of this Guidelines.
- Health effects from ingestion exposure to various water borne pollutants in the discharged effluents and waterbodies as outlined in **Section 4.4** of this Guidelines.
- Cancer effects from exposure to carcinogens such as heavy metals, VOC etc.
- Physical injuries due to work accidents, road traffic accidents, noise-induced hearing impairment from exposure to vehicle or machinery noises.

- Accidents and explosion hazards from handling highly flammable materials on site (pipelines, storage tanks etc.).

4.7.2 Impact Assessment

The health risk assessment for EIA reporting is guided by the Guidance Document on Health Impact Assessment (HIA) in Environmental Impact Assessment published by DOE Malaysia (2012).

Health risk is an outcome of health hazard and exposure to that hazard. Approaches to health risk assessment are namely qualitatively or quantitatively.

Qualitative Assessment

Qualitative health risk assessment involves listing and describing the probable change in health outcomes or endpoints that would be realised due to the proposed project.

For example, inappropriate waste handling during the construction stage may lead to potential breeding of pests like rodents and disease vectors like mosquitoes and flies. However, the quantum of increase in the populations of rodents or mosquitoes or the subsequent increase in the prevalence of diseases associated with them, are not quantified.

Qualitative assessment also applies based on the comparison of the community air pollutant exposure levels with established ambient air guideline levels. If the air pollutant exposure levels are below the guideline levels, then the potential health impact is considered as minimum or insignificant.

Quantitative Assessment

Quantitative health risk assessment generates a risk value on the potential adverse health effects of human exposures to environmental hazards.

The assessment should contain the following:

- Hazard identification
- Dose-response assessment
- Exposure assessment
- Risk characterization

The application of quantitative assessment is mainly limited to the assessment of chemical hazards as biological and physical hazards do not lend themselves well to quantitative assessment. In such cases, qualitative assessment should apply.

4.7.3 Outputs

The main objective of this health impact assessment is to determine the acceptability of these health risks.

Acceptable health risk is a societal acceptance (those who are being subjected to the risk) level of risk, which is considered tolerable or as something people can live with comfortably. The risk tolerability criteria recommended in the Guidance Document on HIA in Environmental Impact Assessment by DOE Malaysia (2012) are:

- Hazard Index is a summation of the hazard quotients for all chemicals to which an individual is exposed. For non-carcinogenic risk, a Hazard Index value of 1.0 or less than 1.0, indicates that no adverse human health effects (noncancer) are expected to occur.
- For carcinogenic risk: values of 10^{-6} to 10^{-4} are given as a range of “generally acceptable risk”.

Table 4.7.1: Sample of Health Index Calculation for Predicted Non-carcinogenic Health Effects of Air Pollutants

Air Pollutant	Max Ambient Concentration (mg/m^3)	Chronic Daily Intake (mg/kg/day)	Reference Dose (mg/kg/day)	Health Index
A1 - Discrete Receptor – Proposed Plant Site				
Nitrogen Dioxide (NO_2)	0.072	4.58×10^{-3}	1	4.58×10^{-3}
Hydrogen Chloride (HCl)	0.0072	4.57×10^{-4}	5.72×10^{-3}	7.98×10^{-2}
Hydrogen Fluoride (HF)	0.0011	6.97×10^{-5}	6.00×10^{-2}	1.16×10^{-3}
Sulphur Dioxide (SO_2)	0.0758	4.81×10^{-3}	3.00×10^{-2}	1.60×10^{-1}
Total Hazard Index				**0.25**
A2 – Sensitive Receptor				
Nitrogen Dioxide (NO_2)	0.028	1.79×10^{-3}	1	1.79×10^{-3}
Hydrogen Chloride (HCl)	0.0012	7.61×10^{-5}	5.72×10^{-3}	1.33×10^{-2}
Hydrogen Fluoride (HF)	0.0002	1.27×10^{-5}	6.00×10^{-2}	2.11×10^{-4}
Sulphur Dioxide (SO_2)	0.0273	1.73×10^{-3}	3.00×10^{-2}	5.77×10^{-2}
Total Hazard Index				**0.07**

4.8 WASTE GENERATION

4.8.1 Sources of Wastes

Construction Stage

Typical type of wastes during construction stage include:

- Excavation spoils / unsuitable soils
- Biomass materials
- Construction wastes – timber, cut piles, concrete, scrape metal etc.
- General solid wastes
- Scheduled wastes. Examples: SW102 (waste of lead batteries), SW305 (spent lubricating oil), SW306 (spent hydraulic oil), SW408 (contaminated soil, debris or matter resulting from cleaning up of chemical, mineral oil scheduled wastes spills), SW409 (disposed containers, bags or equipment contaminated with chemicals, mineral oil or scheduled wastes), SW410 (rags, plastic, paper or filters contaminated with scheduled wastes), SW421 (mixture of scheduled wastes), SW422 (mixture of scheduled and non-scheduled wastes).

Operation Stage

Petrochemical plant generates a variety wastes stream in its operation stage. These wastes basically can be classified into 2 main groups namely:

- Non-hazardous / domestic wastes such as scrap metals, plastic and paper wastes etc.
- Hazardous / scheduled waste which consists of some toxic organic or heavy metal content.

Abandonment Stage

At any stage of project abandonment, sorting and management of wastes are anticipated and these wastes can include:

- Equipment and machineries.
- Non-hazardous / domestic wastes such as scrap metals, plastic and paper wastes etc.
- Hazardous / scheduled waste, consists of some toxic organic or heavy metal content.

Example 3

Scheduled Waste Generation From Ethylene Cracker

Relatively little solid waste is generated in steam cracking process when running on gas or naphtha. The bulk of steam cracker solid waste is organic sludge and coke, but there are also specific generations of spent catalyst, spent adsorbents and solvent purges. In addition, there are generic wastes, such as spent oil, oil filters / cartridges and air-drying adsorbents.

Organic sludge: It is a liquid, pasty or solid materials collected during the normal operation, start-up, shut-down drainage and cleaning of the unit. They typically arise from API separator, the quench oil system, spent methanol, spent lubricating oil, bottoms drains of vessels and settlers, and polymeric material removed from pump strainers and filters.

Spent catalysts: Catalysts (from acetylene, butadiene, and steam cracked naphtha hydrogenation units) have an economic lifetime of roughly 5 years. Spent catalysts are generally sent for recovery of the noble metal.

Spent adsorbents: Drying adsorbents (alumina, molecular sieves) have a typical economic lifetime of 3 – 4 years. They are usually disposed as scheduled waste.

4.8.2 Impact Assessment

The key consideration in the waste assessment includes:

(i) Evaluation and list the type and nature of wastes.

(ii) Estimation of the volume of wastes to be generated.

(iii) Assessment on the proposed handling, storage, transportation and disposal / recovery / reutilisation / recycling method and the potential environmental impacts.

Some of the potential environmental impacts associated with waste generation and handling on site are:

(i) Soil / ground water contamination due to improper storage area or improper disposal method of wastes.

(ii) Water quality deterioration due to untreated leachate from the waste storage area into the nearby waterbodies.

(iii) Odour problem.

(iv) Health risk to the workers and the nearby residents.

4.8.3 Outputs

The main objective of the impact assessment on waste generation is to determine the significance of the effects on existing support resources (example: licensed facilities for scheduled wastes) or the potential impact for on-site storage (example: on-site secured landfill).

4.9 SOCIO ECONOMIC

4.9.1 Socio Economic Concerns

Socio economic concerns are usually gathered and verified through stakeholder engagements. Analysis of the data and information gathered during stakeholder engagement should determine the key social and institutional concerns; identify the key stakeholder groups and determine how relationships between the groups will affect or be affected by the project; and document expectations and proposals from the groups.

Some of the potential key socio economic concerns are:

(i) Lifestyle impacts: on the way how the project will affect the people's lifestyle.

(ii) Cultural impacts: the effect on customs, values, religious belief and other elements which make a social or ethnic group distinct.

(iii) Community impacts: on infrastructure, services, voluntary organizations, activity networks and unity.

(iv) Amenity / quality of life impacts: on sense of place, aesthetics and heritage, perception of belonging, security, liveability and aspiration for the future.

(v) Health impacts: on mental, physical and social well-being.

It is also important to consider how these socio economic concerns may vary in accordance with different stages of a petrochemical plant life cycle as follows.

Pre-construction Stage

During this stage where the project is conceived, project notification and announcement to the community are initiated. Some of the anticipated concerns are changed expectation or fear about the community and its future, increase or decrease in the nearby property or land value, fear of land acquisitions and concerns about the environmental, social and health impacts.

Construction Stage

The construction of a petrochemical plant normally will raise concerns associated with environmental impacts such as noise, dust generation, traffic congestions and other associated hazards that may affect the quality of life of the nearby community. Some projects may require influx of large group of foreign workers which may put a strain on the existing infrastructure and the difference in culture and lifestyle may raise concerns on community unity and cultural values.

Operation Stage

The socio economic concerns during operational stage, may be associated to safety and health hazards. During this stage, the project can have social benefits by offering economic and employment opportunities to the locals.

Abandonment Stage

During decommissioning and abandonment stage of a project, associated concerns may be related to the livelihood (loss of jobs and businesses) and health of the local community.

4.9.2 Impact Assessment

The socio economic impact assessment may use a semi-qualitative assessment approach to describe and evaluate impacts.

Factors taken into account to establish impact significance will include probability, spatial extent, duration and magnitude of the impacts in addition to the sensitivity of receptors (whether impacts are likely to be disproportionately experienced by vulnerable groups). Indirect socio economic impacts (i.e. induced effects) will also be assessed using the same approach.

It is suggested that the followings are considered for socio economic impact assessment:

(i) Assessment is based on the analysis of information gathered from issues scoping, baseline profiling and past experiences to predict possible socio economic concerns and the magnitude of these concerns.

(ii) Determine project activities and receptors interaction.

(iii) Assess the views and perception of the affected stakeholders. The findings mainly from surveys and FGDs may be contentious and often skewed. Therefore, the assessments should have overall on-the-ground judgements, even after the surveys are interpreted by the Qualified Person.

(iv) Identifying trade-offs between the adverse and beneficial impacts of a proposed development is part of this analysis.

(v) Mitigation includes strategies, plans and programmes to reduce, avoid or manage predicted adverse impacts.

4.9.3 Output

Land and property acquisition and / or relocation of communities shall be prioritised and settled first by proponent prior to EIA submission. Compatibility with surrounding land use shall be verified next.

Output of the impact assessment may be presented in risk matrix tabulation or in discussion format in the EIA reporting.

4.10 PREDICTION METHODS AND TOOLS

There is a wide range of predictive tools and models for evaluation and prediction of impacts (**Table 4.10.1**). Among the common methods and tools are:

(i) Expert opinion.

(ii) Consultations and questionnaires.

(iii) Checklists.

(iv) Spatial analysis.

(v) Network and system analysis.

(vi) Matrices.

(vii) Carrying capacity analysis.

(viii) Mathematical and computer modelling.

(ix) Case studies.

Table 4.10.1: Examples of Impact Assessment Prediction Methods and Tools

Impact Assessment	Prediction Methods and Tools	Output
Air Quality	Dispersion model based on gaussian plume - use for screening or refined modelling. Examples: ISCST3, AERSCREEN, AERMOD, CALPUFF	Contour of air pollutants dispersion for various scenarios. Zone of impact on land use map.
Water Quality	Dispersion model for screening or refined modelling on water pollutants dispersion. Examples: QUAL2K, Delft3D-Flow, MIKE 21, WASP7	Graph or dispersion contour of water pollutants over spatial for various scenarios. Zone of impact on land use map.

Impact Assessment	Prediction Methods and Tools	Output
Hydraulic and Hydrodynamics	Guidelines for Preparation of Coastal Engineering Hydraulic Study and Impact Evaluation by DID Use of hydraulic and hydrodynamics 2D/3D modelling software Examples: Delft3D-Flow, MIKE 21	Changes in the wave, water level and current flow and direction for various scenarios. Sediment transport and coastal morphology changes.
Erosion and Sedimentation	Revised Universal Soil Loss Equation (RUSLE) Modified Universal Soil Loss Equation (MUSLE) Computer models / numerical calculations	Soil loss rates and sediment yield. Erosion risk and potential soil loss maps.
Hydrology	Hydrological analysis in accordance with Urban Stormwater Management Manual for Malaysia 2nd Edition (MSMA-2) by DID Examples: HEC-HMS, HEC-RAS, FLO-2D, TUFLOW, EXTRAN and Storm Water Management Model (SWMM)	Estimate peak flood, runoff, watershed analysis, flood plain hydraulics, etc. Flood risk map.
Noise	Numerical calculations / computer models Computer models for multiple and different type of sources, barrier, terrain and meteorological considerations Examples: CadnaA, SoundPLAN	Predicted exposure and project boundary noise levels. Compliance to guideline levels. Zone of impact on land use map.

Impact Assessment	Prediction Methods and Tools	Output
Vibration	Numerical calculations	Predicted exposure levels. Compliance to guideline levels. Zone of impact on land use map.
Risk Assessment	EIA Guidelines for Risk Assessment by DOE (2004) – qualitative or quantitative Computer models for consequence modelling for multiple and different type of hazard sources Examples: CIRRUS, SCOPE, KAMELEON etc.	Predicted exposure risk levels. Compliance to risk acceptance criteria.
Public Health	Guidance Document on HIA in Environmental Impact Assessment by DOE (2012) – qualitative or quantitative	Predicted exposure risk levels. Compliance to risk acceptance criteria.
Waste Generation	Surveys, stakeholder engagements Assessment on proposed wastes management strategies etc.	Determine significance of the effects on existing support resources. Potential impact for on-site storage.
Socio Economic	Surveys, stakeholder engagements Comparative evaluation Risk calculations	Risk matrix with socio economic concerns and the magnitude of impact.

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.

Simple methodology is preferred, though this depends on the complexity of the potential impacts. The chosen method shall be appropriate to address the potential impact, taking into consideration the local conditions of the site.

EIA shall be scientifically and technically sound and whenever necessary, quantitative impact prediction on the more significant impacts should be carried out.

Impact prediction using modelling tools has the capability to capture the impacts under various scenarios, either for short, mid to long term period, normal operation or the worst-case scenario. The outputs shall be presented in a concise manner and all uncertainties should be discussed.

If computer modelling is carried out, the following information is required:

(i) Name and description of method / model.

(ii) Model set-up.

(iii) Data collection and analysis.

(iv) Calibration and validation.

(v) Detail of scenarios for modelling.

(vi) Presentation of results (raw data, table form, graphs, contours).

(vii) Limitations in data collection or method chosen.

Technical reports, references, data analysis and raw data, where applicable, shall be included as appendix in the EIA Report to support the impact assessment methodology.

The main reporting on impact assessment in the EIA Report shall include the predicted results and outputs of respective studies, which have to be in sufficient technical details to support the assessment. It shall also be written in a manner that is easily understood by decision makers and the public.

4.11 EVALUATION CRITERIA

The method to determine the level of significant impact is to benchmark the results against the stipulated and current evaluation criteria which are namely the standards or guidelines limits imposed by DOE and / or various GAs (refer to **Table 4.11.1**).

In situations where there are no local standards or guidelines, regional or international references can be adopted, based on expert opinion of the Qualified Person. However, the chosen criteria shall be suitable and relevant to local conditions.

Table 4.11.1: Common Standards and Guidelines Limits

Impacts	Evaluation Criteria
Air Quality	Emission standard limits: Environmental Quality (Clean Air) Regulations 2014 Ambient air: New Malaysian Ambient Air Quality Standards
Water Quality	Effluent standard limits: Environmental Quality (Industrial Effluent) Regulations 2009 Environmental Quality (Sewage) Regulations 2009 Inland Waters: National Water Quality Standards for Malaysia National Standard for Drinking Water Quality (MOH 2004) Marine Waters: Malaysia Marine Water Quality Criteria and Standard Groundwater: Site Screening Levels (SSLs) in the Contaminated Land Management and Control Guidelines No. 1: Malaysian Recommended Site Screening Levels for Contaminated Land (DOE 2015)

Impacts	Evaluation Criteria
Discharged water from Silt Trap / Sediment Basin	TSS: 50mg/L or 100mg/L, depending on locality Turbidity: 250 NTU
Noise	The Planning Guidelines for Environmental Noise Limits and Control (DOE 2007)
Vibration	The Planning Guidelines for Vibration Limits and Control (DOE 2007)
Risk Assessment	Risk criteria from EIA Guidelines for Risk Assessment (DOE 2004): • Voluntary individual risk: 1 x 10^{-6} fatalities/person per year • Involuntary individual risk: 1 x 10^{-5} fatalities/person per year
Public Health	Risk criteria from Guidance Document on HIA in Environmental Impact Assessment (DOE 2012): • Hazard Index for non-carcinogenic risk: ≤ 1.0 • Lifetime carcinogenic risk: 10^{-6} to 10^{-4}

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 criteria required for environmental assessment and compliance.

The conclusion of an impact assessment shall present the magnitude of potential impact as highlighted in **Box 10**.

Box 10

Outcomes from Impact Assessment

No Impact: This scenario occurs when there are very low to no sensitive receptors in the vicinity of the project to receive the impacts. Examples are communities living very far away, and they are not within the zone of impact. Another scenario is when there are terrain constraints such as steep slopes, but the Project Proponent has redesigned the layout without affecting these areas.

Significant Impact: This scenario is based on the predictive results. In the assessment, if the results showed that the project will generate detrimental impacts, then mitigation measures will have to be provided to address the issues. Any residual impacts shall also be clearly stated in the EIA.

Non-significant Impact: Impacts will inevitably occur in project development but it may not result in significant exceedance of the acceptance criteria. An example is discharge of runoff water with suspended solids due to minor soil movement at stabilised construction area which could meet Class II water quality limits. Under this scenario, the impact is classified as non-significant, with the level of impact abiding by the stipulated criteria.

CHAPTER 5

ENVIRONMENTAL IMPACT ASSESSMENT: MITIGATION MEASURES

5.1 INTRODUCTION

The focus of this Chapter is on the pollution prevention and mitigation measures (P2M2) to sustain the integrity of the project and its surrounding areas, through:

(i) Avoidance of negative impacts by selection of best options / alternatives.

(ii) Adoption of appropriate preventive measures and best management practices (BMPs) to reduce and minimise the impacts, when an adverse impact cannot be avoided.

(iii) Ensure residual impacts are kept within acceptable levels.

5.2 APPLICATION OF P2M2

The core principles of P2M2 are to reduce environmental degradation and pollution through management measures best suited to the site conditions to preserve the integrity of the site and to ensure public safety.

The general approach of P2M2 is by means of the following:

(i) Extent of P2M2 shall correspond to the degree of significance of the predicted impact. Once an impact is identified as significant, P2M2 shall be recommended in the EIA Report. For minor issues, simple management actions will suffice, e.g. water browsing for dust control at site and hoardings for noise.

(ii) Priority shall be given to control at source, than to rectify the impacts later on.

(iii) Mitigation has to be site and project-specific. P2M2 need not be complex and costly, but shall instead be practical, easy to implement and effective.

(iv) P2M2 shall include adequate explanations based on the design and function; and supported by diagrams, illustrations, photos and maps. The technical reports and specifications of the P2M2 shall be included as an appendix in the EIA Report.

(v) The use of new technology is encouraged if it can be proven to be effective in mitigating the impacts.

(vi) P2M2 require regular inspection, maintenance and rehabilitation. These shall be incorporated as part of the environmental management requirements of the project, including the allocation of sufficient budget for such a purpose.

(vii) Effectiveness of P2M2 shall be recorded and documented as part of the monitoring and audit programmes (refer to Chapter 6).

(viii) The Qualified Person shall propose BMPs, if deemed necessary.

(ix) P2M2 and BMPs shall be incorporated early into the overall project design and as part of the Environmental Management Plan.

The submission of the EIA Report and the pledge given by the Project Proponent shall reflect a commitment towards ensuring the P2M2 are implemented during all stages of work activities. These efforts shall include but not limited to measures, actions or due diligence in accomplishing the overarching goal of protecting the environment in project implementation.

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

LD-P2M2 is used to reduce the adverse land based impacts, if these cannot be avoided. Standard requirements for LD-P2M2 is listed in **Table 5.3.1** which is adapted from the EGIM 2016. All submissions shall be accompanied by relevant technical drawings and maps.

Table 5.3.1: Standard Requirements for LD-P2M2

Requirement	Information to be Included
Project Activity and Implementation	Phasing plan and implementation schedule. Description of construction activities. Construction method statements.

Requirement	Information to be Included
Information and Analysis on Project Development	Selected weather and rainfall data. Description of soil and geological characteristics (type, erodibility, hydrologic group, percentage dispersible material, excavation depth, etc.). Site runoff velocity and flow rates (pre- and post-development). 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. Description of adjacent areas that may be affected by land disturbance. List of drainage, streams and river onsite as well as receiving streams and rivers. List of proposed P2M2. Access roads and project components located outside of project boundary. Earthworks cut and fill volume. Biomass, construction waste and domestic waste management. Spill prevention and control plan. Hazardous waste management.
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, DOE, 2016.

5.3.1 Erosion Controls

Objective: To address soil erosion controls at source to reduce the impacts downstream affecting lowland communities and environmental sensitive areas (ESAs) near rivers and waterways.

Examples of P2M2:

(i) Establish proper scheduling and phasing of P2M2 implementation in accordance to the project implementations schedule.

(ii) Retain much of the natural vegetation by reducing the total worked area. Demarcate site and buffer areas.

(iii) Reduce the period of slope and cleared areas exposure.

(iv) Stabilise bare slopes and apply protective covers.

(v) Properly protect stockpile areas.

5.3.2 Stormwater Controls

Objective: To properly manage runoff from the project site to prevent localised flooding and risk of flooding downstream, especially during the rainy seasons. The EIA shall assess the impacts of the drainage system to intercept the rapid conveyance of stormwater by using a series of retardation methods from P2M2 and MSMA-2 designed to manage the volume of flows.

Examples of P2M2:

(i) Installation of temporary drains to minimise concentrated water flows during construction.

(ii) Channelling discharges with a series of check dams to reduce velocity and peak flows.

(iii) Size and capacity of temporary drains should be sufficient for at least a 10-year ARI storm event.

(iv) All drainage and waterway banks shall be stabilised, e.g. rock cover, turf reinforcement mats, etc.

(v) Proper stream crossing and culverts are required along waterways to prevent blockage or restriction in flows.

5.3.3 Sediment Controls

Objective: To ensure effective control of sediments in runoff to minimise risk of water pollution and reduce sedimentation in the receiving waterbodies.

Examples of P2M2:

(i) Installation of sediment controls such as silt fences, silt traps, sediment basins, barriers etc.

(ii) Retardation/capture structures and devices are designed to accommodate the calculated runoff volume to allow adequate time for suspended sediments to settle.

(iii) Use of active treatment systems such as flocculants, anionic polymers, etc. in constraint areas to accelerate entrapment and settlement of fine sediments.

(iv) Regular inspection and maintenance of the P2M2 to ensure the performance efficiency, especially after heavy storm events.

(v) Controls on spillage of materials and mud trekking from vehicles should include tyre washing.

5.4 AIR QUALITY

Objective: To minimise emission of fine dust and gaseous pollutants from construction and operation activities, and prevent impact of ambient air quality pollution.

Examples of P2M2:

Construction Stage

(i) Wet suppression along main logistic routes and earth stockpiles.

(ii) Clean up any spillage along logistic roads and at entrances/exits.

(iii) Periodical maintenance of vehicles and machineries to control dark smoke emissions.

Examples of P2M2:

Operation Stage

(i) Apply suitable Best Available Techniques (BAT) – references to Best Available Techniques Guidance Document on Productions of Petrochemicals and Guidance Document for Fuel Burning Equipment and Air Pollution Control Systems.

(ii) Apply suitable fugitive emission control – references to Guidance Document for Fugitive Emission Control and Guidance Document on Leak Detection and Repair.

(iii) Conduct performance monitoring on process controls.

(iv) Conduct performance monitoring on air pollution control systems – references to Technical Guidance on Performance Monitoring of Air Pollution Control Systems (DOE-APCS-5 First Edition 2006).

(v) Conduct continuous and / or periodical emission monitoring in compliance with Environmental Quality (Clean Air) Regulation requirements – further references to DOE requirement on Predictive Emission Monitoring System (PEMS) and Continuous Emission Monitoring System (CEMS).

5.5 WATER QUALITY

Objective: To minimise discharge of water pollutants to the receiving waterbodies, and to prevent impact to water pollution during construction and operation activities. Where possible, to maintain water quality at baseline conditions or better within the DOE prescribed limits.

Examples of P2M2:

Construction Stage

(i) Provision of toilet facility and maintenance in accordance to the National Water Services Commission (SPAN) requirements.

(ii) Provision of containment facility designed to contain 110% of the largest inventory for petroleum and liquid chemicals storage area. Containment facility shall be made from impermeable materials with spill recovery facility.

(iii) Provision of oil or chemical spill kit.

Examples of P2M2:

Operation Stage

(i) Separate drainage systems for effluent and stormwater.

(ii) Provision of first flush pit at process areas.

(iii) Apply suitable Best Available Techniques (BAT) in generation and treatment of sewage, process effluent and wash water– references to Best Available Techniques Guidance Document on Productions of Petrochemicals and Technical Guidance Document for on the Design and Operation of Industrial Effluent Treatment System (DOE-IETS-9 Sixth Edition 2015).

(iv) Conduct performance monitoring on process controls.

(v) Conduct performance monitoring on industrial effluent treatment systems – references to Technical Guidance Document on Performance Monitoring of Industrial Effluent Treatment Systems (DOE-IETS-1 Seventh Edition 2015).

(vi) Conduct continuous and / or periodical effluent quality monitoring in compliance with Environmental Quality (Sewage) Regulation and / or Environmental Quality (Industrial Effluent) Regulation requirements.

5.6 NOISE AND VIBRATION

Objective: To minimise noise and vibration disturbance to nearby receptors as well as to protect workers in high noise environment.

Examples of P2M2:

(i) Perimeter hoarding.

(ii) Provision of acoustic noise barrier / enclosure.

(iii) Provision of acoustic silencers.

(iv) Periodical maintenance of vehicles and machineries to control noise and vibration emissions.

(v) Schedule piling and blasting works during day time and week days.

(vi) Landscaping and natural buffers to assist in soften of noise effect.

5.7 WASTE MANAGEMENT

Objective: To reduce the amount of waste being generated from the project, and to ensure proper containment, collection, storage, management and disposal of these wastes during construction, operation and abandonment stages.

Examples of P2M2:

Solid Wastes

The measures for proper solid waste management include:

(i) Implementation of 4R (Reduce, Reuse, Recover and Recycle).

(ii) Provision of suitable and adequate temporary storage areas / bins.

(iii) Regular housekeeping.

(iv) Disposal at approved landfill.

Scheduled Wastes

P2M2 shall adhere to the Environmental Quality (Scheduled Wastes) Regulations 2005.

(i) Implementation of 4R (Reduce, Reuse, Recover and Recycle)

(ii) 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.

(iii) Scheduled waste notification, labelling, inventory and consignment to track and control movement of scheduled wastes.

(iv) Provision of oil or chemical spill kit.

(v) Scheduled waste management and disposal at licensed facilities using licensed transporters.

5.8 RESIDUAL IMPACTS

Impacts that persist even after all mitigation measures are judiciously undertaken, are termed residual impacts. The extent of residual impacts shall be clearly detailed in the EIA Report, and associated impact monitoring shall be recommended.

CHAPTER 6

ENVIRONMENTAL IMPACT ASSESSMENT: ENVIRONMENTAL MANAGEMENT PLAN

6.1 INTRODUCTION

The Environmental Management Plan (EMP) is a legal document prepared by the Project Proponent incorporating pollution prevention and mitigation measures (P2M2) and best management practices (BMPs) stipulated in the Conditions of Approval (COA) by the Department of Environment (DOE).

Other than mitigation measures, the EMP includes self-regulation requirements, an environmental monitoring plan and an audit programme to assess the effectiveness of the P2M2 implementation.

The EMP is a living document and has to be updated whenever there are major changes to the project design, layout or construction methods that could result in impacts not originally stated in the EMP.

Application of 5S in upkeeping with latest environmental requirement and improvement of project's environmental management. Refer **Box 11** for the principal of 5S.

6.2 EMP FRAMEWORK

During the EIA stage, the project may not have sufficient information of the project work plan to produce a comprehensive EMP. The EMP chapter in the EIA should only be an EMP framework for eventual morphing into a full EMP post the 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 format for the EMP shall be based on the requirements stated within the EGIM (DOE, 2016), and shall contain details from the LD-P2M2 Document, and the proposed monitoring and audit programmes.

Box 11

Application of 5S in Upkeeping Environmental Compliances

Seiri	Organise, Sort - eliminate things that are obsolete and not in used, and store them away.
Seiton	Set in Order, Neatness - arrange the items or information used regularly so that they can be easily accessible and quickly store.
Seiso	Clean, Shine - everything is checked and functioning properly.
Seiketsu	Standardise - develop routine or programme to organise work areas and processes.
Shitsuke	Discipline, Sustain - create a culture that follows the steps of 5S on a daily basis.

Note: 5S was developed in Japan by Hiroyuki Hirano

6.3 SELF-REGULATION

DOE has initiated a Guided Self-Regulation requirement for all prescribed activities during the project implementation stages. The project shall incorporate into the EMP the requirement of the Environmental Mainstreaming Tools.

This shall cover the seven environmental mainstreaming tools:

(i) Environmental Policy.

(ii) Environmental Budgeting.

(iii) Environmental Monitoring Committee.

(iv) Environmental Facility.

(v) Environmental Competency.

(vi) Environmental Reporting and Communications.

(vii) Environmental Transparency.

6.3.1 Environmental Policy

This refers to the Project Proponent's Environmental Policy and the conveyance of such policies throughout the organisation.

6.3.2 Environmental Budgeting

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

If the budget is not available during the EIA stage, the Project Proponent shall provide a pledge to allocate adequate budget for the project during the post-EIA stage to ensure compliance.

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

6.3.3 Environmental Monitoring Committee

The Project Proponent is required to identify and setup an Environmental Regulatory Compliance Monitoring Committee (ERCMC) at the policy level headed by the Chief Executive Officer (CEO) or organisation chairman.

At the working level, the Environmental Performance Monitoring Committee (EPMC) is chaired by a senior officer 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).

The organisation chart along with the roles and responsibilities of all relevant parties in charge of environmental management for the project in national and state parks shall be included in the EMP framework.

6.3.4 Environmental Facility

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

6.3.5 Environmental Competency

Training requirements are needed to ensure competency for environmental management for all relevant site personnel. The proposed training programme and requirements shall be included in the EMP framework.

6.3.6 Environmental Reporting and Communication

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

(i) Environmental Management Plan.

(ii) Environmental Monitoring Reporting.

(iii) Environmental Audit Reporting.

The mode of communication between the ERCMC, EPMC and the respective EMTs must be clearly defined.

Lines of communication between the Project Proponent, the EPMC and the relevant stakeholders, shall also be clearly defined. This is 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.

6.4 MONITORING AND AUDIT PROGRAMMES

The environmental monitoring and audit programmes are important components of the EMP. Monitoring and audit shall be implemented during the post EIA stage.

6.4.1 Monitoring Category

Environmental monitoring can be categorised into three main categories:

Performance Monitoring (PM)

(i) Relates to monitoring on the performance of treatment systems such as IETS, STS and APCS.

(ii) This shall be undertaken by Competent Person with expertise in the related treatment system.

Compliance Monitoring (CM)

(i) 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 (e.g. effluent, sewage, sediment basin).

(ii) This shall be carried out by Competent Person associated with accredited laboratory.

Impact Monitoring (IM)

(i) Impact monitoring may only be required in cases where there is a possibility that the impacts may still affect receptors outside of the project boundary despite implementation of P2M2. Samplings and measurements are usually taken either from the ambient air, water, noise and vibration and / or from sensitive recipients such as flora and fauna samples.

(ii) This shall be carried out by Competent Person associated with accredited laboratory.

6.4.2 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 to be 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 project, based on site conditions and types of development activities. **Table 6.4.1** shows a typical monitoring programme for a petrochemical project.

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

Table 6.4.1: Sample of Monitoring Programme for a Petrochemical Project

Types of Monitoring / Test Parameters	Sampling Point	Compliance Requirement	Monitoring Frequency
Compliance Monitoring			
Stack Emission VOC	Sampling port of scrubber stack	Second Schedule of the Environmental Quality (Clean Air) Regulation 2014: 150 mg/m^3 (indicated as TOC) for non-halogenated hydrocarbons	Quarterly
Effluent pH, Temperature, BOD, COD, Total	Effluent discharge from IETS	Standard B of Environmental Quality (Industrial	Monthly

Types of Monitoring / Test Parameters	Sampling Point		Compliance Requirement	Monitoring Frequency
Suspended Solids, Mercury, Cadmium, Chromium Hexavalent, Chromium Trivalent, Arsenic, Cyanide, Lead, Copper, Manganese, Nickel, Tin, Zinc, Boron, Iron, Silver, Aluminium, Selenium, Barium, Fluoride, Formaldehyde, Phenol, Free Chlorine, Sulphide, Oil and Grease, Ammoniacal Nitrogen, Colour			Effluent) Regulations 2009	
Noise Leq, Lmax, L10, L90	NB1	North Plant Boundary	Day time: 70 dB(A) Night time: 70 dB(A)	Quarterly
	NB2	East Plant Boundary		
	NB3	South Plant Boundary		
	NB4	West Plant Boundary		
Impact Monitoring				
Ambient Air VOC - Xylene	A1	Within Project Site	Arizona Ambient Air Quality Guidelines: Xylene: 5400 µg/m^3 @ 1 hour average	Quarterly
	A2	Taman Balok Makmur, South of Project site		

Types of Monitoring / Test Parameters	Sampling Point		Compliance Requirement	Monitoring Frequency
	A3	Kg. Gebeng, East of Project site		
Surface Water Temperature, pH, DO, Turbidity, BOD, COD, Total Suspended Solids, Ammoniacal Nitrogen, Oil and Grease, Total Coliform Count, Faecal Coliform Count	W1	Upstream of the small stream.	Class IIB and Class III of the NWQSM	Quarterly
	W2	Small stream near IETS discharge point		
	W3	Small stream before discharging to Sg Balok		
	W4	Upstream of Sg Balok		
	W5	Downstream of Sg Balok		
Groundwater pH, Temperature, Salinity, DO, Conductivity, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Se, Sn, V, Zn, VOC, TPH	G1	Upstream of Tank Farm	Baseline	Baseline to be conducted before commencement of operation Yearly or as per DOE requirement.
	G2	Downstream of Tank Farm, North		
	G3	Downstream of Tank Farm, South		
	G4	Upstream of Process Area		
	G5	Downstream of Process Area, North		
	G6	Downstream of Process Area, South		

6.4.3 Environmental Audit

Environmental auditing is a post EIA evaluation process to determine the effectiveness and performance of the mitigation measures put in by the Project Proponent to comply with the COAs.

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

The typical audit process involves:

(i) Pre-audit: Preparation of a pre-audit checklist and information request to the auditee. Submission of a notification of audit to DOE and auditee.

(ii) 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 which will be submitted to the DOE.

(iii) 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.

CHAPTER 7

ENVIRONMENTAL IMPACT ASSESSMENT: ABANDONMENT PLAN

7.1 INTRODUCTION

An Abandonment Plan is a document prepared by the Project Proponent detailing the overall decommissioning and abandonment strategy and plan once the project abandonment has been identified.

Box 12

When project is abandoned?

(i) Change of project development stages and / or phases.

(ii) Major maintenance or turnaround events during operation stage.

(iii) Temporary cease of activities due to change in project ownership or change in project contractor.

(iv) Temporary or permanent cease of activities due to change of government policies.

(v) Temporary or permanent cease of activities during construction stage due to challenges in project funding.

(vi) Temporary or permanent cease of activities during operation stage due to challenges in company financing.

(vii) Decommissioning and closure of facilities due to the ending of its designed life or at the end of their useful life.

(viii) Decommissioning and closure of facilities due to expiry of concession.

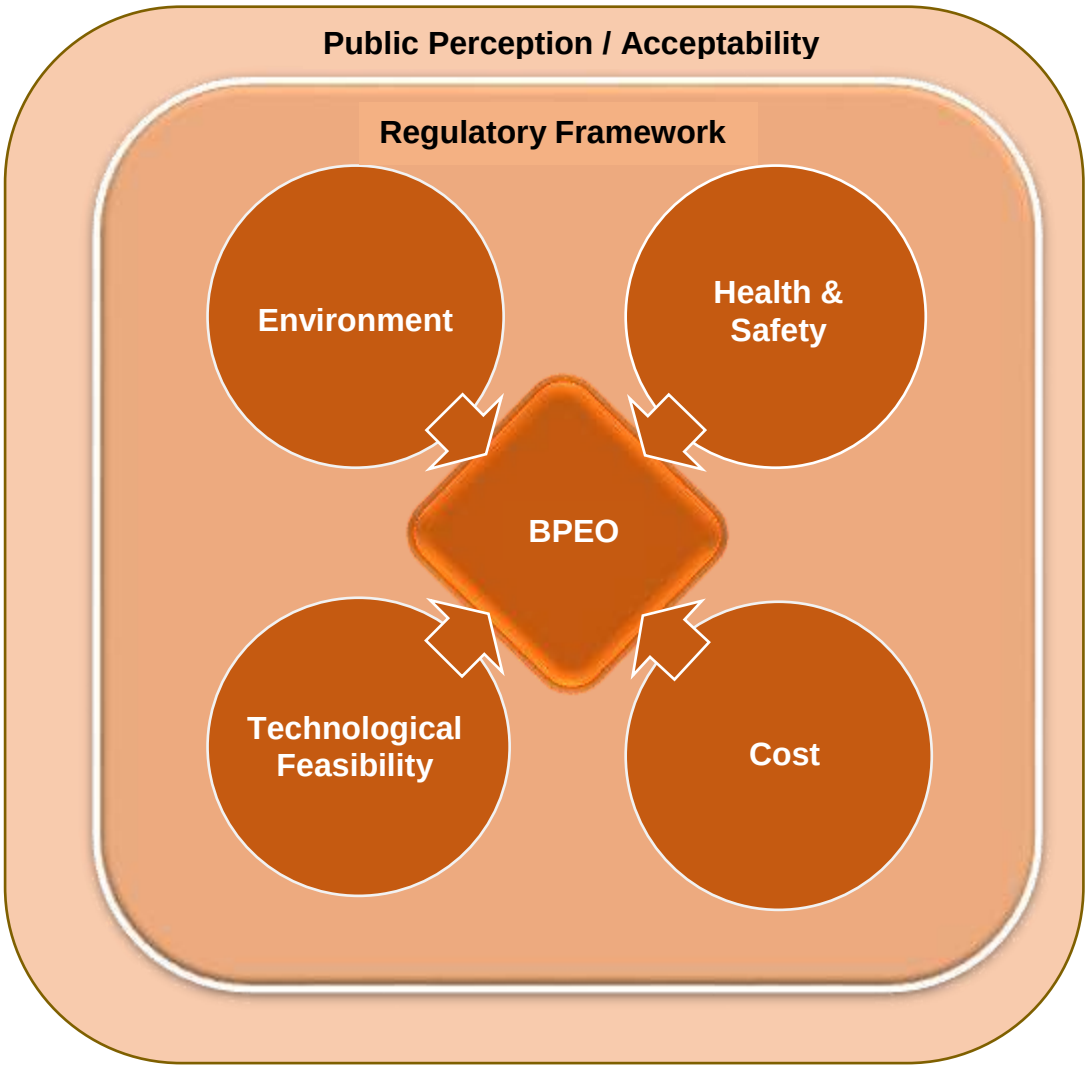
The plan shall also incorporate P2M2 and BMPs that should be implemented when performing the abandonment activities.

7.2 ABANDONMENT PLAN

7.2.1 Pre-Abandonment Activities

To determine the best decommissioning / abandonment option, a **Best Practical Environmental Option (BPEO)** assessment should be performed. This assessment shall be described and the outcome presented in the Abandonment Plan. **Figure 7.2.1** illustrates BPEO Concept.

Figure 7.2.1: Best Practical Environmental Option Concept



The process of decommissioning an industrial facility may raise complex issues. It is widely accepted that in selecting the “best” decommissioning option, it is essential that due consideration is given to the critical and inter-related requirements of human health and safety, environmental protection, technological feasibility and economic stewardship within the broader context of public perception / stakeholder acceptability. A BPEO assessment provides a means of determining which decommissioning option is the most suitable for a facility.

7.2.2 Abandonment Activities

During the abandonment phase of a project, the following activities are normally expected:

(i) Tendering process and awarding of contract for decommissioning and demolition work;

(ii) Removal and disposal of scheduled waste, demolition materials and refuse;

(iii) Disassembling equipment and plant;

(iv) Removal of plant piping, cabling, storage facilities and reusable components;

(v) Demolition of building and breaking up for removal;

(vi) Site levelling and filling; and

(vii) Site stabilisation / Rehabilitation.

Details of the selected or preferred decommissioning option shall be described in the Abandonment Plan.

At a minimum, the following aspects and associated management plans shall be presented in the Abandonment Plan:

(i) Procedures for dismantling or demolishing.

(ii) Procedures for managing excess materials and wastes that would be generated as a result of the decommissioning of the facility.

(iii) Identify all hazards and risks associated with the decommissioning activities and outline mitigation measures to minimize such hazards.

(iv) Emergency response and communication procedures to address concerns related to the decommissioning activities.

Potential environmental impacts associated with project Abandonment stage are suggested in **Table 7.2.1**.

Table 7.2.1: Example of Impacts Associated With Abandonment of Project

Environmental Indicator	Potential Impact During Project Abandonment
Air Quality	Emission of dust due to demolition works, site levelling and filling activities. Emissions from transportation of construction materials and wastes.
Erosion and sedimentation	Dismantling and demolition works may result in soil disturbance causing increase of erosion risks.
Water Quality	Demolition and removal of fuel / chemical storage tanks and associated pipe work and dismantling of effluent treatment plant which may lead to water contamination if the residues are not properly contained. Leaching from demolition works and mishandling of wastes and chemicals.
Noise	Noise from hacking, demolition and transportation works.
Wastes	A variety of wastes to be generated during decommissioning and demolition works. These wastes may include unused machinery, metals wastes, concrete wastes and other solid wastes. Hazardous materials may include unused chemicals, oil or fuel, and scheduled wastes. Improper handling and disposal may lead to land contamination and contamination of water resources.
Socio economic	Decommissioning and abandonment of a project may bring an end to the direct and indirect employment.

7.2.3 Post Abandonment Activities

Appropriate site remediation and restoration activities shall be described if residual site contamination (e.g. hydrocarbons in soil from past leaks and spills) is detected.

A post decommissioning monitoring programme should be conducted to assess environmental changes and implications of the selected decommissioning option and to monitor any potential residual impacts. Depending on the sensitivity of the site, additional survey may be conducted to monitor the recovery of the site.

7.3 REPORTING

The detailed Abandonment Plan shall be submitted to DOE for review and acceptance at **least three (3) months** prior to its implementation.

The format of Abandonment Plan shall comply with the associated guidance document to be issued by DOE.

Environmental Sustainability Report which shall include post abandonment's environmental monitoring, BMP inspections and wastes inventories is to be submitted to DOE office post project abandonment stage.

CHAPTER 8

EIA REPORTING AND REVIEW

8.1 INTRODUCTION

This Chapter provides the format and procedures for an Environmental Impact Assessment (EIA) Report to be submitted to the Department of Environment (DOE) for approval, after the completion of all other necessary studies and requirements.

8.2 EIA REPORT

8.2.1 EIA Report Format

The EGIM (DOE, 2016) provides the specifications and format for EIA reporting under Section 4.6 and Appendix 9 of the guideline.

The EIA Report shall typically include the following contents:

(i) Declaration from the Project Proponent and Qualified Person in the format detailed in Appendix 9 of the EGIM (DOE, 2016). The declaration must be printed in the respective company's letterhead and attached to the EIA.

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

(iii) 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).

(iv) Review of the policy, regulatory and legal requirements for the project (refer to **Chapter 1** of this EIA Guideline for details).

(v) Terms of Reference (TOR) for the EIA Study as endorsed by the DOE (refer to **Chapter 2** of this EIA Guideline for details). Endorsement letter from DOE to be attached as an appendix to the EIA Report.

(vi) 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. Key points are shown in **Box 13**.

Box 13

Key Points for Statement of Need

Among key supporting arguments for a project can include, but are not limited to the following:

- Increasing market demand for the products.
- Fulfilment of or adherence to the goals of national and state policies and plans.
- Social and economic benefits to society.
- Bringing new green and sustainable technology that will benefit the community and country.

(vii) Deliberation on the alternatives and project options (refer to **Section 2.4** of this EIA Guideline).

(viii) Detailed description of the project including site information, concept and breakdown of major components, material and manpower requirements, project activities and time schedule (refer **Table 8.2.1**).

(ix) Description of the baseline conditions (physical-chemical, biological and human environment) within the ZOS that may be impacted by the project (see **Chapter 3** of this EIA Guideline).

(x) 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 **Chapters 4 and 5** of this EIA Guideline).

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

(xii) Environmental Management Plan (EMP) incorporating the LD-P2M2, monitoring and audit programme (see **Chapter 6** of this EIA Guideline).

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

Table 8.2.1: Recommended Project Description in EIA Report

Project Details	Project title. Name and contact details of the Project Proponent. Name and contact details of EIA Team. Location of project (coordinates, lot no, district, etc.). Relevant map of project location and accessibility.
Location	General site plan including ZOS (5-km radius) Project boundary and layout (with coordinates). Description of location in relation to identifiable landmarks (e.g. city centres, main roads, towns, etc.).
Project Component and Design Details	Project details (land area, buffer, lots and land status). Project concept, layout and components. Technology use. Examples of similar project type and scale. Supported with drawings, illustration and diagrams.
Project Activities	Method statement for major project activities during pre-construction, construction and operational stages. Manpower requirements. Resource requirements (e.g. 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.

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.

8.2.2 Executive Summary

The Executive Summary provides a concise brief of the findings and recommendations from the EIA. It shall be written in non-technical language, both in Bahasa Malaysia and English, presenting the following information:

(i) Title of the project.

(ii) Name and contact details of the Project Proponent.

(iii) Name and contact details of EIA Team members.

(iv) Location of the project site.

(v) Relevant maps showing project location and sensitive receptors and extent of the ZOS.

(vi) Alternatives considered.

(vii) A tabulation of significant impacts and proposed P2M2 (format as detailed in EGIM (DOE, 2016)).

(viii) Description of monitoring and audit programme.

(ix) Conclusion to the Study.

Soft copy of the Executive Summary (PDF format) shall be submitted to DOE along with soft copy 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 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 (GAs) upon request.

8.2.4 Conclusion to the EIA Report

The Qualified Person shall provide a pledge that the EIA study is carried out professionally and that the recommendations for P2M2 to be implemented will be able to mitigate against the identified environmental impacts to an acceptable level to ensure minimal degradation of the environment.

The Project Proponent shall also provide a pledge that he has understood the studies and recommendations in the EIA, and shall carry out all P2M2 recommended in the EIA Report.

8.3 PUBLIC DISPLAY

A Second Schedule EIA will have mandatory requirements prior to the approval of the EIA Report. These include:

Public Engagement: Public engagement is mandatory for a Second Schedule EIA. This can take in many forms and the common approach is through focus group discussion or public briefing with the stakeholders within the ZOI. In the briefing, the Project Proponent and EIA Team shall present the project brief followed by a questions and answers session. All discussions will be recorded and reported in the EIA.

Public display and review of EIA Report: EIA Report will be displayed after submission of the EIA Report, for a period of a month whereby the public will have an opportunity to review and officially submit their responses and comments in writing to the DOE. Notification of the public display of EIA Report is published in two local newspapers and / or any other media as approved by DOE.

Display locations: The EIA Report will be displayed at selected locations (DOE office, public libraries and local authority offices) where the public can access and view the documents easily. The Project Proponent and Qualified Person can propose suitable locations for display to DOE.

Online display: All submitted EIA Reports will be uploaded to the DOE website for the duration of the review period.

8.4 EIA REPORT SUBMISSION AND REVIEW PROCESS

The EIA Report submission shall be in line with the steps and procedures outlined in the EGIM (DOE, 2016).

The EIA Report Quality Self-Assessment Tool (RQSAT) in the EGIM (DOE, 2016) can be used by the Project Proponent and the Qualified Person to assist in conducting self-check of the quality of the EIA Report prior to submission to DOE.

An EIA Checklist is appended in **Appendix G**, which is required to be filled in by the EIA preparer and included in the EIA Report.

When the EIA is approved, DOE will issue an approval letter with conditions of approval to the Project Proponent. Outcomes from an EIA review are presented in **Box 14**. If the EIA Report is rejected on the grounds that the EIA Report is lacking in key information and / or assessment or the revised EIA Report cannot be submitted within the EIA review timeline period, the revised or updated EIA Report can be submitted later when it is ready and the EIA review timeline will commence again.

Box 14

Outcomes from EIA Review Process

The possible outcomes of the EIATRC meetings are:

(i) Approval of the EIA Report, provided that the report meets with the requirements of Section 34A (3) of the Environmental Quality Act (EQA) 1974.

(ii) Rejection of the EIA Report, where the report does not meet the requirements of Section 34A (3) of the EQA 1974.

The decision on the EIA Report as issued by DOE marks the end of the EIA process.

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GLOSSARY

Air Pollution Control Systems (APCS)	Facility designed and constructed for the purpose of preventing or reducing the potential emission that causes air pollution, and includes the extraction system, control equipment and chimney.
Appointed Individuals (AIs)	Persons appointed to be part of the Technical Review Committee with expertise and specialist knowledge on specific fields/subjects to contribute to the technical review of a report.
Approving Authority/ Agencies	Any government ministry, agencies or department with the authority to approve a project and/or activity under their jurisdiction by law.
Auditing	An evaluation process carried out by an independent auditor to determine effectiveness and performance of P2M2 and to ensure compliance of a project with the environmental approvals.
Baseline Data	Site specific data pertaining to the existing environment (physical, chemical, biological and human). It establishes the existing and ambient conditions within the zone of study, before changes occur as a result of a project activities.
Best Available Technology (BAT)	The most current and advanced technologies and methods available for pollution prevention and management.
Best Management Practices (BMPs)	The best and practical structural or non-structural methods for the purpose of preventing or reducing pollution from a project activities.
Bill of Quantities (BQ)	Itemised list with estimated quantities of works and management requirements for a project issued to a contractor to quote.
Buffer Zone	An area designated around the boundary of a plant and/or adjacent to environmentally sensitive areas where no or limited development is allowed for the purpose to provide safety buffer and/or mitigate against any potential environmental risks.

Carrying Capacity	Maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water, and other necessities available in the environment. The ability of a built resource or natural resource to absorb changes and related physical development without degradation.
Competent Person	A person with the necessary skills and knowledge to carry out the specific technical task, usually gained through certification, work experience or training. This competent person related to environmental protection may be regulated by the DOE.
Emergency Response Plan (ERP)	A manual incorporating all measures, actions, roles and responsibilities for the project team to take action during emergencies and crisis, covers various scenarios that may occur during construction and operations.
Environment	The area (specific zone to be affected by the project), and all natural resources (physical, biological and human resources), people, economic development and quality-of-life values.
Environmental Impact Assessment (EIA)	A study to identify, predict, evaluate and communicate information about the impacts (both beneficial and adverse) on the environment of a proposed development activity and to detail out the mitigating measures prior to project approval and implementation.
Environmental Management Plan (EMP)	A legally binding document which spells out in concise details the environmental requirements and P2M2 as detailed in the EIA and LD-P2M2 as well at other information, e.g. environmental budget, monitoring and audit programmes and roles and responsibilities of the EMT.
Environmental Management Team (EMT)	Specialist team comprising of relevant personnel of a project with specific roles and responsibilities in the management of environmental matters at-site.

Environmental Sensitive Areas (ESA)	Refers to areas that are of critical importance in terms of the goods, services and life-support systems they provide such as water purification, pest control and erosion regulation. In addition, they also refer to areas that habour the wealth of the nation's biodiversity.
Guided Self-Regulation (GSR)	An initiative by DOE to cultivate environmental ownership and excellence in environmental commitment from the sectors regulated by DOE especially in regards to performance monitoring of pollution control measures, scheduled reporting, record keeping, competent persons and involvement of environmental professionals with specific roles.
Industrial Effluent	Any waste in the form of liquid or wastewater generated from the manufacturing process including the treatment of water for water supply or any activity occurring at any industrial premises.
Industrial Effluent Treatment System (IETS)	Facility with collection system, designed and constructed for the purpose of reducing the potential of the industrial effluent or mixed effluent to cause pollution.
Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2)	Document incorporating construction methods, processes, materials and practices intended to prevent, reduce or eliminate the generation of pollutants at the source (development area) during any land-disturbing activity through the protection of natural resources through incorporation of BMPs.
Land-Disturbing Activities	Activities such as clearing of trees or vegetation, excavating, raising or sloping of ground, trenching, grading and blasting.
Mixed Effluent	Any waste in the form of liquid or wastewater containing both industrial effluent and sewage.
Performance Monitoring	Routine monitoring of certain characteristics to provide an indication that an pollution control system is functional and capable of treating the pollutants generated.

Pollutants	Any natural or artificial substances, whether in a solid, semi-solid or liquid form, or in the form of gas or vapour, or in a mixture of at least two of these substances, or any objectionable odour or noise or heat emitted, discharged or deposited or is likely to be emitted, discharged or deposited from any source which can directly or indirectly cause pollution and includes any environmentally hazardous substances.
Pollution	Any direct or indirect alteration of the physical, thermal, chemical or biological properties of any part of the environment by discharging, emitting or depositing environmentally hazardous substances, pollutants or wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds, wildlife, fish or aquatic life, or to plants or to cause a contravention of any condition, limitation or restriction to which a licence under this Act 127 is subject.
Pollution Prevention and Mitigation Measures (P2M2)	The various methods (structural and non-structural) required to ensure that pollution does not occur or at least minimised as result of a project.
Qualified Person	A person appointed by the Director General of Environment or is certified by DOE under Section 34A (2B) to carry out an EIA study.
Waste	Any matter prescribed to be scheduled waste, or any matter whether in a solid, semi-solid or liquid form, or in the form of gas or vapour which is emitted, discharged or deposited in the environment in such volume, composition or manner as to cause pollution.
Zone of Impact	The area which will receive the impacts from the project.
Zone of Study	Boundary identified for the EIA Study which would be the main spatial area to carry out baseline data gathering, determine extent of modelling and assessment and other supporting studies.

APPENDICES

APPENDIX A

SAMPLE OF PROCESS DESCRIPTIONS

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SAMPLE OF PROCESS DESCRIPTIONS

The descriptions of the proposed project should constitute the concept, material needs (raw materials, final products, residues and / or by-products, and emissions or discharges to the environment), components, key activities, manpower requirements, processing capacity and implementation schedule.

1. Project Concept

The project concept is the introductory statements of the proposed project and shall be presented in a clear and concise manner in order for the reader to understand what issues the project intends to solve and what the Project Proponent intends to develop. Essentially, the key information that needs to be included in the project concept shall be, but not limited to the following:-

(i) Production capacity of the project;

(ii) Project location and size of area involved with boundaries clearly demarcated;

(iii) Explanation of the need of the project; and

(iv) Key components of the project including supporting facilities.

2. Project Components

The key project components shall be listed to give an overall picture of the entire project before zooming into detailed descriptions of each project component to prevent confusion, especially when each project components are described in several subsections. Example of project component for a typical petrochemical plant are, but not limited to the following:-

Reactors – which are usually the core operation of a process because they are responsible for converting the raw materials into products. There is a large range of reactor types, and designs may be very specific to a process but they are broadly classified by mode of operation, reaction phase and reactor geometry, generally.

Emission abatement equipment – is one of the most important parts of a petrochemical plant. A wide variety of end-of-pipe pollution control techniques is available for gaseous, liquid and solid wastes and many are used in common ways across the chemical industry. Many large sites make use of centralized environmental treatment facilities for waste water and waste gases treatment. Central treatment plants take advantage of economies of scale when installing and operation treatment equipment and they damp hydraulic and chemical fluctuations in the effluent feeds thus improving the stability of performance.

Energy Supply System – many petrochemical plant processes have a significant requirement for energy. The energy source depends on the process requirement and the local availability. Some plant may opt to generate its own power on site if there is limited supply from the utility supplier. Some of the typical power sources used by a petrochemical plant are direct-fired process furnaces, steam boilers and power generation in turbines. Electrical power is used for equipment such as pumps, mixers, compressors and lighting.

Cooling System – Most petrochemical plants would have an extensive cooling system; most commonly using water as the cooling medium, but with increasing use of air-cooling. Some cooling process which needs the cooling temperature below 20^{o}C, other cooling media such as ammonia, hydrocarbons and carbon dioxide will be considered. Cooling system typically involve some form of heat exchanger to remove heat from the process, a heat transfer medium and a mechanism for dissipating heat into the environment. The application of cooling system is highly dependent on site-specific conditions.

Refrigeration facility – Refrigeration process is provided where the manufacturing process require temperature below those that can be obtained with cooling water – usually by a central site facility. The source of cooling is distributed around the site using either chilled water (for temperature down to about 10^{o}C) or salt brines (down to -30^{o}C).

Storage and handling facility - The substance that may be stored as gases. Liquid or solids and the storage vessel may take various forms, for example drums, intermediate bulk containers or tanks.

Pump, compressors and fans systems – These are widely used in all installations to increase pressure and hence induce the movement of liquid or gases between equipment. There is a wide choice of equipment, much of it developed for particular applications, but there is a general distinction between centrifugal, rotating and reciprocal types.

Piping system – Pipes are used as conduits for the transfer of gases, liquid or solids in production process. The piping system is designed based on factors such as operating pressure, temperature and corrosivity of substances hence it is very specific to each installation. Pipe connections either have the purpose of joining

pipes or linking ancillary process equipment. These connections may be made by a variety of methods such as flanges, welding and threads.

Utility fluids supply system – A variety of gases is used in installations to facilitate the operation of equipment or to carry out specific activities. Installations normally will have distribution systems for such as gases as nitrogen, carbon dioxide and compressed air. Air, carbon dioxide and nitrogen are normally used for purging vessels and equipment which compressed air is typically used for cleaning purposes and actuating control valves and for operating instruments. Most plant will also have a variety of reticulation systems for different qualities of water (e.g. process water, de-mineralised water for boiler feed etc).

Workshop and maintenance facility – This facility is normally for repairs or keeping maintenance equipment and is normally located within close proximity to the main manufacturing lines.

Management and administrative office – This facility provides the office space for workers, engineers and management officers to work and perhaps for receiving visitors. Normally a worker canteen will be located next to the administrative office.

Laboratory facility – Although some simple sample analysis may be able to be done by operation technicians in the plant area, a petrochemical plant typically will have a laboratory where chemists can analyse samples taken from the plant. Such analysis can include analysis or determination of physical properties of the raw feed as well as the intermediate or final product to ensure quality specifications are met. Normally the laboratory facility will be located at a site separated from the production plants.

Sewage treatment plant - For large petrochemical plants with a large group of workers, it is normally equipped with an on-site sewage treatment plant to treat the sullage generated within the plant area. For some industrial park which provide a centralise sewage treatment facility, the project then can opt to connect to the existing sewer lines and channel the sullage to the third party operated sewage plant for treatment and need not install an on-site sewage treatment system.

3. Detail Descriptions of Project

This section mainly consists of a description of the plant, basis of plant and process technological properties. This section will dictate to what level of details the descriptions should be included, but not limited to, the following items:

(i) Proposed plant capacity (if the development is in phases, the capacity of each phases shall be detailed out).

(ii) Project development schedule including construction stage.

(iii) Land requirement for the project development (each phase of development shall be described and outlined clearly).

(iv) Details of proposed layout clearly demarcating the various facilities / units of the plant.

(v) Complete process flow diagram describing each unit, its processes and operations, along with the material and energy inputs and outputs (material and energy balance for the production of the petrochemical plant).

(vi) Details of proposed source-specific pollution control programme and equipment to meet the required standards.

(vii) Details on requirement of raw materials (e.g. naphtha/gas feedstock) its source, supply and storage at the plant. Also to include details on any requirement for pre-treatment of the feedstocks.

(viii) Details of the steam reforming unit (e.g. for synthesis gas process).

(ix) Details on the cracker unit and its yield (e.g. ethylene, propylene, butadiene etc. for steam cracking process).

(x) Details of catalytic reformers/aromatic plant process for its different products (e.g. benzene, toluene, xylene, p-xylene etc. for catalytic reforming process).

(xi) Details on special environmental precautions during process start-up, normal shutdown and power failure operations.

(xii) Details on point source emissions, fugitive emissions, flare management, etc.

(xiii) Details on management of air pollutants emission – specific plant requirement for least release rates, etc.

(xiv) Details on requirement of energy and water along with its source and authorization from the concerned department.

(xv) Details on water balance including quantity of effluent generated, recycled and reused. Efforts to minimize effluent discharge and to maintain quality of receiving water body.

(xvi) Details of effluent treatment plant, inlet and treated water quality with specific efficiency of each treatment unit in reduction in respect of all regulated environmental parameters.

(xvii) Details of the proposed methods of water conservation and recharging.

(xviii) Management plan for solid/scheduled waste generation including its composition/ characterization/ categorization, storage, utilization and disposal.

(xix) Details regarding infrastructure facilities such as sanitation, fuel storage, restroom, etc to the workers during construction and operation stage.

In the case of expansion of existing industries, remediation measures adopted to restore the environmental quality if the groundwater, soil, crop air, etc. are affected, and the proposed programme to comply to the acceptable environmental conditions.

Some of the project descriptions pertaining to the different sections of the plant shall be made reference to the following sections.

Feedstock Delivery and Acceptance

Petrochemical plants normally will accept liquid feedstock from refineries namely: naphtha, kerosene, and cracked LPG. Information to be furnished in the section of the EIA shall include, but not limited to, the following:

(i) Description of the feedstock delivery logistic – pipeline, land transport, ship etc (with percentage of breakdown if more than one types of delivery methods are used).

(ii) With pipeline transport, the alignment and design of the pipeline (with right of way) to be outlined in the report.

(iii) Descriptions on the feedstock properties (temperature, pressure, physical and chemical properties) and transport quantity (tonnes/day or tonnes/ month) etc.

(iv) Descriptions on the acceptance criteria of the feedstock: control upon acceptance, sample-taking, analysis, laboratory equipment etc.

Feedstock / Raw Material Storage

Information to be furnished includes the following:

(i) Description of feedstock / raw material storage – design, storage capacity (m^3 or metric tonnes), storage time etc;

(ii) Description of measures to mitigate any atmospheric emissions during the storage period (emissions may come from vent holes, during charging in of materials in to the storage container etc);

(iii) Description of measures to prevent fire in the area of feedstock / raw material storage.

Feedstock Pre-treatment

This section shall provide a brief process description on the pre-processing of feedstock before it is being processed in the main line. Some gas cracker plant will have a gas sweetening system for the removal of CO_2 and H_2S; and gas fractionation unit for the separation of methane from C_2/C_3 fraction. Some of the information to be furnished shall include, but not limited to the following:

(i) Description of the feedstock pre-treatment system.

(ii) Description of the output streams of the pre-treatment process (properties, quantity etc.).

(iii) Electrical, thermal or water supply needed for the pre-treatment system.

(iv) Identification and quantification of the waste generated during the pre-treatment process.

(v) Description of the storage design for the intermediate products.

Main Feedstock Cracking / Processing Reactor

Some of the information to be furnished shall include, but not limited to the following:

(i) Description of the cracking reactor / gas reformer system.

(ii) Description of auxiliary boiler(s) in the system.

(iii) Description of the cooling system.

(iv) Description on the feed water throughput, pressure, temperature and any pre-treatment requirement.

(v) If steam is used, the steam parameters such as throughput, pressure and temperature.

(vi) Efficiency of the reactor.

(vii) Details of fuel source or electrical power usage rate for the reactor.

Flue Gas Treatment and Air Pollution Control System

Some of the information to be furnished shall include, but not limited to the following:

Emission Related Information:

(i) Identification of all the sources of emission of air pollutants from all stages of production. A manufacturing (or production) process flow chart identifying all the emission generation points.

(ii) Reliable estimates of the air emission flowrate and emission quality from each source.

(iii) Quantification of fugitive emission source are to be provided.

(iv) Description of significant air emission parameters (maximum and average concentration) that will be removed prior to discharge to atmosphere.

Air Pollution Control System (APCS) Related Information:

(i) Description of the APCS technologies proposed and make comparison to the “best available technologies” or “best available technologies not entailing excessive cost” or state of the art technologies”.

(ii) Descriptions of how the APCS is able to remove all the significant air emission parameters to compliant level prior to discharge.

(iii) Reliable operational data from existing APCS operating elsewhere as evidence of the applicability of the proposed APCS technologies is able to treat the air emission to meet the compliance standards.

(iv) Process engineering design of the entire APCS including the following:

(v) APCS flowchart (block diagram) showing the entire APCS treatment components

(vi) Mass balance of the significant parameters

(vii) Detailed APCS engineering design with design calculations based on estimated emission flowrate and characteristics.

(viii) Working engineering drawings, Process and Instrumentation (P&I) diagram.

(ix) Performance monitoring procedure and instruments

A sample of air emission data to be provided in the EIA is outlined in **Table 1**.

Table 1: Example of Air Emission Parameters

Source of emission:	Stack 1
Stack height (m):	55 m above ground
Stack diameter (m):	0.8 m (inner diameter)
Flue gas flow rate (m^3/hr):	21,500 m^3/hr
Exit temperature of flue gas (^oC):	65 ^oC
Pollutant concentration in flue gas (mg/Nm^3):	SOx < 100 mg/Nm^3 NOx < 200 mg/Nm^3 Particulate matters < 50 mg/Nm^3

Note: All air emission concentration is expressed as mg/Nm^3 to the standard conditions for temperature and pressure for dry gas (volume at 273 K, 101.3 kPa) as specified in item 13(2) in the Environmental Quality (Clean Air) Regulations 2014.

Storm water Management System

Information to be furnished shall include, but not limited to, the following:-

(i) Descriptions of the storm water management of the project site during the construction stage (emphasis to be put on the Best Available Technologies or mitigation measures for erosion and sediment control)

(ii) Descriptions of the storm water management of the overall plant (it shall be separated from other water management system i.e. sewage or industrial effluent system)

(iii) Layout plans of storm water drainage systems indicating clearly the discharge location from the plant to any external drainage system or receiving water bodies.

Industrial Effluent Treatment System

Information to be furnished shall include, but not limited to, the following:-

Effluent Related Information:

(i) Identification of all the sources of effluent generation from all stages of production. A manufacturing process flow chart identifying all the effluent generation point to be provided.

(ii) Estimates of the flowrate and quality of the effluent generated from each source to be given.

(iii) Description on the significant effluent parameters (maximum and average concentration) that require treatment prior to be discharged.

Industrial Effluent Treatment System (IETS) Information:

(i) Description of the IETS technologies proposed and make comparison of the technologies to the type described as “best available technologies” or “best available technologies not entailing excessive cost” or “state of the art technologies”.

(ii) Descriptions of the IETS in removing all significant parameters to compliant levels prior to discharge. Reliable operation data from existing IETS operating elsewhere as evidence of the applicability of the proposed IETS technologies to treat the effluent to comply with the discharge standards.

(iii) Process engineering design of the IETS including the following:

(iv) A flowchart (block diagram) showing the entire IETS treatment components proposed to remove all the significant effluent parameters.

(v) Mass balance diagram of the significant parameters

(vi) Detailed IETS engineering design calculations of the entire IETS based on the estimated effluent flowrate and characteristics.

(vii) Working engineering drawings, process and instrumentation (P&I) diagram and performance monitoring procedure and instruments.

Solid and Scheduled Waste Generation

Information to be furnished shall include, but not limited to the following:-

(i) For each waste stream (either solid or scheduled waste) which is being generated by a new petrochemical installation (e.g. in the form of either solid, semi-solid or liquid) the following parameters have to be specified:-

- Amount of waste generated at full load operation (tonne/day, tonne/month and in tonne/year).
- To identify clearly which of those waste is classified under the schedule waste category and which is domestic waste.
- Clear specification of the scheduled waste is categorised under which scheduled waste code under the First Schedule (Regulation 2) of the Environmental Quality (Scheduled Wastes) Regulations 2005.

(ii) Detailed description of the chemical / physical properties, pollutant content of the waste generated.

(iii) If the wastes generated are being treated or processed on site, the following information will be needed :-

(iv) Description of the waste treatment installation (descriptions on the process, device used and any residue waste (either in the form of solid or liquid waste) generation will need to be provided)

(v) Plant capacity (tons of waste treated per day or per month)

(vi) Descriptions of the chemical and physical properties of the input and output stream of the waste

(vii) Energy and water demand for the operation of the on-site treatment plant

(viii) Intermediate storage of waste generated in the process (storage area, storage capacity and logistics)

(ix) Descriptions of the measures proposed to mitigate odour, dust and effluent from the storage area.

(x) Proposed method of recovery or disposal of the wastes.

Noise Generation

Information to be furnished shall include, but not limited to, the following:-

(i) List of machineries (both during construction and operation stage) which are expected to generate high noise levels. Some of the typical high noise generation machinery in a petrochemical plants are:

- Rotating machineries
- Conveyors belt
- Exhaust fans
- Pumps;
- Boilers / furnaces; gas turbines;
- Back up / black start generators;
- Cooling tower / ventilators
- Light and heavy transporting machines

(ii) Normally flare system is known to generate significant noise to the surrounding during the operation stage. Hence, the flare operation duration and the height should be specified in this chapter.

(iii) Quantification of the noise generation level and the noise generation duration of each significant noise source.

(iv) To described if there is any attenuation or mitigation measures incorporated into the design of the plant to minimise the noise level of the significant sources.

Process Control of Normal Operation and During Emergency Shutdown and Start-up After Shutdown

Information to be furnished shall include, but not limited to, the following:-

(i) Descriptions of continuous monitoring or detection system for process failure to be substantiated with PID such as:-

- Continuous emissions monitoring system (CEMS) for treated flue gas discharge with specification for cut-off valves indicating breach of specified limits
- Continuous monitoring system for treated effluent from the IETS with Descriptions of continuous monitoring specification for cut-off valves indicating breach of specified limits.

(ii) Descriptions of cut-off methods to stop the process flow in the event of detection of emergency outbreak i.e. pressure valves, dampers, gate valves etc.

(iii) Sequence of shutdown procedures in the event of emergencies outbreak i.e. disruptions in power supply, fire, natural disasters etc with priority be given on the containment of pollution in the form of untreated flue gas and untreated industrial effluent from escaping into the environment.

(iv) Specification whether there is any backup generator installed at site to supply back up power in the event of power disruption.

(v) Descriptions whether there is any temporary effluent containment system for storage of untreated effluent on site during the event of power disruption which prevent the IETS from functioning.

(vi) In the worst case scenario where uncontrolled release of pollutants (untreated flue gas or industrial waste water) to the environment, the period of uncontrolled release and the quantity of pollutants needs to be identified. (quantity as in kg/hr or kg/day) – tis information is necessary for subsequent impact assessment stage such as air pollutants and water pollutants dispersion modelling for such scenario;

(vii) Sequence of start-up procedures after the emergency shutdown.

(viii) Indication of probable frequency of shutdown or emergency breakdown based on track record of similar plant installed elsewhere or local scenes (i.e. historical record of power disruption, natural disasters etc).

Manpower Requirements

The manpower requirements for the proposed project shall be indicated for each stage of the project development, as this information is essential to predict the magnitude of the impacts arising from the influx of either local or foreign workers to the project site .

<u>During Construction Stage:</u>

Expected number of workers at site (to be indicated in different phases of construction is the construction is expected to take a long time or be separated into different phases such as site clearing, earth works, piling and plant installation, etc). The EIA report should identify if there is a need for the project to establish a workers camp on site and how the sewage will be treated.

<u>During Operation Stage:</u>

Expected number of workers in different categories i.e. management, semi-skilled, contract workers, general workers etc. The need for a permanent works quarters

on site and also how the sewage will be treated (either by a centralized treatment system or by channelling to the existing sewer network) shall be identified. The number of workers at different work shift shall also be described.

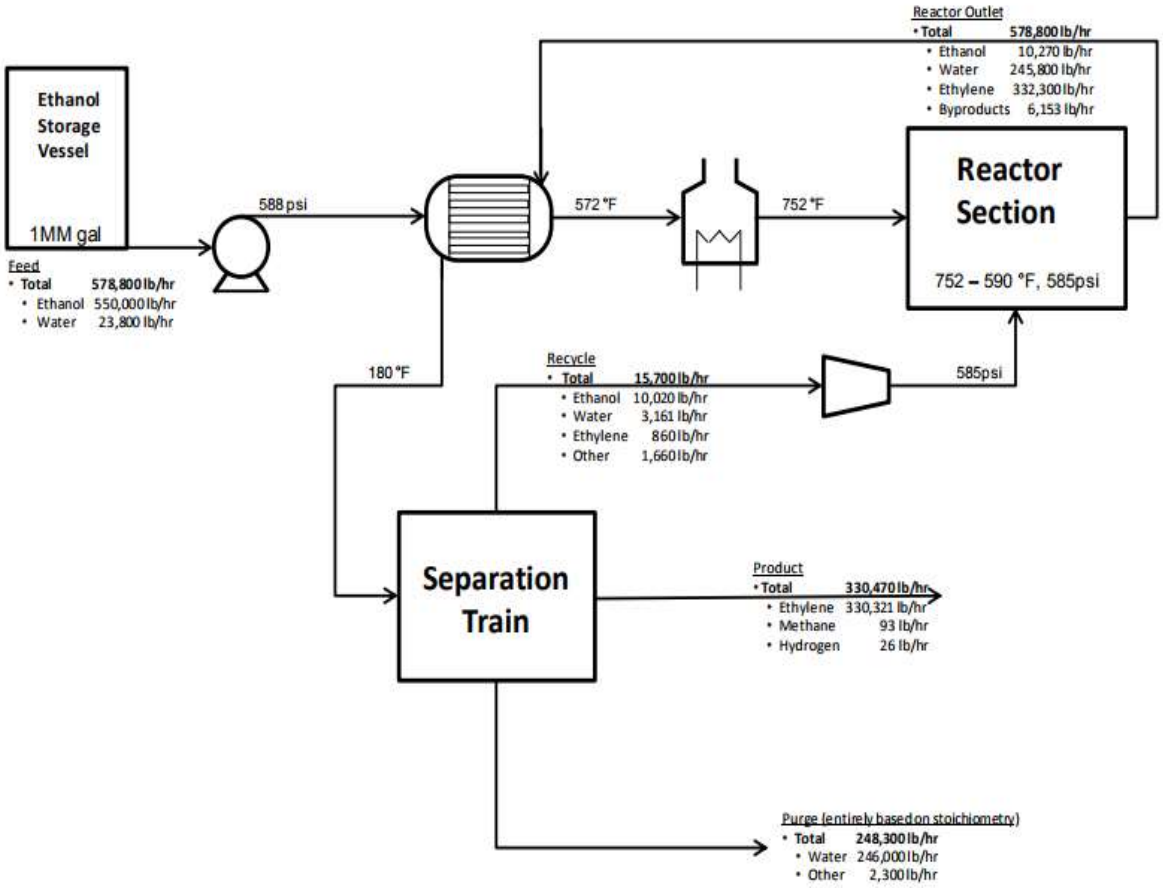
Material Balance

The general form of mass balance is defined as “The Mass That Enters A System Must, By Conservation of Mass, Either Leave The System or Accumulated Within The System”. It is an application of conservation of mass to the analysis of physical systems. By accounting for material entering and leaving a system, mass flows can be identified illustrating all inputs (raw materials, fuel, chemicals, etc.) and outputs (by-products, products, wastes either in gaseous, liquid or solid forms).

In the EIA context, this material balance diagram shall be provided and it shall indicate, in specific quantity of incoming and outgoing materials in units such as metric tonnes per day for solid, normal cubic meter per hour (Nm^3/hr) for gaseous materials and cubic meter per day (m^3/day) for liquid.

A typical material balance diagram is illustrated in **Figure 1**.

Figure 1: Typical Material Balance Diagram of an Ethylene Plant



APPENDIX B

LIST OF GUIDELINES AND GUIDANCE DOCUMENTS

List of Guidelines and Guidance Documents by Department of Environment

No	Guidelines / Guidance Documents	Source
1.	Best Available Techniques Guidance Document on Productions of Petrochemicals	www.doe.gov.my
2.	Contaminated Land Management and Control Guidelines No. 1: Malaysian Recommended Site Screening Levels for Contaminated Land, 2015	www.doe.gov.my
3.	Contaminated Land Management and Control Guidelines No. 2: Malaysian Recommended Site Screening Levels for Contaminated Land, 2015	www.doe.gov.my
4.	Contaminated Land Management and Control Guidelines No. 3: Malaysian Recommended Site Screening Levels for Contaminated Land, 2015	www.doe.gov.my
5.	Environmental Essentials for Siting of Industries in Malaysia, 2017	DOE Offices
6.	Environmental Impact Assessment Guidance in Malaysia, 2016	DOE Offices
7.	Environmental Impact Assessment Guidelines for Risk Assessment, 2004	DOE Offices
8.	Guidance Document of Health Impact Assessment (HIA) in Environmental Impact Assessment (EIA), 2012	DOE Offices
9.	Guidance Document on Implementation of Self-Regulation Initiative in Industrial Manufacturing Premises – Environmental Mainstreaming Tools, 2016	DOE Offices
10.	Guidelines on Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2), 2017	DOE Offices
11.	Technical Guidance Document for on the Design and Operation of Industrial Effluent Treatment System (DOE-IETS-9 Sixth Edition 2015)	Environment Institute of Malaysia (EiMAS)
12.	Technical Guidance Document on Performance Monitoring of Industrial Effluent Treatment Systems (DOE-IETS-1 Seventh Edition 2015)	Environment Institute of Malaysia (EiMAS)
13.	Technical Guidance on Performance Monitoring of Air Pollution Control Systems (DOE-APCS-5 First Edition 2006)	www.doe.gov.my
14.	The Planning Guidelines for Environmental Noise Limits and Control, 2007	www.doe.gov.my
15.	The Planning Guidelines for Vibration Limits and Control. 2007	www.doe.gov.my

APPENDIX C

SAMPLE OF ENVIRONMENTAL SCOPING MATRIX

Sample Environmental Assessment Matrix For A Petrochemical Plant

Key:

NA	Insignificant and excluded from Matrix	**I-D**	Potentially significant adverse environmental impact for which a design solution has been identified
I-T	Environmental impact that is potentially but on a temporary basis and will assume equilibrium after certain period of time	**I-R**	Residual and significant adverse environmental impact
I-M	Environmental impact that is potentially significant but there is insufficient data to make reliable prediction. Close monitoring and control is recommended	**I+**	Significant environmental enhancement

			PROJECT ACTIVITIES	PRE CONSTRUCTION			CONSTRUCTION							OPERATION				
				SURVEY	PROJECT DESIGN	ENGAGEMENT WORKS	MOBILISATION TO SITE	SITE CLEARING	EARTHWORK	CIVIL AND STRUCTURAL WORKS	MECHANICAL AND ELECTRICAL WORKS	TESTING AND COMMISSIONING WORKS	ABANDONMENT	NORMAL OPERATION	MAINTENANCE WORKS / OUTAGE PERIOD	ABNORMAL OPERATION	MATERIAL HANDLING AND STORAGE	ABANDONMENT
ENVIRONMENTAL COMPONENTS	PHYSIOCHEMICAL	LAND	Landforms															
			Soil Profile															
			Soil Composition															
			Slope Stability															
			Subsidence and Compaction															
			Seismicity															
			Flood Plains/Swamps															
			Land Use															
			Engineering and Mineral Resources															
			Buffer Zones															
		SURFACE WATER	Flow Variation															
			Water Quality															
			Drainage Pattern															
			Water Balance															
			Flooding															
			Existing Use															

Key:

NA	Insignificant and excluded from Matrix	**I-D**	Potentially significant adverse environmental impact for which a design solution has been identified
I-T	Environmental impact that is potentially but on a temporary basis and will assume equilibrium after certain period of time	**I-R**	Residual and significant adverse environmental impact
I-M	Environmental impact that is potentially significant but there is insufficient data to make reliable prediction. Close monitoring and control is recommended	**I+**	Significant environmental enhancement

			PROJECT ACTIVITIES	PRE CONSTRUCTION			CONSTRUCTION							OPERATION				
				SURVEY	PROJECT DESIGN	ENGAGEMENT WORKS	MOBILISATION TO SITE	SITE CLEARING	EARTHWORK	CIVIL AND STRUCTURAL WORKS	MECHANICAL AND ELECTRICAL WORKS	TESTING AND COMMISSIONING WORKS	ABANDONMENT	NORMAL OPERATION	MAINTENANCE WORKS / OUTAGE PERIOD	ABNORMAL OPERATION	MATERIAL HANDLING AND STORAGE	ABANDONMENT
ENVIRONMENTAL COMPONENTS	PHYSIOCHEMICAL	GROUND WATER	Water Table															
			Flow Regime															
			Water Quality															
			Recharge															
			Aquifer Characteristics															
			Existing Use															
		ATMOSPHERE	Air Quality															
			Air Flow															
			Climatic Changes															
			Visibility															
		NOISE	Intensity															
			Duration															
			Frequency															
	BIOLOGICAL	SPECIES AND POPULATIONS	Terrestrial Flora															
			Terrestrial Fauna															
			Aquatic/Marine Flora															
			Aquatic/Marine Fauna															

Key:

NA	Insignificant and excluded from Matrix	**I-D**	Potentially significant adverse environmental impact for which a design solution has been identified
I-T	Environmental impact that is potentially but on a temporary basis and will assume equilibrium after certain period of time	**I-R**	Residual and significant adverse environmental impact
I-M	Environmental impact that is potentially significant but there is insufficient data to make reliable prediction. Close monitoring and control is recommended	**I+**	Significant environmental enhancement

			PROJECT ACTIVITIES	**PRE CONSTRUCTION**			**CONSTRUCTION**							**OPERATION**				
				SURVEY	**PROJECT DESIGN**	**ENGAGEMENT WORKS**	**MOBILISATION TO SITE**	**SITE CLEARING**	**EARTHWORK**	**CIVIL AND STRUCTURAL WORKS**	**MECHANICAL AND ELECTRICAL WORKS**	**TESTING AND COMMISSIONING WORKS**	**ABANDONMENT**	**NORMAL OPERATION**	**MAINTENANCE WORKS / OUTAGE PERIOD**	**ABNORMAL OPERATION**	**MATERIAL HANDLING AND STORAGE**	**ABANDONMENT**
ENVIRONMENTAL COMPONENTS	**BIOLOGICAL**	**HABITATS AND COMMUNITIES**	Terrestrial Habitats															
			Terrestrial Communities															
			Aquatic Habitats															
			Aquatic Communities															
			Estuarine Habitats															
			Estuarine Communities															
			Marine Habitats															
			Marine Communities															
	HUMAN	**HEALTH AND SAFETY**	Physical Safety															
			Psychological Well-Being															
			Parasitic Disease															
			Communicable Disease															
			Physiological Disease															
		SOCIAL AND ECONOMIC	Employment															
			Property / Relocation															
			Education															
			Utilities / Amenities															

Key:

NA	Insignificant and excluded from Matrix	**I-D**	Potentially significant adverse environmental impact for which a design solution has been identified
I-T	Environmental impact that is potentially but on a temporary basis and will assume equilibrium after certain period of time	**I-R**	Residual and significant adverse environmental impact
I-M	Environmental impact that is potentially significant but there is insufficient data to make reliable prediction. Close monitoring and control is recommended	**I+**	Significant environmental enhancement

			PROJECT ACTIVITIES	PRE CONSTRUCTION			CONSTRUCTION							OPERATION				
				SURVEY	PROJECT DESIGN	ENGAGEMENT WORKS	MOBILISATION TO SITE	SITE CLEARING	EARTHWORK	CIVIL AND STRUCTURAL WORKS	MECHANICAL AND ELECTRICAL WORKS	TESTING AND COMMISSIONING WORKS	ABANDONMENT	NORMAL OPERATION	MAINTENANCE WORKS / OUTAGE PERIOD	ABNORMAL OPERATION	MATERIAL HANDLING AND STORAGE	ABANDONMENT
ENVIRONMENTAL COMPONENTS	HUMAN	AESTHETIC AND CULTURAL	Landforms															
			Biota															
			Wilderness															
			Water Quality															
			Atmospheric Quality															
			Climate															
			Tranquillity															
			Sense of Community															
			Community Structure															
			Man-Made Objects															
			Historic Places or Structure															
			Religious Places or Structure															
			Landscape															

APPENDIX D

NEW MALAYSIA AMBIENT AIR QUALITY STANDARD

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New Malaysia Ambient Air Quality Standard

Pollutants	Averaging Time	Ambient Air Quality Standard (μg/m^3)		
		IT-1 (2015)	IT-2 (2018)	IT-3 (2020)
Particulate matter with the size less than 10 micron (PM_{10})	1 year	50	45	40
	24 hour	150	120	100
Particulate matter with the size less than 2.5 micron ($PM_{2.5}$)	1 year	35	25	15
	24 hour	75	50	35
Sulphur Dioxide (SO_2)	1 hour	350	300	250
	24 hour	105	90	80
Nitrogen Dioxide (NO_2)	1 hour	320	300	280
	24 hour	75	75	70
Ground level ozone (O_3)	1 hour	200	200	180
	8 hour	120	120	100
*Carbon Monoxide (CO)	1 hour	35	35	30
	8 hour	10	10	10

Note:

*measurement in mg/m^3

There are 3 interim targets set which include interim target 1 (IT-1) in 2015, interim target 2 (IT-2) in 2018 and the full implementation of the standard in 2020. All projects should strive to achieve the interim target 3.

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APPENDIX E

MALAYSIA NATIONAL WATER QUALITY STANDARDS

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Malaysia National Water Quality Standards

Parameter	Unit	River Class					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	>12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	>100
Dissolved Oxygen	mg/l	7	5 – 7	5 – 7	3 – 5	< 3	<1
pH	-	6.5 – 8.5	6 – 9	6 – 9	5 – 9	5 – 9	-
Colour	TCU	15	150	150	-	-	-
Electrical Conductivity*	µS/cm	1,000	1,000	-	-	6,000	-
Floatables	-	N	N	N	-	-	-
Odour	-	N	N	N	-	-	-
Salinity	%	0.5	1	-	-	2	-
Taste	-	N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4,000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature	^{o}C	-	Normal + 2 ^{o}C	-	Normal + 2 ^{o}C	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	Count / 100ml	10	100	400	5000 (20,000)[a]	5000 (20,000)[a]	-
Total Coliform	Count /100ml	100	5,000	5,000	50,000	50,000	>50,000

Notes:

N = No visible floatable materials or debris, no objectional odour or no objectional taste

* = Related parameters, only one recommended for use

** = Geometric mean

a = Maximum not to be exceeded

Parameter	Unit	River Class				
		I	IIA/IIB	III	IV	V
Al	mg/l	Natural Levels or Absent	-	(0.06)	0.5	Levels above IV
As	mg/l		0.05	0.4 (0.05)	0.1	
Ba	mg/l		1	-	-	
Cd	mg/l		0.01	0.01* (0.001)	0.01	
Cr(IV)	mg/l		0.05	1.4 (0.05)	0.1	
Cr(III)	mg/l		-	2.5	-	
Cu	mg/l		0.02	-	0.2	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l		-	-	3 SAR	
K	mg/l		-	-	-	
Fe	mg/l		1	1	1 (Leaf) 5 (others)	
Pb	mg/l		0.05	0.02* (0.01)	5	
Mn	mg/l		0.1	0.1	0.2	
Hg	mg/l		0.001	0.004 (0.0001)	0.002	
Ni	mg/l		0.05	0.9*	0.2	
Se	mg/l		0.01	0.25 (0.04)	0.002	
Ag	mg/l		0.05	0.0002	-	
Sn	mg/l		-	0.004	-	
U	mg/l		-	-	-	
Zn	mg/l		5	0.4*	2	
B	mg/l		1	(3.4)	0.8	
Cl	mg/l		200	-	80	
Cl_2	mg/l		-	(0.02)	-	
CN	mg/l		0.02	0.06 (0.02)	-	
F	mg/l		1.5	10	1	
NO_2	mg/l		0.4	0.4 (0.03)	-	
NO_3	mg/l		7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l		50	-	-	
SO_4	mg/l		250	-	-	
S	mg/l		0.05	(0.001)	-	
CO_2	mg/l		-	-	-	
Gross-α	Bq/l		0.1	-	-	

Parameter	Unit	River Class				
		I	IIA/IIB	III	IV	V
Gross-β	Bq/l	Natural Levels or Absent	1	-	-	Levels above IV
Ra-226	Bq/l		<0.1	-	-	
Sr-90	Bq/l		<1	-	-	
CCE	µg/l		500	-	-	
MBAS/BAS	µg/l		500	5,000 (200)	-	
O&G (mineral)	µg/l		40; N	N	-	
O&G (Emulsified Edible)	µg/l		7,000; N	N	-	
PCB	µg/l		0.1	6 (0.05)	-	
Phenol	µg/l		10	-	-	
Aldrin / Dieldrin	µg/l		0.02	0.2 (0.01)	-	
BHC	µg/l		2	9 (0.1)	-	
Chlordane	µg/l		0.08	2 (0.02)	-	
t-DDT	µg/l		0.1	(1)	-	
Endosulfan	µg/l		10	-	-	
Heptachlor / Epoxide	µg/l		0.05	0.9 (0.06)	-	
Lindane	µg/l		2	3 (0.4)	-	
2,4-D	µg/l		70	450	-	
2,4,5-T	µg/l		10	160	-	
2,4,5-TP	µg/l		4	850	-	
Paraquat	µg/l		10	1800	-	

Notes:

* = At harness 50 mg/l $CaCO_3$

= Maximum (unbracketed) and 24-hour average (bracketed) concentrations

N = free from visible film sheen, discoloration and deposits

Water Classes and Uses

CLASS	USES
Class I	Conservation of natural environment Water supply I – Practically no treatment necessary Fishery I- very sensitive aquatic species
Class IIA	Water Supply II – Conventional treatment required Fishery II – Sensitive aquatic species
Class IIB	Recreational use with body contact
Class III	Water Supply III – Extensive treatment required Fishery III – Common, of economic value and tolerant species, livestock drinking
Class IV	Irrigation
Class V	None of the above

APPENDIX F

MALAYSIA MARINE WATER QUALITY CRITERIA AND STANDARD

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Malaysia Marine Water Quality Criteria and Standard

Parameter	CLASS 1	CLASS 2	CLASS 3	CLASS E
Beneficial uses	**Preservation, Marine Protected areas, Marine Parks**	**Marine Life, Fisheries, Coral Reefs, Recreational and Mariculture**	**Ports, Oil and Gas Fields**	**Mangroves, Estuarine and River- mouth Water**
Temperature (^oC)	≤ 2 ^oC Increase over max ambient	≤ 2 ^oC Increase over max ambient	≤ 2 ^oC Increase over max ambient	≤ 2 ^oC Increase over max ambient
Dissolved oxygen (mg/L)	>80% saturation	5	3	4
Total suspended solid (mg/L)	25 mg/L or ≤ 10% increase in seasonal avg, whichever is lower	50 mg/L (25 mg/L) or ≤10% increase in seasonal avg, whichever is lower	100 mg/L or ≤10% increase in seasonal avg, whichever is lower	100 mg/L or ≤30% increase in seasonal avg, whichever is lower
Oil and grease (mg/L)	0.01	0.14	5	0.14
Mercury* (µg/L)	0.04	0.16(0.04)	50	0.5
Cadmium (µg/L)	0.5	2(3)	10	2
Phenol (µg/L)	1	10	100	10
Copper (µg/L)	1.3	2.9	10	2.9
Nitrate (NO_3) (µg/L)	10	60	1000	60
Nitrite (NO_2) (µg/L)	10	55	1000	55
Arsenic (III)* (µg/L)	3	20(3)	50	20(3)
Ammonia (unionized) (µg/L)	35	70	320	70
Lead (µg/L)	4.4	8.5	50	8.5
Chromium VI (µg/L)	5	10	48	10

Parameter	CLASS 1	CLASS 2	CLASS 3	CLASS E
Zinc (µg/L)	15	50	100	50
Cyanide (µg/L)	2	7	20	7
Phosphate (µg/L)	5	75	670	75
Tributyltin (TBT) (µg/L)	0.001	0.01	0.05	0.01
Polycyclic Aromatic Hydrocarbon (PAHs) ng/g	100	200	1000	1000
Faecal coliform (human health protection for seafood consumption)- (MPN/100ml)	70	100(70)	200	100(70)

Note:

* levels in parentheses are for coastal and marine water areas where seafood for human consumption is applicable.

APPENDIX G
CHECKLISTS

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CHECKLISTS

CHECKLIST FOR TERMS OF REFERENCE (TOR) / ENVIRONMENTAL SCOPING INFORMATION (ESI)

Item		Adequacy Check		Remarks
		Yes	No	
1.0	**Is the project a NEW development?**			
2.0	**Is the project an AMENDMENT to an existing development? If so,**			
	(a) Was there an EIA for the existing development?			
	(b) Does the addition involve new area development? If so how much and where?			
3.0	**Has policies compliance been met by the Project Proponent?**			
	(a) Federal / state approvals			
	(b) Land status/ acquisition			
	(c) Land use compatibility			
	(d) Environmentally Sensitive Areas			
	(e) Others (Forest, Fisheries, etc.)			
4.0	**Who were involved in the scoping tasks?**			
	(a) Project Proponent			
	(b) Town planner/Architect			
	(c) Engineering consultants			
	(d) Environmental consultant			
	(e) Affected public/stakeholders			
	(f) Government agencies			
	(g) Others			
5.0	**Does the project involve the following activities?**			
	(a) Establish accessibility			
	(b) Base camp and site facilities			
	(c) Mobilisation of workers, equipment and materials			
	(d) Site clearing and biomass removal			

Item		Adequacy Check		Remarks
		Yes	No	
	(e) Earthworks			
	(f) Drainage works			
	(g) Civil and structural works			
	(h) Electrical and mechanical works			
	(i) Testing and commissioning works			
	(j) Materials/products handling and storage			
	(k) Process controls			
	(l) Air pollution control system			
	(m) Industrial / Sewage effluent treatment system			
	(n) Noise / vibration controls			
	(o) Safety controls			
	(p) Waste generations			
	(q) Others			
6.0	**Land use on site and surrounding areas**			
	(a) Are the following features intersected by the Project?			
	(i) Rivers and/or lakes			
	(ii) Coastal areas			
	(iii) Wetlands/Mangroves			
	(iv) Coral reefs/Seagrass beds			
	(v) Forest reserves			
	(vi) Built-up areas			
	(vii) Tourism/recreational areas			
	(b) Are the environmental issues with each feature identified?			
7.0	**Timeline**			
	(a) Project implementation schedule (by phase, in chronological order of occurrence)			

Item		Adequacy Check		Remarks
		Yes	No	
8.0	**Project information provided**			
	(a) Project concept and layout			
	(b) Project activities			
	(c) Material sources and storage			
	(d) Infrastructure, utilities and amenities requirement			
9.0	**Site Suitability Assessment**			
	(a) Siting constraints / suitability addressed?			
	(b) Have the affected public be informed/consulted?			
	(c) Alternative project layout provided?			
	(d) Best available technology (BAT) considered?			
	(e) Carrying capacity considered?			
	(f) No Project Option?			
11.0	**Significant impacts scoped and prioritized?**			
	(a) Identified Impacts			
	(i) Water quality			
	(ii) Air quality			
	(iii) Noise and vibration			
	(iv) Safety impact			
	(v) Health impact			
	(vi) Waste generation			
	(vii) Others			
	(b) For each significant impact, were the methods and scope sufficient for impact assessment?			
	(c) Were mitigation measures proposed to address the significant impact?			

CHECKLIST FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

Item		Adequacy Check		Remarks
		Yes	No	
1.0	**Executive Summary (Brief and concise)**			
	(a) In Bahasa Malaysia			
	(b) In English			
2.0	**Introduction**			
2.1	(a) Title of the project			
	(b) Project Proponent details			
	(c) EIA Consultant details			
	(d) Project location (boundary coordinates)			
	(e) Relevant maps showing project location and ESAs			
2.2	Legal requirements			
3.0	**Terms of Reference**			
4.0	**Statement of Need**			
	(a) Principle reasons for proposed project (include relevant supporting documents)			
	(b) Aim of Project			
5.0	**Project Options**			
	(a) Alternatives considered?			
	(b) Project optimization done?			
6.0	**Project Description**			
6.1	Project Concept:			
	(a) Layout plan			
	(b) Size and land requirement			
	(c) Project component			
	(d) Method statement			
	(e) Labour requirement			
	(f) Raw material requirement			
	(g) Infrastructure/Utilities/Amenities			
6.2	Project activities: Construction			
6.3	Project activities: Operational			

Item		Adequacy Check		Remarks
		Yes	No	
6.4	Project Implementation Schedule (Chart)			
7.0	**Description of Existing Environment**			
7.1	Baseline			
	(a) Physico-chemical			
	(i) Land use, land use zoning and compatibility			
	(ii) Topography / Bathymetry			
	(iii) Geology and soil			
	(iv) Hydrology			
	(v) Climate			
	(vi) Water quality			
	(vii) Ambient air quality			
	(viii) Ambient noise			
	(b) Biological (where applicable)			
	(i) Terrestrial ecology			
	(ii) Aquatic/Marine ecology			
	(iii) Fishery resources			
	(c) Socio-economy			
	(i) Demography			
	(ii) Public Health			
	(iii) Historical, cultural and archaeological aspects			
	(iv) Stakeholders Engagements			
7.2	Others agencies requirement:			
	(a) Social Impact Assessment			
	(b) Health Impact Assessment			
	(c) Traffic Impact Assessment			
	(d) Marine Traffic Risk Assessment			
	(e) Others			

Item		Adequacy Check		Remarks
		Yes	No	
8.0	**Evaluation of Impacts**			
8.1	Detailed examination of impacts during:			
	(a) Pre-construction Phase			
	(b) Construction Phase			
	(i) Establish accessibility			
	(ii) Base camp and site facilities			
	(iii) Mobilisation of workers, equipment and materials			
	(iv) Site clearing and biomass removal			
	(v) Earthworks			
	(vi) Drainage works			
	(vii) Civil and structural works			
	(viii) Electrical and mechanical works			
	(ix) Testing and commissioning works			
	(x) Waste generation			
	(xi) Site stabilization and landscaping			
	(xii) Others			
	(c) Operational Phase			
	(i) Materials/products handling and storage			
	(ii) Process controls			
	(iii) Air pollution control system			
	(iv) Industrial / Sewage effluent treatment system			
	(v) Noise / vibration controls			
	(vi) Safety controls			
	(vii) Waste generations			
	(viii) Others			

Item		Adequacy Check		Remarks
		Yes	No	
	(d) Abandonment / Decommissioning Phase			
	(i) Removal of facilities / structures			
	(ii) Removal of materials			
	(iii) Removal of wastes			
	(iv) Rehabilitation works			
9.0	**Pollution Prevention and Mitigation Measure (P2M2)**			
9.1	Environmental Aspects			
	a) Water pollution			
	b) Air pollution			
	c) Noise and vibration			
	d) Waste management			
	e) Others			
10.0	**Environmental Management Plan (EMP)**			
10.1	Guided Self-Regulation requirement			
10.2	LD-P2M2			
10.3	P2M2			
10.4	Proposed Monitoring Programme:			
	(a) Location of monitoring points			
	(b) Frequency of monitoring			
	(c) Parameters to be measured			
	(d) Procedures for reporting			
10.5	Environmental Audit Programme			
11.0	**Study Findings**			
12.0	**Reference**			
13.0	**Appendices**			

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