Environmental Impact Assessment (EIA)

Guidelines for Land Reclamation Activities

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Foreword

The Environmental Impact Assessment (EIA) has been widely used as a critical tool in managing and clarifying the complex interrelationships between development and the environment. It provides assessment of the environmental consequences of development actions in a systematic, holistic and multidisciplinary way.

In Sabah, the Environment Protection Department is imposing two environmental impact assessment categories namely the EIA or the Proposal for Mitigation Measures (PMM) in managing any development listed as prescribed activities under the Environment Protection (Prescribed Activities) (Amendment) Order 2013.

The purpose of these Guidelines is to provide practical guidance to environmental consultants, developers, planning authorities and any other stakeholders on procedural aspects as well as the processes involved in the preparation of the EIA/ PMM report. It intents to provide a structured framework for the scope of environmental considerations required during the planning, implementation and maintenance stages of any prescribed development activity. Identification of potential environmental issues at the initial stage of development is essential for the selection of realistic mitigation measures. Significance of this approach will ensure that any development activity will be carried out with minimal adverse residual environmental impacts.

It is the Department's hopes that these Guidelines will result in greater consistency and understanding on the basic of environmental requirements, selection of alternatives, identification of environmental issues, preparation of mitigating measures as well as environmental compliance and monitoring to ensure sustainable and profitable activities are achieved.

The Department gratefully appreciate the valuable assistance from government agencies, organizations and individuals in their comments, feedback and inputs on these Guidelines. We welcome comments and suggestions for the continuous improvement of these Guidelines in future.

Yabi Yangkat
Director
Environment Protection Department

Contents

1 Introduction

1.1 Definitions

The aim of this EIA guideline is to provide a framework for the preparation of an Environmental Impact Assessment (EIA) report for land reclamation or any indirect connection to land reclamation activities in the State of Sabah, Malaysia. This EIA guideline should serve as an operating manual for the Project Proponents as well as a guide for environmental consultants.

Within Sabah, any land reclamation within the river, sea, foreshore area or wetland forest for the purpose of housing, commercial or industrial estate, resorts, recreational or tourism facilities as well as construction of major roads or buildings for public is categorised as a “prescribed activity” under the Second Schedule of the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005. This requirement therefore subjects the Project Proponent to appoint an environmental consultant registered with the Environment Protection Department (EPD), to conduct an EIA report for submission to, and approval by EPD Sabah prior to project commencement.

The term “land reclamation” (usually known as reclamation) in this guideline, is defined as the creation of new land/ area from the sea, lakes or riverbeds (refer to Plate 1-1). This process generally entails filling using borrow material at the site and the subsequent construction of buildings or other developments upon the reclaimed land. The process of reclaiming the useable land from the sea/ river may in some cases involve other methodologies such as constructing a bund/ wall around the area to be reclaimed with subsequent construction/ filling within the bund. Plate 1-2 shows an example of reclamation carried out through initial construction of a cofferdam.

Plate 1-1: Typical coastal reclamation at Kimanis, Sabah

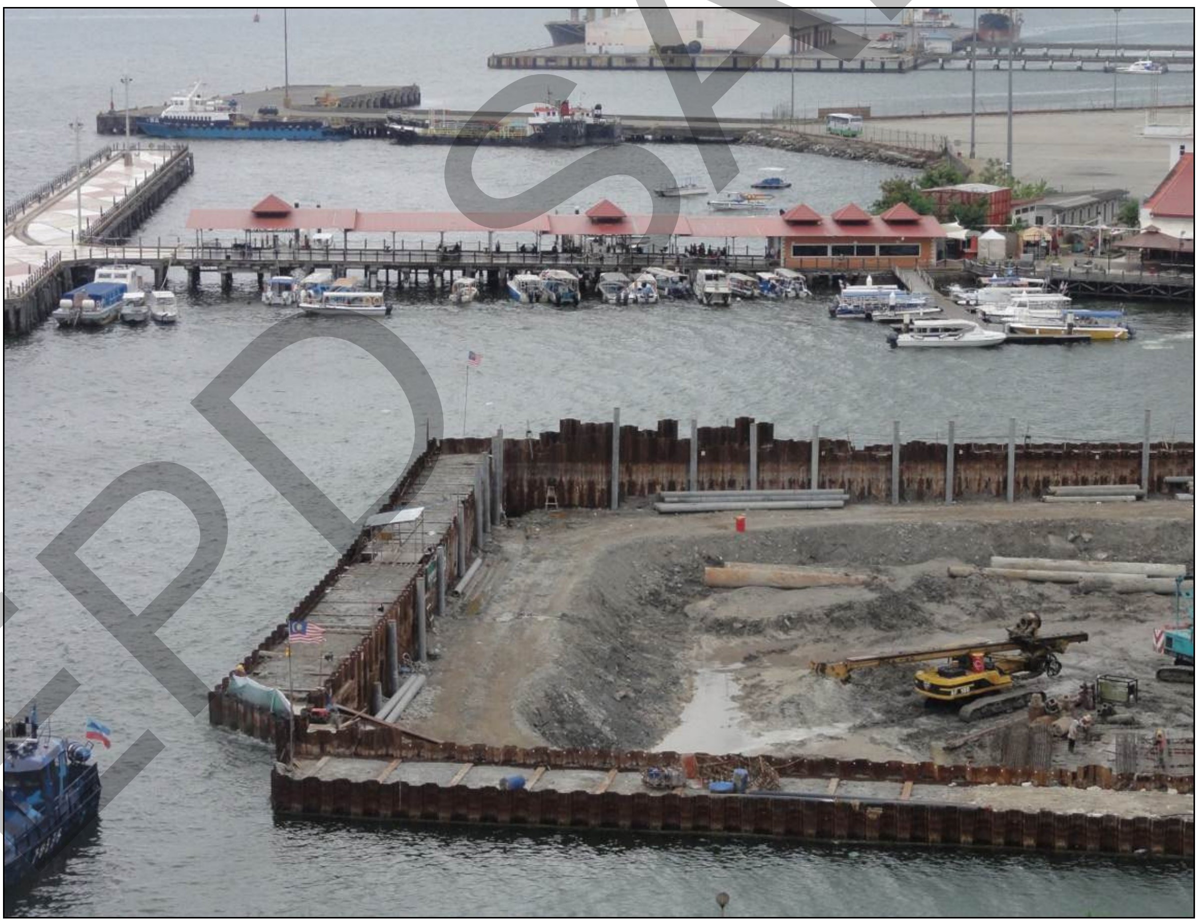


Plate 1-2: Example of reclamation carried out through initial construction of a cofferdam with subsequent construction/ filling inside the drained area

Other developments or situations which do not necessarily include fill material, but for which this guideline may apply include: closed jetties, causeways, breakwaters and in some cases stockpiling and beach nourishment. Closed jetties, causeways and breakwaters can impact the shoreline in a similar way to land reclamation and as such the impact prediction and evaluation methodologies for these developments are also covered under these guidelines.

This guideline focuses on riverine and coastal areas, and excludes offshore mining, excavating, extraction or dredging activities, which lie more than 1.5 km off the coastline, or at water depths of greater than 10 metres, measured from the Lowest Astronomical Tide, whichever is further from the shoreline. Coastal area, in this guideline is defined as the foreshore, inter-tidal and marine areas extending seaward up to 1.5 km offshore. The foreshore may be defined as 20 m inland of the high water mark. Note that the filling of mangrove swamp areas shall also be classified as reclamation, as these areas fall within the intertidal zone as defined by the HAT. This EIA guideline will only cover the site preparation (including reclamation) and construction phases of these developments under the prescribed activity.

This EIA guideline focuses on the planning and control of developments involving land reclamation and management of impacts on adjacent areas. The main objective of this guideline is to provide environmental consultants, developers, contractors and government agencies involved in land reclamation activities with:

i. Information on how to avoid and minimise environmental impact, which is preferable to the more costly option of undertaking remedial action;

ii. Information on the likely impact of land reclamation activities on the environment and how this is to be assessed; and

iii. Suggested best practice environmental measures to meet the performance objectives.

This EIA guideline is not prescriptive or detailed. Each environmental assessment will require the environmental consultants to tailor their assessment to particular site conditions and make their own assessment of measures appropriate to the site.

The content of this EIA guideline may be amended from time to time in order to keep abreast with the latest developments and improvements in techniques and new understanding of the environmental impacts and risk. Such changes may be issued by EPD in a complete revision of this document, or in separate additional guidance notes which address specific issues.

This EIA guideline has been produced in consultation with relevant technical departments, stakeholder representatives, and other interested organizations. Printed copies of this and other EIA guidelines are available from EPD.

1.2 Assessment Procedure – A Quick Reference

The environmental assessment procedure may be divided into seven steps as described in Table 1-1. Of these steps, only steps 3 and 4 are dealt with in this guideline as these include issues particular to land reclamation activities. The remaining steps are standard procedures, common to all EIA reports. These steps are described in detail in the Handbook on Environmental Impact Assessment in Sabah (November 2005) issued by EPD.

Table 1-1: Assessment Procedures

The Seven Steps	Summary of Main Required Activities
Step 1: **Project Screening**	**Project Proponent:** • Check Section 2.3 to see if the project is required to undertake an EIA • Consult with EPD as to whether the project should undertake an EIA • Consult with EPD whether planning documents are sufficient
Step 2: **Selection of Environmental Consultants**	**Project Proponent:** • Select EPD registered consultants to undertake preparation of TOR and the EIA
Step 3: **Project Scoping and Preparation of Terms of Reference**	**Environmental Consultant:** • Undertake scoping activities • Assess initial project description and assist the Project Proponent to make amendments. • Perform initial site visit • Prepare a draft TOR • Undertake the public hearing activities required for Special EIA • Participate in review meetings • Finalise the TOR for EIA and obtain final approval from EPD
Step 4: **Undertaking the EIA Study**	**Environmental Consultant:** • Assess the project details • Assess the existing environments

The Seven Steps	Summary of Main Required Activities
	• Assess the environmental impacts • Devise and propose mitigation measures • Devise and propose monitoring programmes
Step 5: **Preparation of the EIA Report**	**Environmental Consultant:** • Adhere to EPD requirements based on the approved TOR in the preparation of the EIA report • Prepare the EIA report in line with EPD chapter by chapter recommendations • Discuss with the Project Proponent on the findings and content of the EIA report
Step 6: **Submission of the EIA Report**	**Environmental Consultant:** • Submit the EIA report to EPD • Undertake the public hearing activities required for Special EIA • Participate in review meetings • Submit additional information if required and finalise the EIA report
Step 7: **Preparation of the Agreement of Environmental Conditions**	**Project Proponent:** • Review the draft Agreement of Environmental Conditions (AEC) prepared by EPD • Signing of Letter of Undertaking on AEC • Implement mitigation measures and monitoring programmes • Submission of periodic environmental compliance report as required in the AEC

2 Sabah Context

2.1 Geographical Overview

Coastal land reclamation has been used extensively in the past in the most developed areas of the State. This is most apparent by for instance comparing today's coastline of the State capital (Kota Kinabalu) with maps and pictures from the past. Basically the entire coastline of Kota Kinabalu, from Tanjung Aru in the south, along Tg. Lipat (see Plate 2-1) to the Yayasan Sabah building in the north, is reclaimed land.

Plate 2-1: Reclaimed coastline at Tg. Lipat, Kota Kinabalu

Natural coastal landscapes are varied; in Sabah they include such features as littoral beaches, rocky headlands, river outlets and deltas, tidal flats and tidal inlets, sand spits and mangrove swamps. The coastline is dynamic in nature, with some areas eroding and others building up, in response to sediment transport driven by hydro-dynamic forces such as waves and currents.

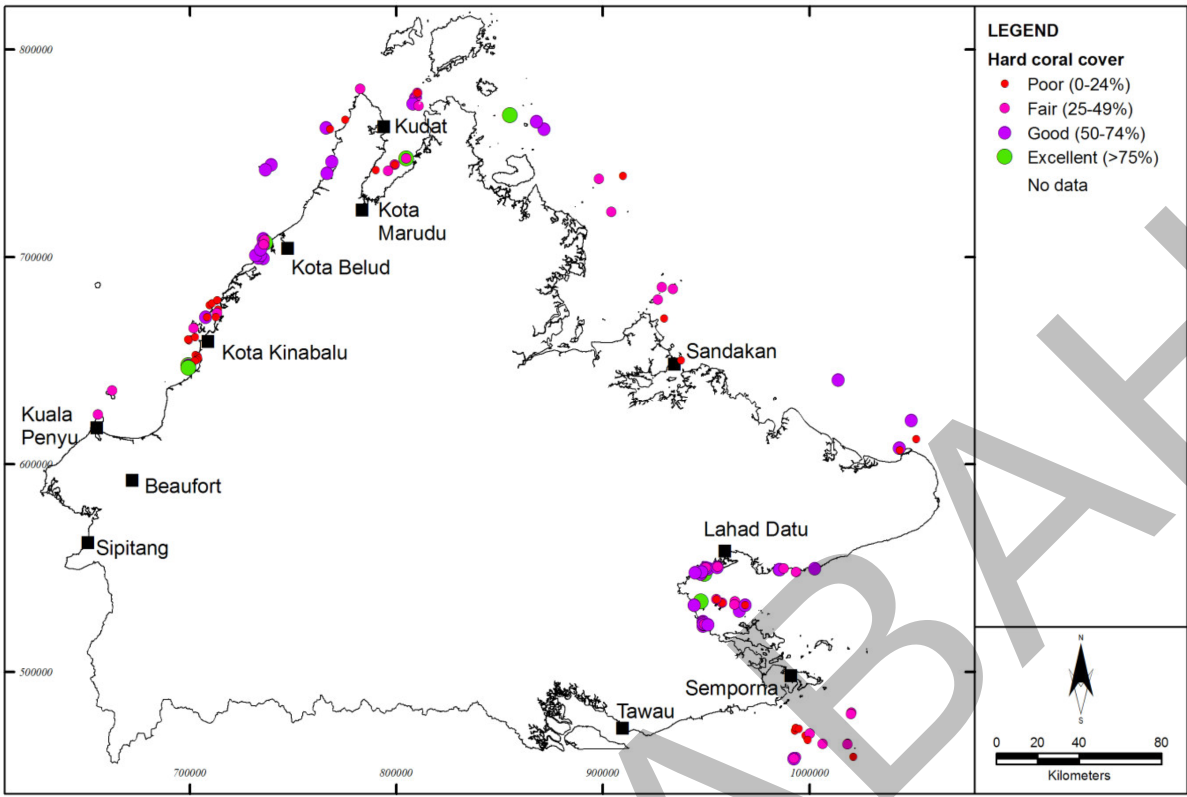
Waves and currents together with sediment sources from rivers are the main drivers for sediment transport and morphology. The coastline of Sabah is exposed to three different "seas" with the west coast from Brunei Bay to Pulau Banggi facing the South China Sea, Pulau Banggi to the eastern tip of Borneo at Hog Point facing the Sulu Sea, and the remaining part of the coastline from Hog Point to Tawau facing the Sulawesi Sea. Current and wave exposure varies significantly, leading to different sediment transport patterns and morphology for each region.

Two important marine environments dominate the coastline of Sabah, namely, coral reefs and mangrove forests. Often associated with these reefs and mangroves are seagrass beds, which play an equally important role in ecosystem dynamics, but have a less extensive distribution along Sabah's coastline.

Coral Reefs

Plate 2-2: Coral Reefs in Kudat District

Coral reef growth and development are predominately in water depths of 1-12 m (refer to Plate 2-2). The more extensive and least disturbed reefs are concentrated along the coast from Teluk Usukan to Teluk Ambong, in Tunku Abdul Rahman Park off Kota Kinabalu, around Pulau Dinawan and Pulau Tiga Park, Darvel Bay and the islands off Semporna. Figure 2-1 illustrates data available from the Shoreline Management Plan (EPD, 2005). This is not comprehensive, and any environmental assessment for reclamation, dredging or other marine construction activities with potential impacts to any reef areas should specifically address and assess potential impacts to the reefs.



Source: Sabah Shoreline Management Plan, 2005

Note: Data both primary and secondary is available. Reef areas with no data available are not shown

Figure 2-1: Location and quality of reefs around Sabah

Mangrove Forests

Mangrove forests have a patchy distribution along the West Coast of Sabah, occurring primarily along the shores of the Kudat and Bengkoka Peninsulas and the estuaries of the Klias and Padas Rivers. Mangroves also line the banks of the various tidal lagoons, for example, Teluk Sulaman and rivers such as Sg. Kinarut, and form a coastal fringe in protected bays such as Teluk Ambong and Teluk Sapangar (refer to Plate 2-3). The most extensive mangrove habitats are on the east coast of Sabah, covering much of the coastline and forming large swamps, for example in Labuk Bay, Sandakan Bay, Kinabatangan and Tawau Bay (Cowie Harbour). In other areas, mangroves form a narrow fringe along the coastline, for example in Semporna where mangroves can be found growing in sand and limestone.

Direct habitat impacts through reclamation in mangroves should be avoided wherever possible, while the EIA study should also investigate other impacts which may affect nearby mangrove areas, such as sedimentation and erosion, changes in water quality and salinity, and changes in tidal prism.

Plate 2-3: Coastal mangrove in Sipitang

Seagrass Beds

Seagrass distribution in Sabah has not been well documented. Known areas include extensive seagrass within the Sulaman and Mengkabong estuaries on the West Coast of Sabah, while a number of other areas have smaller, patchy seagrass beds. Along the east coast, scattered distributions of seagrass beds are found in many areas, such as in Darvel Bay and the Semporna islands (refer to Plate 2-4). Seagrass beds were also observed and/ or reported around Jambongan and the Beluran area, as well as at Tambisan. Given the lack of information on seagrass, it is important to consider whether the environmental conditions at the location would support seagrass habitats and to carry out initial site investigations to verify the presence or absence of these habitats within the vicinity of the proposed development site.

Plate 2-4: Seagrass habitat in Semporna District

2.2 Current Trends

Population expansion and industrialisation are the two main factors that have contributed to the escalating demand for prime land in the State. In the Sabah Shoreline Management Plan (EPD, 2005), coastal reclamation is generally discouraged, but there are some areas where the positive effects are judged to outweigh the potential negative impacts, and where reclamation in a properly planned manner is recommended.

Some of the reclamation that has taken place along the frontage of the State capital has been instrumental in the economic development of the city, for instance by:

- Providing/ upgrading infrastructure development (airport, harbour, coastal road).
- Tourism attractions (Shangri-La's Beach Hotel, Sutera Harbour complex, Waterfront).

Whereas coastal reclamation can provide significant planning and development opportunities as well as benefits to the public if properly planned and executed, there are also numerous potential negative impacts that have to be taken into account. The potential impacts are site specific, depending, among other factors, on the wave, current and sediment transport climate at the location; nearby environmental receptors; site size and layout as well as reclamation practices.

It is important that the Project Proponent and environmental consultant verify that the project is in line with the Sabah Shoreline Management Plan (EPD, 2005) when selecting sites to reclaim in order to avoid coastal sensitive areas.

The SMP indicates areas where development should be prohibited or restricted. It is noted, however, that the SMP is a plan at a regional scale, and hence any borderline cases should be reviewed in detail and any deviations from the SMP thoroughly explored and justified. It is therefore recommended that such a review/ preliminary study be carried out prior to, or at the TOR stage, in order to allow the authorities to make a decision on the project before significant project development works, including the EIA, are carried out.

2.3 Legal Requirements

Under the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005, the submission of an EIA is a mandatory requirement for land reclamation activities in Sabah under the Second Schedule of the Order. Specifically, the prescribed activity is:

Second Schedule: List of Prescribed Activities Requiring Environmental Impact Assessment (EIA) Report

Item 5: Land reclamation

> *Reclamation of land by the sea or along the river banks for development of housing, commercial or industrial estates, construction of major roads, or other public purposes*

There are also other prescribed activities that have an indirect connection to land reclamation activities. These include (but are not limited to):

First Schedule: List of Prescribed Activities Requiring Proposal for Mitigation Measures (PMM) Report

Item 1: Agriculture

Para (iii) *Conversion of wetland forests into agricultural estates or plantations covering an area of 20 hectares or more but less than 50 hectares*

Item 3: Housing, commercial and industrial estates

Para (ii) *Conversion of wetland forests into housing, commercial or industrial estates covering an area of 2 hectares or more but less than 30 hectares*

Item 4: Fisheries and aquaculture

Para (i) *Conversion of wetland forests into fisheries or aquaculture development covering an area of 10 hectares or more but less than 50 hectares*

Second Schedule: List of Prescribed Activities Requiring Environmental Impact Assessment (EIA) Report

Item 1: Agriculture

Para (iii) *Conversion of wetland forests into agricultural estates or plantations covering an area of 50 hectares or more*

Item 3: Housing, commercial and industrial estates

Para (ii) *Conversion of wetland forests into housing, commercial or industrial estates covering an area of 30 hectares or more*

Item 6: Fisheries and aquaculture

Para (i) *Conversion of wetland forests into fisheries or aquaculture development covering an area of 50 hectares or more*

Item 9: Quarries

Para (iii) *Excavation or dredging of sand or rock materials from watercourses, streams, rivers, coastal area or sea for commercial or construction purpose*

Item 12: Any other activities which may damage or have an adverse impact on quality of environment

Para (iv) Construction of closed landing jetties for commercial or public use along rivers or sea front

Fill material for land reclamation may be from a land-based source such as hill cut soil. Suitability of fill material used for land reclamation needs to be sufficiently addressed in the EIA, as well as the other effects such as the clearing and cutting of affected hills and vegetation to obtain the backfill material. A separate EIA may be required for the use of land-based fill material should it involve earthwork with a volume of 40,000 cubic metres or more.

Similarly, any capital dredging required as part of the project (for instance in port developments involving reclamation) should be covered under the same EIA. Land reclamation EIAs in principle should cover all activities related to the source of borrow material, including but not limited to dredging. However, given that the EIA process should be initiated as early as possible in the project planning and development process, it is often found that the full details of borrow material locations or dredge spoil disposal locations are not available at the EIA stage. Moreover, the finalisation of such information is often contingent upon approval (or imminent approval) of the EIA. Separate EIAs for borrow dredging and/ or dredge spoil disposal activities are therefore permissible. This guideline does however include dredging impacts and recommends that this be included in the same EIA wherever possible.

Under Section 12A of the Environment Protection Enactment 2002, amended in 2012, failure to comply to the requirement for an EIA may result in a fine not exceeding fifty thousand ringgit (RM50,000) or imprisonment for a term not exceeding two years, or both a fine and imprisonment, under the First Schedule. Under the Second Schedule, failure to comply may result in a fine not exceeding one hundred thousand ringgit (RM100,000) or imprisonment for a term not exceeding five years, or both a fine and imprisonment.

An EIA is an important technique for ensuring that the likely impacts of the land reclamation activities on the environment are fully understood and taken into account, before the commencement of such activities. The main objectives of an EIA for land reclamation activities are:

- To assess and recommend the most appropriate land reclamation options based on existing site conditions, so as to minimise impacts on the environment;

- To identify, predict and wherever possible quantify the significance of any adverse impacts on the environments and communities that are likely to be affected by the land reclamation activities;

- To formulate and incorporate appropriate and cost effective mitigation and abatement measures into overall planning for land reclamation activities; and

- To determine a suitable and effective programme for ensuring environmental compliance and monitoring of residual impacts.

It is noted that some of the above prescribed activities may have project components that are discussed under the EIA Guidelines for Shoreline Development Activities which include project components which extend 200 m landwards of the HAT water line. The reader is therefore referred to the EIA Guidelines for Shoreline Development Activities for additional guidance.

Other legal requirements applicable to land reclamation activities, which should be referred to by the environmental consultant during preparation of the EIA report are:

Legal Requirements	Relevance
Environmental Quality Act, 1974	– Restriction and prohibition of pollution (air emissions, noise pollution, inland waters, soil, waste, hazardous and scheduled substances) – Prohibition of open burning – Management of scheduled waste
Environmental Quality (Sewage) Regulations 2009	– Provision and proper operation of sewage treatment system – Sewage discharge quality
Environmental Quality (Scheduled Wastes) Regulations 2005	– Management and disposal of scheduled waste including storage and labelling
Wildlife Conservation Enactment 1987	– Protection and management of plants and animals
Town and Country Planning Ordinance (Sabah Cap. 141)	– Preparation and approval of schemes for designated landuse of an area (zoning)
Land Ordinance (Sabah Cap. 68)	– Land matters, shore reserve.

Legal Requirements	Relevance
Water Resource Enactment, 1998	– Water conservation areas – Flood plain management areas – River reserves – Shore reserves
Cultural Heritage (Conservation) Enactment 1997	– Preservation and conservation of cultural heritage sites
Explosive Act 1957 (revised 1978)	– Use, storage and transport of explosives
Local Municipal Rules including Earthwork By-Laws	– Requirements for planning submission including earthwork, drainage, construction and others.
Sabah Biodiversity Enactment, 2000	– License to access biological resources
Fisheries Act, 1985	– Conservation and development of maritime and estuarine fishing and fisheries in Malaysian waters – Protection of aquatic mammals and turtles and riverine fishing – Development of aquaculture
Ports and Harbours Enactment, 2002	– Issuance of ship/ vessel licence – Control and regulation of traffic flow by water in ports and harbours – Oil pollution by vessel within port limits or harbour

In addition to the legal requirements, there are several guidelines related to the environment which should be considered by all land reclamation activities applicants. These include (but are not limited to):

- Handbook on Environmental Impact Assessment in Sabah (Second Edition) (Environment Protection Department, November 2005);
- Environmental Impact Assessment Guidelines for Coastal and Land Reclamation (Department of Environment, 1998);
- Environmental Impact Assessment (EIA) Guidance Document for Coastal and Land Reclamation Activities (Department of Environment);

- Environmental Impact Assessment (EIA) Guidance Document for Sand Mining/ Dredging Activities (Department of Environment);

- Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia (Department of Environment, 1996);

- Sabah Shoreline Management Plan (Environment Protection Department, 2005);

- Guidelines for Public Safety and Health at Construction Sites (Department of Occupational Safety and Health, 2007);

- Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition) (Department of Irrigation and Drainage, 2011);

- National Landscape Guidelines (Department of Town and Country Planning, 1995);

- Guidelines on Erosion Control for Development Projects in the Coastal Zone (Department of Irrigation and Drainage, 1997); and

- Guidelines for Erosion and Sediment Control in Malaysia (Department of Irrigation and Drainage, 2nd Edition 2011).

These guidelines should be followed as appropriate (depending on the project concept and site specific issues) by the environmental consultant during preparation of the EIA report for submission to EPD.

The guidelines and legislation above are correct as of November 2012. It is the duty of the environmental consultant at all times to update the list and to apply the latest regulations as issued by relevant government agencies.

2.4 Application and Approving Procedures

Any person who intends to undertake land reclamation activities in the State of Sabah is required to submit an EIA report to the Director of EPD, Sabah for approval. The contact details for EPD are:

DIRECTOR
ENVIRONMENT PROTECTION DEPARTMENT
Tingkat 1 – 3, Wisma Budaya
Jalan Tunku Abdul Rahman
Beg Berkunci 2078
88999 Kota Kinabalu, Sabah, Malaysia

Telephone Number:	+60 (088) – 251 290/ 251 291/ 267 572/ 268 572
Facsimile Number:	+60 (088) – 238 120/ 238 390
Email Address:	jpas@sabah.gov.my
Website Address:	http://www.sabah.gov.my/jpas

In addition, written approval of the development report/ plan from the relevant City Council/ Municipal Council/ Local District Council is required but may not be limited to the previously mentioned approval requirement.

The procedure for submitting and obtaining approval for the development plan is shown in Figure 2-2 and summarised as follows:

- The applicant must submit a development proposal report or plan, prepared by a qualified person [generally an architect], to the relevant City Council/ Municipal Council/ Local District Council.

- The City Council/ Municipal Council/ Local District Council will refer the development report/ plan to the relevant departments (including EPD) for technical comments and acceptance. If the proposed development is categorised as a "prescribed" activity under the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005, an EIA report is required for approval from the EPD.

- In the event that the proposed development involves a change in the land use, approval is required from the Central Town and Country Planning Board of the area where the construction works will be carried out, for rezoning of the land (change of land use). This is in accordance to Part I, Section 3 of the Town and Country Planning Ordinance 1950.

- The City Council/ Municipal Council/ Local District Council may approve the proposed development upon receiving approval from the Central Town and Country Planning Board for rezoning, approval of the EIA report from the EPD, and compliance with all technical comments and acceptance from the relevant departments on the application.

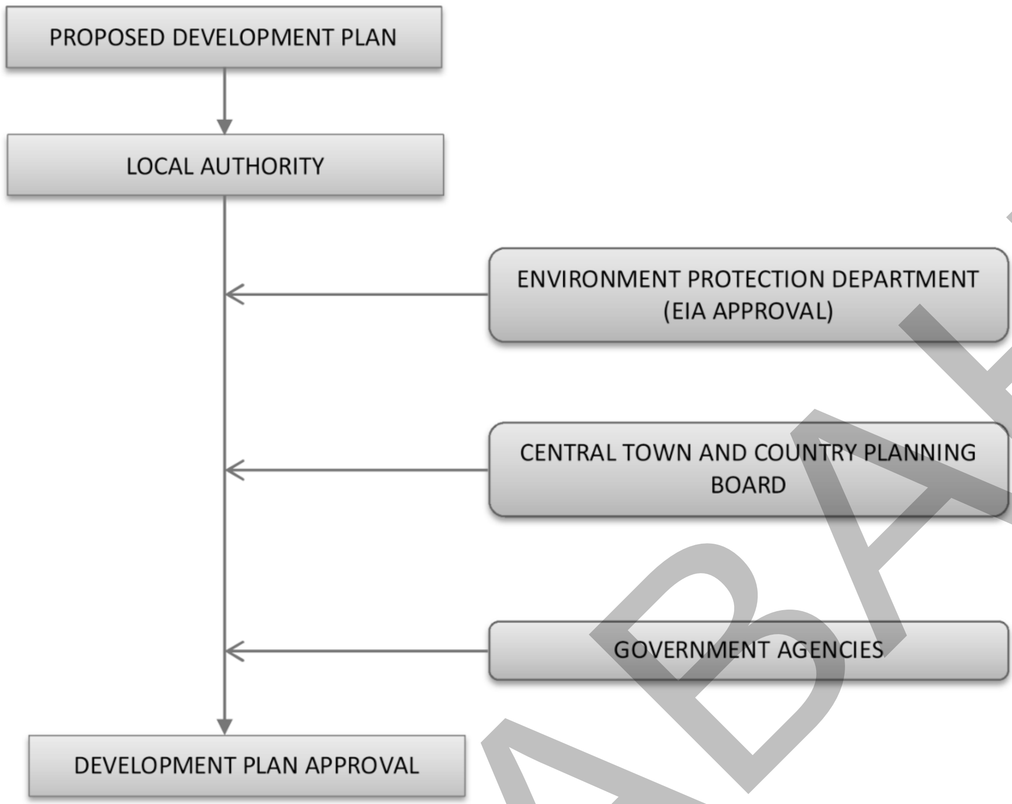


Figure 2-2: Procedure for processing of Development Plan

2.5 Key Stakeholders

As part of the environmental assessment procedure, EPD will seek technical comments from relevant departments with responsibilities for specific aspects relating to land reclamation activities. The main responsibilities of these departments in relation to the environmental assessment are listed below. However, the departments may also comment on any other aspect of the assessment, if deemed relevant.

Department	Technical Role
Lands and Surveys Department	– Land titles/ ownership
District Office	– Local settlement issues, i.e. flooding, public complaints and others
Department of Irrigation and Drainage	– Rivers and drainage systems, water catchment areas, coastal zone and shoreline management
Town and Regional Planning Department	– Landuse planning, zoning

Department	Technical Role
Municipal Council	– Municipality issues, i.e. waste management
Department of Environment	– General environmental concerns (air, effluent, water, scheduled waste and others)
Department of Fisheries	– Aquaculture and fisheries, fish habitats
Sabah Parks	– Development within or nearby marine parks
Sabah Forestry Department	– Forestry issues, in particular mangrove forest reserves
Sabah Wildlife Department	– Habitat and wildlife issues
Marine Department	– Shipping and navigation areas, vessel management
Ports and Harbours Department	– Oversee water traffic in all ports, harbours and rivers, boats/ ship licences under 15 NRT

This list of departments is not exhaustive and may vary depending on the development concept and sensitivity of the location.

EPD is responsible for overseeing the environmental assessment procedure in relation to the prescribed activities and at the same time, requires comments/ concerns/ advice from the key stakeholders for decision making.

3 Typical Project Activities

3.1 Project Plan

An environmental impact assessment is an assessment of an intent, i.e. the assessment of the potential impacts occurring from well described planned activities.

It is therefore important that all activities, which have potential environmental impacts, are planned properly and described in sufficient detail prior to the environmental assessment. After the initial project information, the EIA report therefore concerns the project description or plan.

The Project Proponent must provide the environmental consultant with a detailed description of all activities; both the land reclamation activities and the supporting activities.

3.2 Project Stages

Generally, reclamation activities and subsequent development will involve four (4) main stages, i.e. pre-development; site preparation; construction; and abandonment/ post-construction. The activities involved during these stages are listed below in Table 3-1.

Table 3-1: Typical Activities for Reclamation Projects

Stage	Activities
Pre-development	• Land acquisition and access - Acquire land - Relocation of existing occupants (if any) • Investigation - Detailed site surveying - Preparation of feasibility studies - Preparation of conceptual plan, soil investigation report - Detailed reclamation work planning (identification of fill source, method of extraction – e.g. dredgers, work sequence, disposal ground for dredge spoil or unsuitable materials - Detailed design for Erosion and Sediment Control Plan (ESCP) and drainage plan - Environmental Impact Assessment (EIA) study

Stage	Activities
Site Preparation	• Site clearing/ stripping - Construction of temporary access roads - Demolition and removal of existing structures (if any) - Construction of temporary drainage system • Temporary occupation - Establishment of site office, workers quarters and any other temporary construction and lay-down areas - Provision for electricity, water, telecommunication, solid waste and sewage facilities - Employment of workers - Machineries and equipment servicing and maintenance • Construction of containment structures (bund) • Construction of settling ponds and outlets • Reclamation works - Fill source material extraction (e.g. dredging) - Transport of material to reclamation site - Placement of fill material at project site • Soil improvement works • Coastal protection works • Capital dredging works – construction of operational navigation access, dredging of channel water ways - Dredging - Disposal of dredged material • Construction of tidal gates and drainage outlets
Construction	• Construction works - Construction of development components and facilities - Transportation of construction materials - Installation of permanent drainage system - Regular drainage maintenance work - Landscaping
Abandonment	In addition, there is also the possibility of abandonment during the implementation of proposed land

Stage	Activities
	reclamation activities. The types of activities involved during this stage are: - Unsuitable/ surplus material removal or stockpiling - Workers' quarters and site office removal - Solid waste disposal - Equipment and machineries removal - Liquid waste disposal - Site rehabilitation works, i.e. soil stabilization and other

Land reclamation is generally carried out for various developments such as ports, marinas, industries, resorts or other commercial and residential developments. These developments or operational activities upon the reclaimed land are in many cases prescribed activities and as such would be subject to an EIA. While the EIA Guidelines for Land Reclamation Activities does not include each of these various activities, the following table provides guidance on what activities should, or should not, be assessed as part of the EIA for land reclamation, versus those requiring a separate EIA study.

Scope to be covered under the Reclamation EIA

- ports
- marinas
- jetties
- capital (and subsequent maintenance) dredging
- breakwaters
- groynes
- causeway
- bridges
- undersea tunnels
- sewerage pipelines
- submarine cables

Separate comprehensive EIA study permitted

- hotels
- residential
- sand mining (borrow area).
- Site for disposal of dredged spoil.
- industry*
- airports*

** denotes "prescribed activity" under DOE*

Although a separate EIA may be prepared (and may be submitted to a different authority, i.e. DOE) for the built development components, sufficient information should be provided to EPD in the EIA report for land reclamation activities to enable a holistic assessment of the long-term impacts of the overall development at a strategic level. For example, a statement of need for the overall project and a summary of operational impact (e.g. what are the affected environmentally sensitive receptors and anticipated or predicted significance of the impacts).

3.2.1 Excavation and Reclamation

A reclamation project may involve excavating material from pits and quarries (gravel, sands or rocks) or other sources and transporting the material to the site for landfill by barges or by road transport. Generally, these operations are on a much smaller scale than that involving filling by offshore dredging operations but the general principles remain the same. They still require similar project activities as described above, however significant road transportation can raise other environmental and social problems that may need to be taken into account.

Particular attention should be paid to the type of fill material used, and the fines content and any contaminants that may be washed into the sea during filling operations. Generally, the fines content can be very high as some materials obtained from land based sources have not been pre-washed by the sea or rivers prior to placement. River gravels and sands that contain a lot of silt may over the years have absorbed numerous contaminants that have entered the rivers from land-based runoff and discharges. Care should be taken when considering the materials and the washout and how it is to be controlled. Any land-based fill material containing a lot of fines should consider any immediate and long term future settlements of the landfill once placed.

3.2.2 Dredging

A reclamation project may involve dredging for two reasons, namely borrow dredging and capital dredging.

(i) Borrow Dredging

Borrow dredging entails the removal of sediments to use as reclamation fill material, also termed 'borrow material'. The viability of coastal reclamation projects will often depend on the availability of a suitable and easily accessible source of fill material. Reclamation materials must be solid, inert and non-hazardous. In Sabah, marine sand fill is generally sought for significant reclamation projects, whereas earth fill (from land-based sources) may be used in smaller scale projects.

Sand sourcing involves dredging of the sand at the borrow site, transport of the sand and placement at the reclamation site.

The properties of the fill material, in particular the percentage of fine material and grain size distribution, have direct implications on the potential impacts on water quality during the reclamation process. Material with a high amount of fines will in general give rise to higher impacts, as the fine material is dispersed over greater distances, thus increasing the zone of impact. The potential for dispersion of the fines is however highly dependent on the filling or placement methodology.

Good reclamation-quality marine sand borrow areas in Sabah are generally found in offshore areas, associated with shoals or coral reefs. Hence, site selection is often constrained by environmental considerations; for example, areas of live coral should be avoided while near-shore areas tend to be dominated by mud which is not suitable as fill for land reclamation.

The Guidelines on Erosion Control for Development Projects in the Coastal Zone, (Garispanduan JPS 1/97 (1997)) do not in general permit sand mining in near-shore areas which are less than 1.5 km from the Mean Low Water Line, or 10 m water depth (from Lowest Astronomical Tide), whichever is further from the shore. This is to ensure that the sand mining does not result in any disruption to near-shore littoral transport. However, the guidelines do allow exceptions if it can be demonstrated (through hydraulic studies) that the sand mining operation would not lead to adverse impacts on the coastal processes, aquatic ecosystems and stability of the adjacent shorelines.

(ii) Capital Dredging

Capital dredging is the removal of soil, rock or debris from beneath the water to create a greater depth than had previously existed for the purposes of new or improved marine transport facilities such as harbour basins or navigation channels.

Capital dredging in many cases occurs in areas with fine sediments (e.g. river channels, sheltered harbours for ports). Depending on the location of the dredging project, contaminated sediments may be a concern. For example, many of Sabah's larger towns and cities have for a long time allowed their sewage and industrial waste to spill out into the near-shore areas, while the silt on the bottom of rivers has over the years absorbed numerous contaminants that have entered the rivers from land-based runoff and discharges. Dredging can spread the particles to which the contaminants are attached and increase the speed with which they spread.

Maintenance dredging may also be required, and the frequency and impacts of the maintenance dredging should also be assessed in the EIA.

3.2.3 Dredging and Reclamation Process

The characteristics of a dredging project can change considerably from one project to another; however, the following phases are common to almost any dredging project regardless of the purpose, type of equipment and methods used:

i. Dislodging of the in-situ material;

ii. Raising of the dredged material to the surface;

iii. Transport of dredged material to placement site; and

iv. Placement of the dredged material at the site.

(i) Dislodging of the Material

The first phase of a dredging cycle is dislodging of the in-situ material. This excavation process is relatively easy in areas with soft sediments; however it can be made more difficult by the presence of hard rock. The dislodging is generally carried out by a cutting device such as a cutter head, drag-head or cutting edge of a bucket grab.

(ii) Raising the Material

The second phase involves raising the dislodged material to the water surface, either mechanically or hydraulically. Using mechanical methods, the material is raised in a bucket (backhoe, clam-shell dredger and others) (refer to Plate 3-1). Hydraulic dredgers (cutter suction, trailing suction hopper) use a suction pipe, where the dislodged material, mixed with water, is sucked into the suction mouth by a centrifugal pump and raised through the pipe to the dredger or barge (refer to Plate 3-2).

Plate 3-1: Clam shell dredger

Plate 3-2: A suction dredger with a hopper for transport of sand to reclamation site

(iii) Transport of the Material

The excavated material from the dredging area is transported to the placement site. Depending on the distances involved between the dredging and placement sites, this may be carried out mainly by three potential methods:

- Hydraulic pipeline transport;
- Transport by hopper dredgers; or
- Transport by barges.

These methods are linked primarily to the type of dredger being used. Barge transport is generally selected for mechanical dredging; while pipeline transport is used mainly with hydraulic dredgers.

(iv) Placement of the Material

The final phase of a dredging operation is the placement of the material at the final destination, i.e. at a reclamation site, beach nourishment location, or a disposal site onshore or offshore.

For the disposal of dredge spoil, the type of material to be dredged will greatly influence the method of disposal. Before deciding on the method of disposal, the dredged sediments must first be classified according to their potential to contaminate the environment where they are to be deposited. Sediments may be classified under one of three classes (Netherland Standards):

- Class 1 – clean material, allowable for placing in any type of open water disposal site;
- Class 2 – slightly contaminated, allowable for placing in certain open water disposal sites but requiring remediation, owing to increased risks to public health and the environment;
- Class 3 – contaminated material. In principle, not suitable for open water disposal but to be confined in either very strict or well-controlled disposal sites.

In Sabah, the occurrence of contaminated sediment is not well known. However, areas adjacent to industrial zones, ports and harbours in particular are suspect and need to be investigated.

3.2.4 Dredging and Reclamation Equipment

The optimum choice of dredger is mainly dependent on location (depth, manoeuvrability), the type of material to be removed and the method of disposal. A brief overview of the main types of dredging equipment in use in the region and their environmental impacts is given below.

Hydraulic Dredgers

Hydraulic dredgers include all dredging equipment which utilise centrifugal pumps for dredging and placement process. Three primary types of hydraulic dredgers are in common use: (i) Stationary Suction Dredgers (SD), Cutter Suction Dredgers (CSD) and Trailing Suction Hopper Dredgers (TSHD).

Suction Dredger (SD)

The suction dredger is the simplest form of hydraulic dredger and comprises a suction pipe and dredge pump sitting on a barge or floating pontoon. The suction pipe is lowered to the bottom and by the suction action of the dredge pump; the bottom material is sucked up. The material is then either hydraulically discharged through a floating pipeline to shore, or loaded into barges.

Cutter Suction Dredgers (CSD)

The cutter suction dredger is generally used for dredging harder materials and for access channels in shallow areas. The CSD dislodges the material with a rotating cutter head, equipped with cutting teeth. The material is then sucked into the suction mouth located in the cutter head by means of a centrifugal pump. The pumping distance of the CSD is limited, and hence the CSD either has to pump material onshore through a floating pipeline to a nearby placement area, or into transport barges.

Trailing Suction Hopper Dredgers (TSHD)

The trailing suction hopper dredger is generally used for dredging sand, silts and soft clays. These dredgers have a cargo hold (hopper) which allows transport of the dredged materials over longer distances.

The TSHD navigates at low speed with the suction ladder and drag-head lowered. The drag-head agitates a thin layer of the seabed, and the loosened material and water is sucked into the suction pipe by means of a centrifugal pump, which is installed in the vessel’s hull. The material is pumped into the ship’s hopper. Generally the TSHD continues to load after the hopper is filled with a mixture of water and sand, and hence the excess water flows overboard together with some of the finer material, while the coarser (sand) fraction predominantly accumulates in the hopper. This increases the quantity of sediment effectively loaded into the hopper during each dredge cycle, hence ensuring economic viability of the dredging operation, in particular for longer transport distances. However, this overflowing process leads to adverse environmental impacts. There has to be a balance between the increase in dredging cost, due to transporting a high proportion of water mixed with sand; and increased impacts to the environment through discharging turbid water back into the water column.

At the placement site, the bottom doors of the TSHD's hopper can open allowing the sediment to fall directly to the seabed. The TSHD may also pump material ashore through a floating pipeline or discharge through a strong "jet" through the air in a process called "rain-bowing".

Mechanical Dredgers

There is a wide variety of mechanical dredgers, the most commonly used types include:

- *Grab dredger*: consists of a crane mounted on a pontoon or self-propelled hopper that operates a clamshell grab. Grab dredgers are mainly used for relatively small dredging projects; and
- *Bucket or backhoe dredger*: consists of a hydraulic excavator mounted on a pontoon or self-propelled hopper that operates a bucket.

Mechanical dredgers may cause minimal disturbance and dilution of clays compared to hydraulic methods used by CSD and TSHD dredgers, but for fine, loose sediments, there may be high levels of spillage as the grab or bucket is raised through the water column.

Impacts can be minimised by the use of a closed grab dredger, although these are only commonly used in the removal of contaminated sediments.

Mechanical dredgers will normally discharge into a hopper barge.

3.2.5 Reclamation/ Placement Techniques

Underwater Placement

Underwater placement is generally for disposal at offshore locations and reclamation in sufficiently deep waters. The TSHD or hopper barge sails to the placement site where the vessel's bottom doors are opened and the material falls directly to the sea or river bed. Some of the fines in the hopper load will be re-suspended into the water column during bottom dumping. The proportion that will be re-suspended depends both on the material composition, the water depth and the current conditions.

Land Placement

Placement on land (along the shoreline or riverbanks) is generally carried out by pumping the dredged material either through a pipeline (refer to Plate 3-3), which ends within the confined destination area, or directly through rainbowing.

Rainbowing is a technique for spraying dredged material from a TSHD to a receiving site by pumping it at high speed through a nozzle over the bow or side of the dredger. The pumped material forms an arc that resembles the shape of a rainbow, hence the name.

Plate 3-3: Shore transport of dredged material through pipeline

Pumping ashore through a pipeline can be carried out by a TSHD or CSD. This method is used by the TSHD when depths or the type of dredged material do not allow direct placement or rainbowing. Pipeline transport may be considered an environmentally friendly transport method as it takes place in a closed system, but this depends on the control of run-off from the receiving site.

For both rainbowing and pumping, the dredged material must be mixed with significant volumes of seawater in order to create slurry suitable for pumping.

Typically, the slurry is controlled by the use of bunds to enable settlement of solids and improve water quality before it is discharged.

Where sand is pumped, the resulting turbidity is typically confined to a small area near the discharge due to low fines content. However, where silts and clays are pumped, turbidity plumes can be greater.

4 Scoping

This chapter deals with the scoping stage which defines the work scope for preparation of the EIA report (refer to Table 4-1).

Table 4-1: Assessment Procedures - Scoping

The Seven Steps	Summary of Main Required Activities
Step 3: Project Scoping and Preparation of Terms of Reference	Environmental Consultant: • *Undertake scoping activities* • *Assess initial project description and assist the Project Proponent to make amendments* • *Perform initial site visit* • *Prepare a draft TOR* • *Undertake the public hearing activities required for Special EIA* • *Participate in review meetings* • *Finalise the TOR for EIA and obtain final approval from EPD*

Scoping is the identification of potential environmental impacts and the predicted extent of the impacts. This exercise is an important early stage of the environmental assessment process to ensure that the assessment is carried out properly and appropriately, i.e. that the report is sufficiently comprehensive, while at the same time preventing the assessment from becoming unnecessarily protracted or expensive due to inappropriate focus on issues of only minor concern.

In general, the scoping process is outlined in the EPD's Handbook on Environmental Impact Assessment in Sabah. This section briefly outlines the main steps in scoping, but primarily focuses on providing specific guidance on:

- Identification and preliminary assessment of potential impacts with respect to certain reclamation types and approach and with respect to specific project locations; and

- Selection of appropriate assessment methodologies, based on project sensitivities.

In order to carry out the above, a comprehensive description of the project in terms of location, activities and processes needs to be developed. This is described in the following section.

4.1 Project Information

The first step in scoping is to obtain as much relevant information about the project as possible, to ascertain the scale of the project and its component activities which may result in impacts to the environment.

4.1.1 Description

A description of the project location, activities and potential qualitative and quantitative impacts should be developed at this stage in order to identify the stages, activities or characteristics of the proposed project that are likely to give rise to environmental impacts.

4.1.2 Project Location

A preliminary assessment of the baseline conditions shall be made to identify key sensitive receptors for both the proposed borrow area and the reclamation site. Consideration should be given to the existing coastal/ riverine regime and features, bathymetric conditions, river estuaries, water quality as well as sensitive habitats and land uses.

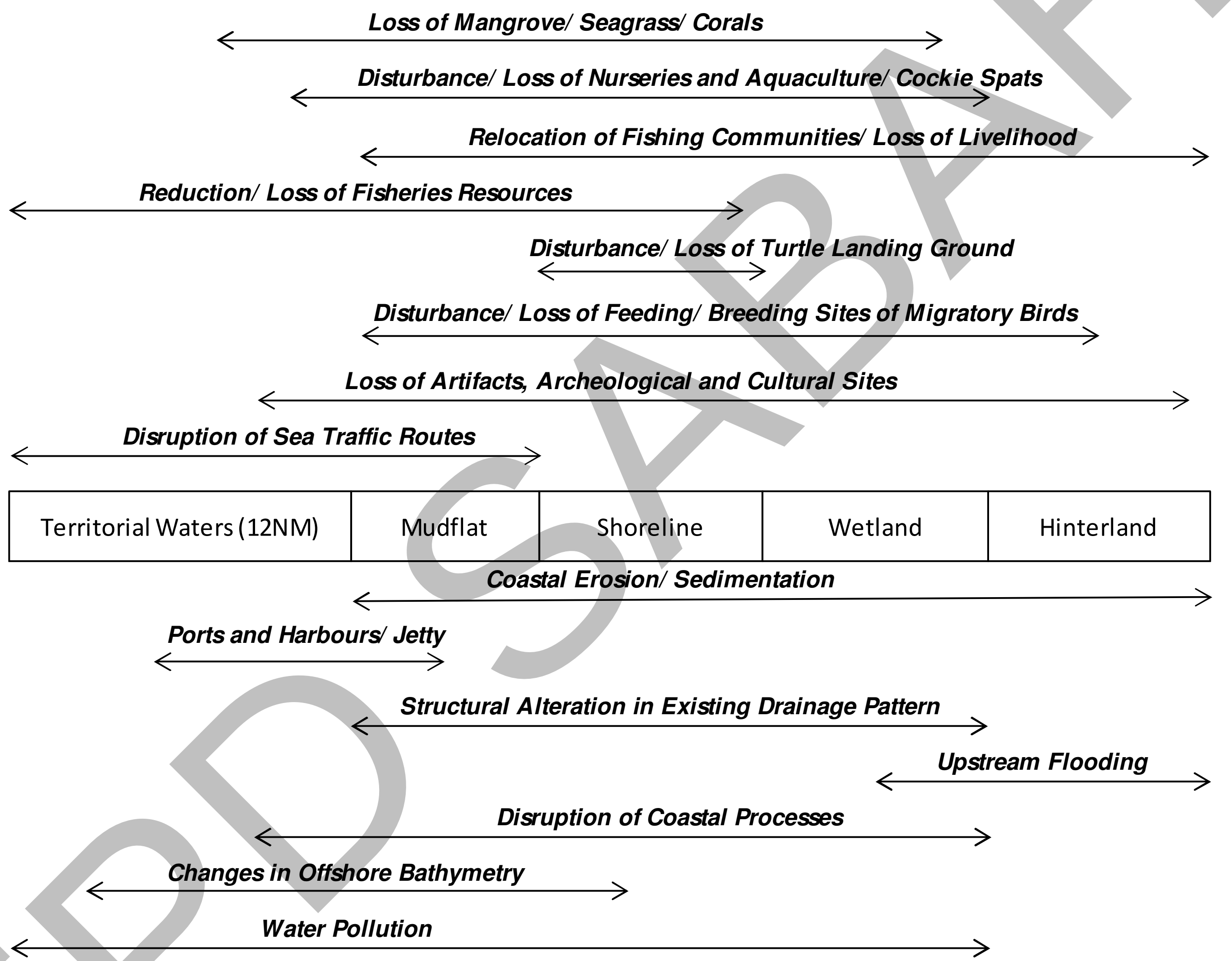
A site visit and preliminary consultations with relevant regulatory authorities must be undertaken during the scoping exercise.

4.1.3 Identification and Prioritisation of Impacts

Based on the previous steps, a list of all potential environmental impacts should be made with a preliminary estimate of their relative significance. The key impacts are those with the highest potential significance, considering both spatial scale, significance to stakeholders, potential impact severity and mitigation potential. EPD's Handbook on Environmental Impact Assessment in Sabah is a useful resource for this assessment. A prioritised list of impacts shall thereby be established and clearly described.

For each key impact identified, the anticipated zone of impact should be estimated by the expert judgement of the relevant specialists, based on conditions at the site. The zone of impacts may differ depending on the environmental component; the zone of impact for noise pollution for example may be much smaller than the potential water quality zone of impact, owing to properties of both the polluting and the dispersing agent and the conditions at the site.

Some potential impacts and their zone of impact for land reclamation projects are shown in Figure 4-1.



Source: Adapted from DOE Malaysia EIA Guidelines for Land Reclamation Projects (DOE 2008)

Figure 4-1: Main issues and extent of impacts for land reclamation projects

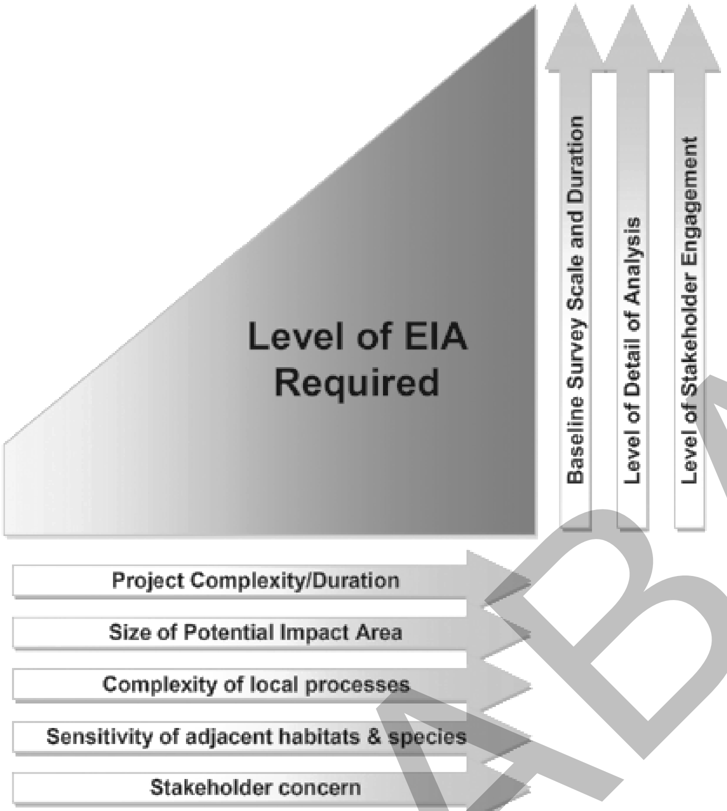
4.2 Types of Impacts

Whereas land reclamation activities can provide significant planning and development opportunities as well as benefits to the public if properly planned and executed, there are also numerous potential adverse impacts that have to be taken into account. The potential impacts are site and project specific, depending, among other factors on wave, current and sediment transport conditions at the location, nearby environmental receptors, size and layout, reclamation practices and others.

Whilst the environmental assessment evaluates both positive and negative impacts, the positive impacts are generally site specific, related to the project objectives, whilst the negative impacts can be considered as generic impacts on the physical, ecological, or socio-economic environments. A non-exhaustive list of main potential impacts related to land reclamation activities is provided in Section 5.3; these are also listed in Figure 4-1.

4.3 Terms of Reference

The TOR for the EIA shall directly reflect the scoping exercise whereby the environmental consultant should address the identified impacts as fully as practicable. The level of analysis from baseline studies and the sophistication of prediction and evaluation methodologies, shall be tailored to the level of significance of the impacts and hence level of precision required for the evaluation as illustrated in Figure 4-2. Less attention should be given to those issues which have lesser significance. In practical terms, this means that the level of uncertainty may be higher for these issues.



Source: PIANC 2010

Figure 4-2: Key factors in determining the level of environmental assessment required

4.3.1 Data Collection Requirements

Collecting existing data is always the first step in the collection of baseline information. It must however be reviewed for its relevance to the proposed site, its accuracy, and used as a basis for determining what primary field investigations may be required to 'fill the gaps'.

Primary field surveys are almost always required for most aspects of the environment, such as: existing sediment characteristics, water quality, aquatic biology, currents and water levels, socio-economic and other factors. Field surveys are needed either because published information in Sabah often does not exist at a suitable scale, or it is not applicable to the project being assessed.

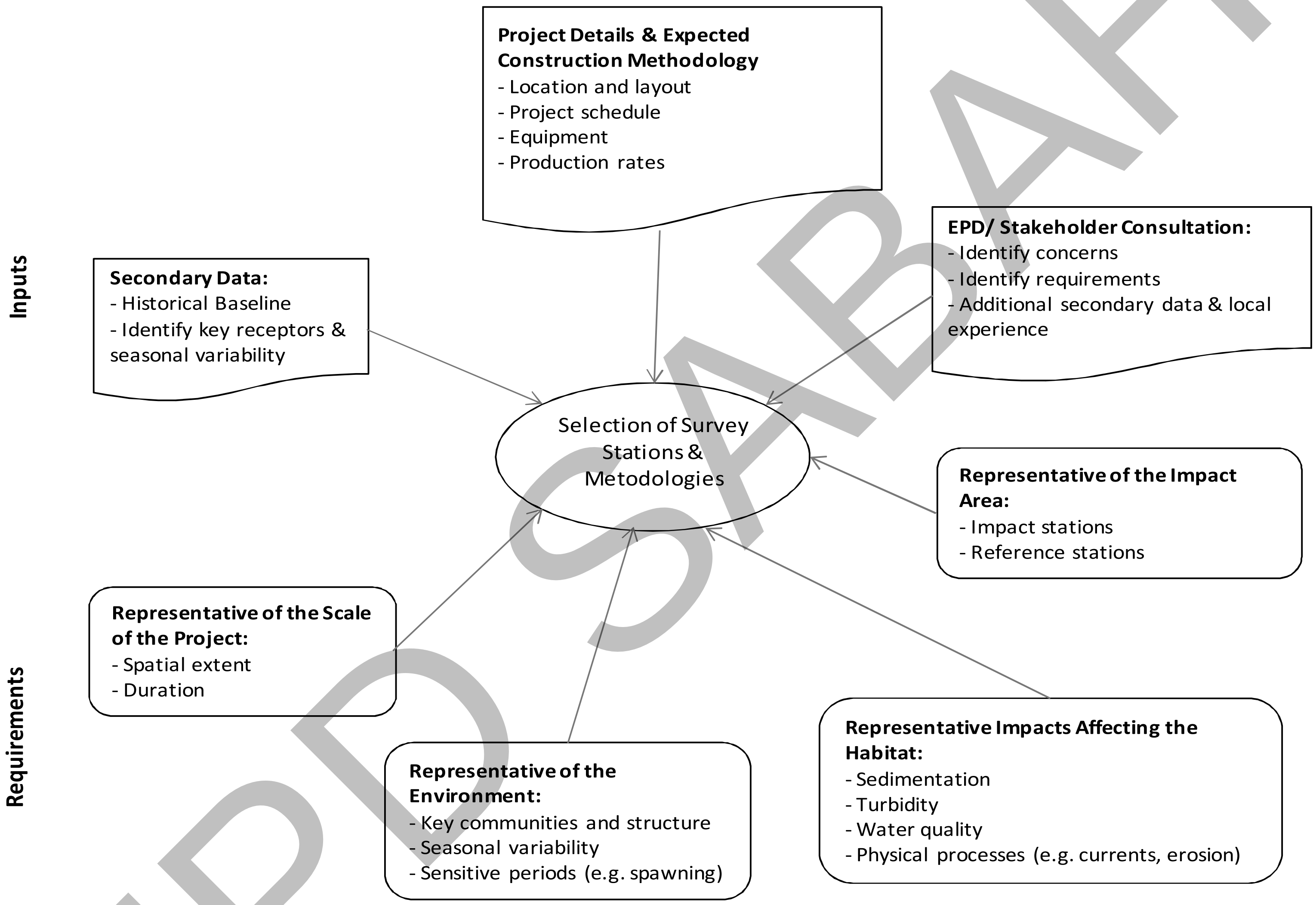
Existing (secondary) data should also be reviewed in terms of its validity, which includes considerations on the age of the data, the suitability of the methods used and a critical assessment of the results themselves. With respect to the age of secondary data, an assessment of the stability of the environment and parameter in question should be made. In a stable environment, data that is several years old may be adequate, whereas a highly dynamic environment would necessitate the use of recent data and supplementation by primary field data. For example, current patterns in an area are not likely to change significantly over the years in a natural environment. However, if there has been recent development in the area, such as the construction of a jetty or reclamation, then the currents would need to be reassessed.

Where primary field surveys are required, careful consideration must be given to the design of the field survey and sampling programme (refer to Figure 4-3). The data collection must focus on the key issues needed to be examined for the EIA (identified during the scoping process), and should be collected at the appropriate time(s) of the year. In Sabah, this may include consideration of rainy and dry seasons, and on the coast, the monsoon and inter-monsoon periods.

It is important to address the temporal scale of the project when designing the baseline survey programme. A long-term dredging or reclamation programme (e.g. one or more years) would require a baseline survey that captures natural seasonal variations within that period; while for a short project (e.g. 1-3 month construction phase), capturing a snapshot of the existing conditions can be sufficient.

In addition, the survey programme shall take into account the anticipated zone of impact for the issue in question to ensure that all potential sensitive receptors are included.

It should also be highlighted that a more detailed baseline, capturing seasonal variations, provides more security for the Project Proponent, in the event that natural variations are incorrectly perceived by stakeholders or regulators as project-derived impacts.



Source: Adapted from PIANC, 2010

Figure 4-3: Examples of criteria for selection of baseline survey stations and methodologies

5 Impact Prediction and Evaluation

This chapter deals with the assessment of the impacts that are likely to occur in the existing environment when the project activities are implemented (refer to Table 5-1).

Table 5-1: Assessment Procedures - Description of Impact Assessment

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA study	Environmental Consultant: • *Assess the project details* - *Plan assessment* • *Assess the existing environments* - *Physical environment* - *Biological environment* - *Human environment* • *Assess the environmental impacts* - *Hydraulic/ morphological impacts to the shoreline* - *Flooding risk due to altered hydrology or impacts on flows of drain outlets and river mouths* - *Water quality deterioration from increase of suspended solids and discharges of other pollutants* - *Ecological impacts on marine and terrestrial habitats, flora and fauna* - *Conflict of land uses e.g. loss of coastal area used e.g. for fishing, leisure, eco-tourism or navigation* - *Air and noise pollution* - *Waste handling (biomass, solid waste, sewage and scheduled waste)* - *Impacts on existing land or marine traffic* - *Social economic concern/ benefits* - *Potential abandonment* • *Devise and propose mitigation measures* • *Devise and propose monitoring programmes*

This section outlines procedures for identifying the environmental impacts associated with land reclamation activities, as well as proposed methodologies for assessing the scale and extent of the environmental impact.

The magnitude of the impacts depends on the combination of existing conditions and the selected reclamation technologies and methodologies, while the zone of impact depends on existing environmental conditions such as wave, current, wind, aquatic flora and fauna, land use, traffic or nearby settlements. Adverse environmental impacts affect habitats and livelihoods outside the project area and hence the Project Proponent is responsible to minimise such impacts by adopting mitigation measures. As a general principle, mitigation measures should preferentially focus on addressing the impacts in order to eliminate/ minimise the residual impacts.

The assessment should consider site characteristics, the proposed reclamation and subsequent construction activities and the cumulative effects with other existing or proposed developments within close proximity to the site. The environmental consultant’s approach to assessing these interrelated factors should be clearly described based on the TOR as approved by EPD.

5.1 Description of Plans and Site

Step 4 of the overall environmental assessment process may be divided into four (4) main parts:

i. Description of planned activities and existing environment conditions;

ii. Assessment of environmental impacts;

iii. Devising mitigation measures; and

iv. Formulation of monitoring programme.

This chapter deals with the description of plans and the existing conditions within the site and the zone of impact (refer to Table 5-2).

The assessment of the existing environment and thus the activities and associated mitigation will, to a large extent, be based on an analysis of topographic maps combined with knowledge of the field conditions. The actual delineation of areas and mitigation measures must be based on the verifiable conditions in the field, i.e. be based on field surveys.

Table 5-2: Assessment Procedures - Description of Plans and Existing Environments

The Seven Steps	Summary of Main Required Activities

Step 4:
Undertaking the EIA study
	Environmental Consultant:
	• *Assess the project details*
	  • *Plan assessment*
	• *Assess the existing environments*
	  • *Physical environment*
	    - *Water*
	    - *Air and noise*
	    - *Bathymetry*
	    - *Wind, waves, current*
	  • *Biological environment*
	    - *Aquatic flora and fauna*
	  • *Human environment*
	    - *Public administration*
	    - *Demography*
	    - *Livelihoods and economic activities*
	• *Assess the environmental impacts*
	• *Devise and propose mitigation measures*
	• *Devise and propose monitoring programmes*

The impact assessment is, as mentioned, based on a combined knowledge of the intent and the existing environment.

An assessment must therefore be made of the existing environment, its components and its sensitivity to impacts from the land reclamation activities. In order to provide a basis for comparison during later monitoring, it is important to have a set of baseline data, describing clearly the pre-project conditions. The description provided must be clear and direct to the point being discussed.

5.1.1 Project Options

Land reclamation activities can have inherent risks. These risks are usually manageable, but involve increase costs, relative to alternative sites. The decision to reclaim a land area should be assessed and justified through a discussion of alternative project options.

The justification needs to identify why the proposed functions or objectives of the development can only be achieved by located it on a reclaimed land. This approach is aimed at preventing inappropriate land reclamation activities which can possibly cause irreversible environmental impacts in the long run.

5.1.2 Project Screening

Screening is recommended to be applied by environmental consultants to determine the aspects that should be covered in an EIA report. The process of screening should be simple and rapid, but effective enough to eliminate major potential environmental impacts that have residual significance, such as destruction of environmentally sensitive areas or priority habitat.

Screening allows for focus on real environmental issues at an early stage of the assessment process and allows for environmentally sensitive planning and the early resolution of some issues. This will minimise the possibility of residual impacts. Project screening is conducted by assessing the project details in relation to the existing environment as described in Section 5.1.3 and Section 5.1.4.

5.1.3 Assess the Project Details

In order to be able to propose realistic mitigation measures, the following initial information should be obtained prior to embarking on any field surveys or assessments. This information will provide the scope of work for the assessments to be included in the EIA report.

A more detailed description of the project concept, with all available technical data should be given in the EIA report, in terms of:

i. Project Location and Concept

- Exact location of the proposed project site and all receptors within 3-km radius, particularly those within the zone of impact. These should be shown on a map with an appropriate scale and coordinate system;
- Description and illustration of the proposed project including all the related components (development plan and cross-sectional views);
- Implementation schedule for site clearing, reclamation and construction activities;
- Local structure plan for the area and its nearby surroundings;

- Details on present land and sea-based traffic conditions and future anticipated conditions (if the proposed project increases the traffic volume significantly); and

- Statement of need for the proposed project.

ii. Reclamation Details and Methodology

- Estimated amount of earthwork including location of proposed borrow area/ spoils disposal sites, layout plans and cross sections. The vertical and horizontal scales on all cross sectional **drawings must be 1:1**;

- Dredging and reclamation methodology including phasing plan and sequence;

- Type and quantity of dredgers to be used,

- Hydrological features of the site including proposed drainage layout plan;

- Erosion and sediment control plan detailing out the erosion control measures to be implemented; and

- Details on siting of temporary structures such as site office, workers quarters, workshop, stockpile area, and others, including estimated number of workers to be employed (if available).

iii. Construction Works Methodology

- Site layout plan (including location of proposed structures, material storage area, workers quarters and site office);

- Type of piling method adopted for building foundation works;

- Drainage plan showing plans for conveying surface and sub-surface water away from the site; and

- Landscaping proposal for the proposed project (if available).

5.1.3.1 List of Supporting Documents Required

The following reports/ details (plus other appropriate reference sources) should be made available and incorporated in the EIA report, where relevant:

Report/ Study	Details Required
Geological/ Soil Investigation Report prepared by a registered geologist/ professional engineer	– Detailed marine geology, subsurface geological profile, coastal morphology and processes, bathymetry survey, reclamation materials (source – quarry or borrow areas) results
Erosion and Sediment Control Plan (ESCP) as prepared by a competent party (latest as per submitted to the local authority)	– Layout and design details for erosion control facilities such as sediment basin, silt traps and temporary drainage network mainly for reclamation stage (compulsory) and construction stage (where applicable)
Drainage Report prepared by a professional engineer (latest as per submitted to the local authority)	– Drainage pattern onsite before and after development, water catchment areas, runoff flow direction
Reclamation/ Earthwork Plan (in phases) prepared by a professional engineer (latest as per submitted to the local authority)	– Earth/ sand filling areas, comparison between existing and finished ground levels, reclamation implementation in phases detailing out the activities involved in each phase

5.1.4 Assess the Existing Environment

It is necessary to provide sufficient information to give a brief but clear illustration of the existing environmental components. These components include, to the extent applicable (but are not necessarily limited to) the following:

- **Physical Environment**: bathymetry, wind, wave, current, coastal morphology, soil, geology, hydrology, water and air quality and noise level.

- **Biological Environment**: wildlife, forest - mangrove, rare, protected or endangered species (both aquatic and terrestrial flora and fauna), fisheries, wilderness or protected areas, key conservation value habitats or species.

- **Human Environment**: population and communities (including numbers, locations, compositions, employment and other), land use, infrastructural facilities (including water supply, electricity, sewerage and others), institutions (such as schools, hospitals and places of worship), transportation (roads, navigation and other), archaeological, historical and cultural values and aesthetic values.

The baseline study for the EIA should concentrate on identifying those environmental components that may be significantly impacted by the proposed project. These may be identified through ground observation, literature review and stakeholder consultation. The description can be presented in the form of mapping, listing or reports in the EIA report.

5.1.5 Study Area and Zone of Impact

Generally, a study area for the preparation of an EIA report covers a 3 km radius from the project site boundaries. However, the study area should focus on what the environmental consultant deems to be the zone of impact. A clear delineation of the study area based on actual ground survey conducted is important to define the area within which impacts must be considered.

There may be different zones of impact for the physical (such as marine water quality, coastal morphology, drainage pattern, and air emission/ noise nuisance), biological (such as marine species, habitat and diversity) and human (such as social issues affecting communities, cultural and aesthetic aspect and land use) environment. The environmental consultant should overlap these impact zones and decide which zone is particularly sensitive and where impacts are likely to be of some significance. Such zones may reach far downstream from the site, particularly if there are sensitive areas seawards or locality concerns. The zone of impact can be determined after understanding the concept of the proposed development and conducting ground observations to identify these sensitive areas.

The extent of the study area/ zone of impact must be mapped out, clearly defined and justified in the TOR document and agreed upon with EPD. This will particularly include human settlements that are to be included in the assessment surveys for the preparation of the EIA report.

5.2 Impact Assessment

The EIA for land reclamation activities will assist in the following:

- Planning of site preparation, reclamation activities and subsequent construction works;
- Identification of environmental impacts and the risk of negative impacts;
- Exclusion or protection of sensitive or vulnerable areas; and

- Protecting environmental components in the immediate site area, in adjacent areas and in the broader environment.

Integrating environment protection at the project planning stage will ensure that measures to avoid and minimise pollution can be built into the project design and work schedule. The EIA should not only consider the environmental impact on a site, but whether or not significant off-site effects are likely. An initial assessment of the site should be conducted to identify sensitive environmental areas or land-uses that require protection. These may include:

- Sensitive or endangered flora and fauna;
- Aquatic plants and animals, if a natural waterway is affected; and
- Historical buildings/ cultural areas that are considered as sensitive.

The first activity to be performed as part of the EIA process is to identify environmental issues which are important and which will need to be studied in detail, and to identify and eliminate issues which are of little or no importance and therefore can be excluded from the EIA study.

In addition to an assessment of the specific impacts related to the project, an overall assessment should be made based on the carrying capacity of a particular coastal area, and/ or river system to accommodate dredging and land reclamation activities, while still maintaining its geomorphic and ecological characteristics. In this respect, an assessment of the "cumulative impacts", of the dredging and reclamation project being assessed, plus other existing and planned dredging and land reclamation operations on the same coastal area or river drainage system is important. Integrated assessment of the sensitivity of broader coastline or river system to cumulative impacts of a number of dredging and reclamation projects will assist in managing the area and its resources in a way that is compatible with "best practice" environmental protection.

5.2.1 EIA Matrix

Impact assessment is not an exact science. The assessment of impacts therefore requires a deep knowledge and understanding of the local environment, coastal hydraulic processes and the development concept. Therefore, different assessments are likely to come to similar but still somewhat different conclusions.

The environmental consultant should combine their personal experience with recent international and local research results, monitoring reports from neighbouring areas of active reclamation activities and construction works, new survey data and in many cases from the results of modelling.

Literature on the impacts of land reclamation activities already exists and in the first instance this should be consulted. A review of known impacts documented for similar environments is likely to provide a good foundation for the basis of the impact assessment.

Results obtained from computerised mathematical models need to be verified against field data. It should be recognised that for the results to be representative, the data requirements are high and limited by the quality of the input data. To enable verification by EPD, actual procedures should be made available. Before using computer models, prior consultation and approval with EPD is advisable.

It cannot be stressed enough that the environmental consultant should take a realistic and site specific view of the project. They shall neither promote nor criticise the proposed activities but realistically present, what in their professional opinion is realistic to expect as a result of the plans. In order to have an impact on the planning, the environmental consultant should focus on a limited number of significant key issues supported by literature review and project specific information. In addition to an assessment of the probability (risk) of the impact to occur, each issue shall be described with a view of:

- The magnitude of the projected impact.
- The permanence of the projected impact.
- The reversibility of the projected impact.
- Cumulative impacts over time of the projected impact.

This means that these four points must be represented as sub-headings for each description of each impact.

The summary of results shall be presented in an EIA Matrix, an example of which is shown in Table 5-3. To guide the reader of the EIA report, this summary table is best placed before the descriptions of environmental impacts.

Table 5-3: EIA Matrix (Example)

Impacts	Magnitude	Permanence	Reversibility	Cumulative
Key Environmental Impacts				
Morphological Impacts	2	3	3	3
Suspended Sediment Plume	2	2	2	3
Air and Noise Pollution	1	2	2	2
Waste Management	2	2	2	2
Ecology	1	3	3	3
Other Environmental Impacts				
Traffic and Transportation	2	2	2	2
Vibration	2	2	2	2
Social Economic	1	3	3	2
Visual/ Aesthetic	2	3	3	2

Legend	**Score**		
Criteria	**1**	**2**	**3**
<u>*Magnitude*</u> *Measure of the importance of the condition in relation to spatial boundaries*	Change/ effect within project site only	Change/ effect to local conditions and/ or to areas immediately outside	Regional/ national/ international change/ effect
<u>*Permanence*</u> *To define whether the condition is temporary or permanent*	No change/ not applicable	Temporary	Permanent
<u>*Reversibility*</u> *Measure of the control over the effect of the applied condition*	No change/ not applicable	Reversible	Irreversible
<u>*Cumulative*</u> *Measure of whether the effect will be a single effect or a cumulative effect over time or a synergistic effect with other conditions*	No change/ not applicable	Non-cumulative/ single	Cumulative

When scoring the level of impact, the environmental consultant should give justification on how the scoring has been done and what has caused very high or very low assessment scores. This can be done by repeating the table row at the end of each impact description. An example is given in Table 5-4.

Table 5-4: Activity Level EIA Matrix (Example for Suspended Sediment Plume Impact)

Criteria	Score	Justification
Magnitude of change/ effect	2	Plume impacts extend approximately 8 km from project site
Permanence of Impact	2	Temporary – duration approximately 5 months
Reversibility of Condition	2	Reversible upon cessation of dredging.
Cumulative Impact	2	No cumulative effect over time, and no other major sources in the vicinity.

5.2.2 Use of Geographical Information System (GIS)

The representation of spatial data by means of a GIS provides an appropriate tool for representing and analysing spatial data sets, particularly for larger, more complex and sensitive projects. GIS therefore offer good opportunities to examine the environmental sensitivity of different environments.

It is a requirement to submit datasets directly to EPD. The GIS used by the environmental consultant should be able to export datasets in a format readable by the EPD's system. The environmental consultant should therefore consult EPD before the analytic work begins in order to ensure such compatibility.

EPD may from time to time issue a list of map formats including standardised map symbols or spatial data requirement, which must be used in maps submitted as part of an EIA.

5.2.3 Numerical Modelling

Many environmental impacts from dredging and land reclamation activities are not easily quantifiable. Numerical modelling is a key tool to quantify hydraulic impacts as it provides spatial and temporal information about the existing environment and the ability to predict future changes in response to a project. Comparing model results for existing conditions with results that include the proposed reclamation/ dredging can be used to assess the potential impacts.

Except for small projects in areas with no, or very limited, sensitive receptors, where a lower level of certainty in the impact prediction may be accepted, hydraulic studies based on numerical modelling are considered a requirement to quantify potential impacts. For the small, non-sensitive projects, expert judgement based on an understanding of the site conditions may be sufficient for the evaluation of impacts. An example of small/ non-sensitive projects that may not require modelling could be small scale reclamation works in an intertidal area along a coastline with no or limited littoral transport, and where the area is bunded prior to reclamation to prevent any sediment spills into the marine environment. Whilst modelling may not be required because the potential impacts are minor and can be predicted without modelling, this needs to be evaluated and justified in the EIA report together with consideration of appropriate mitigation measures.

Results obtained from computerised mathematical models need to be verified against field data. It should be recognised that for the results to be representative, the data requirements are high and limited by the quality of the input data. The environmental consultant is referred to the Department of Irrigation (DID)'s guidelines for numerical modelling which include guidelines on data collection, model calibration and validation.

5.2.4 Optimisation of Project Plan

The environmental consultant will at several points during the assessment, find that the plan description provided by the Project Proponent is suboptimal seen from an environmental point of view. There may be environmental management issues, which are not included in the plan description, there may be certain parts of the project scope, timing or lay-out, which are not seen as acceptable, or there may be suboptimal choices of technologies or methodologies. The environmental consultant will, when such flaws in the plan description become obvious, advise the Project Proponent on recommendable plan changes so the final plan, which is being assessed by the environmental consultant, is optimised for environmental management, i.e. negative environmental impacts are being minimised through proper choice of scope, technologies and methodologies.

It is unavoidable that the project activities will cause some residual impacts even when all activities are carried out in the best possible manner. The assessment by the environmental consultant will then concentrate on assessing the magnitude and effect of these residual impacts. There will be no more that the Project Proponent can do to minimise them. There will, however, be some mitigation in the form of compensation that can be implemented. Off-set planting or replacement of habitat conservation, cash compensation or substitutes for lost livelihoods or environmental services are among the options for mitigating unavoidable and thus residual, impacts.

Project optimisation options should be thoughtfully considered and reported in the EIA report so that the maximum benefits of the project are clearly understood. These benefits should be considered against any residual impacts that may be identified in the EIA.

5.3 Environmental Impacts

The key environmental impacts associated with land reclamation and subsequent construction works concern:

- Hydraulic Impacts – changes in currents, flushing, water levels and waves
- Morphological Impacts due to changes in current, wave and sediment transport patterns
- Water quality deterioration due to changes in flushing characteristics
- Ecological impacts
- Socio-economic impacts
- Release of fine sediments into the aquatic environment
- Increased noise levels from construction activities
- Dust and atmospheric pollutants from machinery and transport vehicles
- Increase in marine/ river traffic associated with reclamation activities.

The potential impacts can be divided into "construction" and "project" related impacts. The construction impacts are often of temporary character during construction, while the project related impacts are caused by the presence of the project and often are of more permanent character. Construction impacts are typically mitigated through careful management during construction, whereas project related impacts are best mitigated trough siting and layout design optimisation in the early project planning phase. It is thus essential that the environmental consultant gets involved in the project development at an early stage during project planning to ensure that environmental considerations are included in the design optimisation process.

Documented advice should be provided to Project Proponents at an early planning stage on best ways to improve the environmental sustainability of the project. For example, provide site location or design alternatives that reduce the risk of environmental impacts and improve the environmental performance and aesthetics of the project. This may require the environmental consultant to obtain specialist advice from technical specialists (i.e. designer or engineer/ architect) on such matters.

Different activities related to land reclamation activities cause different impacts, while technologies, methodologies and local, site specific conditions determine the extent of the impacts, i.e. the zone of impact and the severity. As a planning tool, it is important that the EIA gives very clear recommendations to the Project Proponent on how activities should be implemented. The surrounding community, however, is more concerned on where, when and how, impacts will affect their livelihoods; less on why. The definition of impact, particularly residual impact, should therefore be clear and define impacts in terms of time, quantity and quality.

5.3.1 Coastal Hydraulics

Alterations to the riverbank or shoreline configuration through the creation of new land masses or channels may change wave, current and sediment transport patterns, which could result in a range of direct or indirect impacts including (but not limited to):

- Siltation of waterways at river mouths, rivers, navigation channels, ports and harbours, drains, outfalls and others, and at environmental receptors;
- Berthing and navigational impacts (from waves, eddies, cross-currents, tunnel-flow and others);
- Flooding impacts (from extension or siltation of rivers and drains, often at the outlets if these are sheltered by a reclamation);
- Flushing impacts at corals, mangroves, embayed water bodies, water villages and others (from shadowing, changes in tidal prism and others);
- Trapping of floating debris; and
- Changes in salinity which may impact both habitats and water intakes.

Assessment Methodology:

Quantification of hydraulic impacts generally requires a hydraulic model study. To assess the potential impacts to the hydraulic regime and coastal environment from the proposed development, comparisons of hydrodynamic simulations for both existing conditions and with the proposed development need to be carried out. The assessment should include considerations of seasonal effects and project phasing. The scope of the modelling required is site specific. If for instance there is significant stratification of the water column at the site, or salinity or temperature modelling is required, a 3D model is likely required.

The potential hydraulic impacts should not only be assessed for the planned layout design, but also for the likely future conditions taking potential morphological changes into account. An example of this is the evaluation of backwater effects in rivers and drains where the outlets are sheltered by the reclamation, which potentially could lead to sedimentation at the outlets. It is thus required to assess the potential sedimentation in any drain/ river outlet and the impact of this on the drainage patterns to evaluate the potential for added flow resistance leading to backwater effects and upstream flooding.

An initial flood impact assessment can be carried out by assessing the changes in water levels within streams/ drains by running a local model for the area (including all relevant rivers and drains potentially affected) with extreme discharges in the rivers/ drains affected by the reclamation. By comparing the water levels with and without the project included in the model, an initial quantification can be carried out. The assessment should include a consideration of potential sedimentation as outlined above, and should further consider potential increased storm water level setup at the outlet.

A full assessment of flooding impacts (which requires modelling of the full catchment, including overland flow modelling where relevant) is only required if the initial assessment of flood impacts shows risk of significant changes to drainage patterns and water levels within the drains, and these cannot be prevented through design changes. Such impacts may for instance result from an extension of drainage channels across or around reclaimed areas; if there is significant risk of higher water level setup from storm conditions at the outlet and/ or the risk of clogging outlets through sedimentation induced by the reclamation. The flood impact study would in this case have to estimate changes in flood levels and frequency throughout the area affected.

Baseline data requirements are project dependent and should be assessed as part of the project scoping. For coastal projects including hydraulic modelling, minimum requirements for the assessment of hydraulic impacts is specified in DID guidelines and include:

- Current measurements. Minimum two locations for at least 3 days over spring and neap tides at each location;

- Water level measurements for a minimum of 15 days (simultaneous with current measurements);
- Bathymetry. Detailed around the immediate area with decreasing resolution requirements with distance from the site; and
- Coastal profiles/ river cross-sections.

For the assessment of coastal or riverine morphological impacts, a comprehensive bottom sediment survey of the area surrounding the proposed reclamation and within the proposed borrow area should be performed.

It is noted that the minimum requirements are only sufficient to capture basic short-term conditions such as tidal currents. Seasonal climatic conditions need to be considered and data for this should as far as possible be sourced from the site or nearby areas with similar characteristics. Extreme conditions may be assessed through numerical modelling.

5.3.2 Morphological Impacts

The hydraulic changes and associated changes in sediment transport patterns can result in morphological changes. The morphological changes induced by reclamation and dredging projects are often critical if they result in: coastal erosion, bank erosion or siltation of waterways.

Coastal morphology and riverine morphology are not static conditions. An on-going process of erosion and deposition is fundamental to the natural environment. The potential impacts relate to interventions that either accelerate, reduce, or significantly change the pre-existing balance of morphological change.

Assessment Methodology:

The historical rate of morphological change, and the trajectory under existing conditions, can often be assessed by an examination and comparison of historical aerial photos, as well as on-site identification of changes in riverine channel course, or shoreline movement (refer to Plate 5-1 and Figure 5-1).

Plate 5-1: Site visits to identify areas of coastal erosion

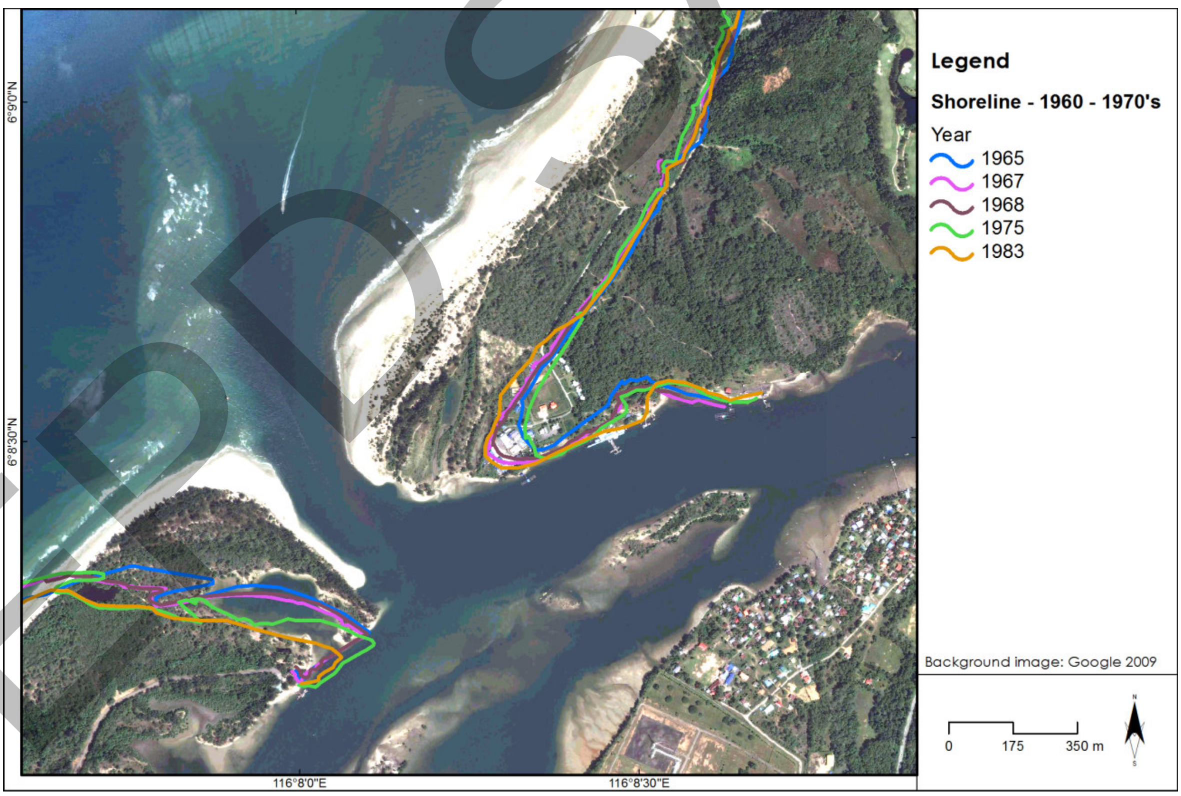


Figure 5-1: Historical analysis of coastal erosion is important in some areas

Depending on the location, scale and configuration of the reclamation, the morphological impact assessment may require numerical modelling. In simpler cases with no major impacts expected, an expert assessment may be carried out through an evaluation of the predicted changes in the current and wave conditions and its anticipated effect on morphology.

However, if the scale of the project is substantial and larger scale changes in current and wave patterns are expected around the project site, or if there are sensitive shoreline land uses or intertidal habitats in the area, a more comprehensive approach is required. Numerical modelling in these instances should be carried out to identify potential erosion and deposition areas and quantify changes in sediment budget and sediment transport capacities in these areas.

Some potential morphological impacts related to dredging and reclamation projects include:

- Blockage of the littoral transport if reclamation is located along an open coastline and/ or a navigation channel traps the littoral sediment transport. This will typically lead to accumulation of sediment on the updrift side and erosion on the downdrift side of reclamation and potential erosion on the downdrift side of a dredged channel. Depending on the coastline configuration at the site and the littoral sediment transport rates, the downdrift impacts may be localised or gradually extend kilometres from the site. Impact to the littoral sediment transport can lead to long term, regional impacts and the existing littoral sediment transport budget needs to be assessed (refer to Figure 5-2).

Figure 5-2: Coastal setback due to obstruction of littoral transport caused by jetty structure (Kimanis). Red arrow indicates extent of setback, yellow dashed line indicates original shoreline location

- Localised sheltering effects caused by the reclamation may lead to accumulation of sediment and changes to the local sediment characteristics with potential negative impacts such as:
  - Siltation of drainage channels and river outlets, increasing the risk of upstream flooding and/ or areas with stagnant water with impacts to water quality.
  - Siltation in neighbouring sheltered areas with impacts on navigational access.
- Changes to aesthetics by for instance changing a sandy beach to a silty/ muddy beach.
- Changes to benthic habitats.
- Excessive sedimentation in mangrove areas leading to choking of mangroves and/ or changes to the drainage patterns.
- Reclamation within a lagoon area, e.g. of mangrove areas, will reduce the tidal prism within the lagoon and thereby impact the flushing through and the morphological stability of the lagoon entrance.

- A dredged channel may act as a sediment sink that starves adjacent areas for sediment.

5.3.3 Water Quality

Potential water quality impacts may be both project related due to changes in flow characteristics caused by the project and/ or construction related caused by the dredging/ reclamation process. Among these are:

Dislodging of the Material Phase

- Increase of suspended sediments: the cohesion of the in-situ material is broken by the dislodging process and part of the material can be brought into suspension by the cutting action.

- In the case of hydraulic dredging, water is mixed with the material during the cutting and suction process to facilitate transport of the material. The ratio of soil to water varies from dredger to dredger, hence this information will need to be provided by the dredging contractor in order to estimate and predict the potential impacts.

- Disturbance and/ or destruction of the benthic environment at the dredge site.

Raising the Material Phase

- *Release of suspended sediments*: in the case of mechanical raising in an open bucket/ backhoe type of dredger, the dredged material is in direct contact with the surrounding water column which can dilute and disperse suspended sediments in the surroundings. With hydraulic transport, the potential problems during the raising process are limited to the point at which the material enters the suction mouth.

- *Overflow during loading of hopper or barges*: the overflow of excess water inevitably brings sediment into the surrounding waters. This effect is greater when hydraulically loading as compared to mechanical dredging as the material is mixed with a higher ratio of water, which will need to be discharged (overflow) before the material is transported to the placement site. In this case, the hopper or barges act like settling ponds, with the soil material settling in the bottom of the barge and the water collecting on the top, which is then discharged as overflow water (see Figure 5-3 and Plate 5-2). Prohibition or limiting of overflow when dredging in soft sediments will effectively prevent loss of sediment into the water column.

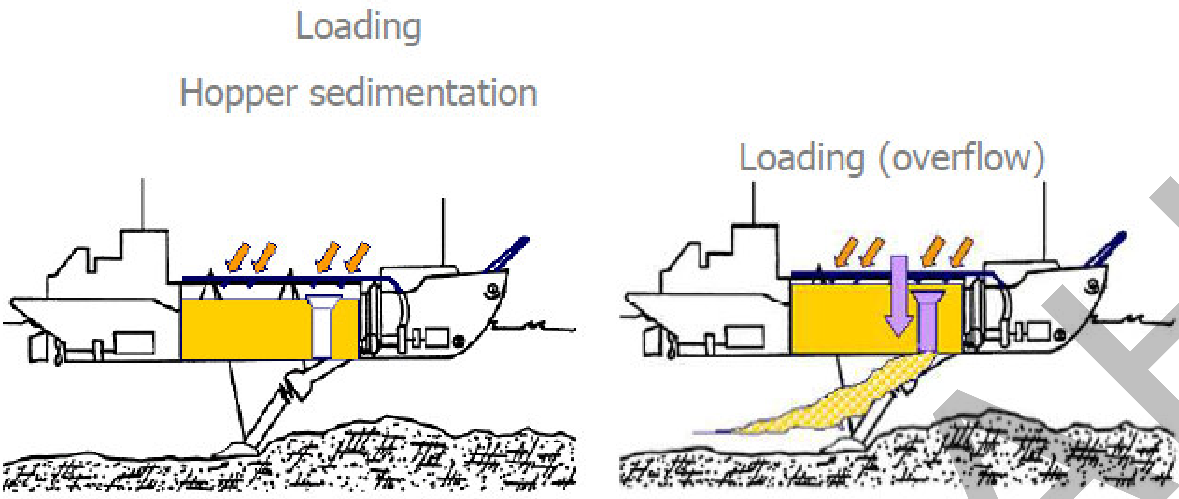


Figure 5-3: Schematic of loading with overflow from hopper

Plate 5-2: Sediment plume from dredger overflow

Transport of the Material Phase

In general, the environmental impacts of the transport process are slight compared with the other phases of the dredging cycle. Some spillage of sediment may occur through leakage at pipeline joints or spillage from barges during transport.

Placement of the Material Phase

- Direct loss of existing surface and habitat due to the reclamation/ disposal footprint.

- Dispersion of the material: depending on water depth, the effects of natural wave and current conditions can result in the dispersion of the fine material into the surrounding water.

Water quality measurements should be taken from all significant discharge channels in the area as well as around/ offshore of the project site. These should be taken over ebb and flood tide over several tidal cycles. Parameters should be tailored to the nature of the project and identified effluents and pollution sources.

In addition, references should also be made to the following planning documents for a more complete assessment:

- Development plan

- Reclamation/ earthwork layout plan including erosion and sediment control components

- Soil investigation and/ or geological report (if applicable)

- Drainage layout plan

Project Related Water Quality Impacts

Potential project related water quality impacts for reclamation projects are predominantly associated with sheltering effects with potential flushing issues. Issues associated with operational discharges from development on the reclamation have not been specifically addressed here as this depends entirely on the type of development, but these would have to be addressed as part of the environmental assessment. This may include industrial and/ or domestic loading unless otherwise addressed by separate assessments for example for DOE.

Dredging and reclamation projects may also affect the saline balance of a river/ estuary if for instance:

- The tidal prism of the system is changed;

- The controlling depth for a saline wedge at the entrance to a river/ estuary is changed; or

- The mixing zone at the entrance to a river/ drain/ lagoon system is changed.

The following section focuses on the assessment of water quality impacts through flushing.

Flushing/ Retention Time

Hydrodynamic conditions (the motion of water) in the sea govern the mixing of runoff water or a semi-enclosed body of water with ambient sea water. In a semi-enclosed bay or estuary, the water exchange or mixing rate can be slow (long flushing times), which can cause problems from an accumulation of, and increased concentration of, vectors that affect water quality. Along an open straight coastline, the water exchange and mixing can be much faster, which can minimise accumulation.

Land reclamation, depending on its configuration, has the potential to influence water quality conditions by altering the flushing characteristics of the area; for example through the creation of semi-enclosed or more sheltered areas along the coastline/ riverbanks. This may cause stagnant or poorly-flushed areas which can accumulate rubbish or pollutants (refer to Plate 5-3), in particular where the reclamation is carried out near a source of pollutant discharge, such as an urbanised river or main drain, or if the reclamation layout incorporates convoluted features such as lagoons and canals.

Plate 5-3: Debris and floating rubbish accumulated in semi-enclosed area along KK city waterfront

Another consideration is the type of development to be constructed on the reclaimed land and whether significant waste water or other pollution sources are expected to be discharged from the site.

<u>Assessment Methodology</u>:

Numerical modelling of flushing and/ or water quality, pre- and post-development, should be carried out when it is considered that there are risks of impacts to the water quality. The assessment should take into account various climatic and flow scenarios. The flushing simulations provide a general indication of residence times around the reclamation area. However, if more detailed information is required, for example actual concentrations of a given pollutant of concern, water quality modelling should be carried out.

Water quality and ecological models including food-web and explicit nutrient recycling (including loss processes such as de-nitrification) are now readily available. Many of these can couple directly to hydro-dynamic models which fully resolve advection and dispersion of these processes (hydrodynamic as well as nutrients) in the water column, at very high resolution. More specifically these models can also be used to determine eutrophication, contamination of organisms by heavy metals and specific seabed water column nutrient exchanges through mineralisation.

These models are generally data intensive and hence their use should be weighed against the study requirements. For example if flushing is anticipated to be a problem in an area which is already facing significant water quality issues, then water quality modelling to quantify the potential increases in certain parameters may be required to evaluate actual concentrations against available standards or the tolerances of the identified sensitive receptor(s).

Construction Related Water Quality Impacts

Suspended Sediment Plume Impacts during Dredging and Reclamation

If the project involves dredging or reclamation with significant discharge of fine sediments into the aquatic environment, key potential impacts during construction are related to turbidity and sedimentation caused by the dispersion of fine sediments.

Increased amounts of suspended solids in the water column will increase the turbidity and sedimentation in affected areas. The level of impacts will depend on a combination of the amount and location(s) of suspended solids generated, its dispersion from the source(s), and the presence of sensitive receptors.

During dredging, the disturbance and suspension of sediments in the water column can also result in the release of heavy metals and other pollutants previously adsorbed into the sediment, possibly in toxic or harmful concentrations for human and/ or aquatic fauna.

Data Requirements:

Key data required for the assessment of dredge and reclamation plume impacts depend on the method of reclamation. If a reclamation project is based on marine fill (sourced through dredging), the dredge plume dispersion is important. If a reclamation project is based on fill sourced from land, the key source of fines will be from potential erosion of the reclamation perimeter and runoff from the site. Data requirements for dredging and reclamation are outlined separately below, although they are closely tied together in a reclamation project with marine fill from dredging.

Key data required for dredge plume modelling include:

- Detailed dredge plan. This should include information on:
    - Dredge and reclamation volumes
    - Dredge and reclamation methodology
    - Type and size of dredger(s)

- Production rates and schedules

- Soil composition of dredge/ borrow material including type, consolidation and percentage of fines (mud and silt fractions).

For assessing the spill(s) from the reclamation site, key data includes:

- Detailed reclamation plan. This should include information on:
  - Reclamation volumes
  - Reclamation methodology – i.e. will the material be wet or dry fill, will a bund be constructed around the reclamation site prior to filling, or will the reclamation site be built out progressively
  - Type and size of dredger(s)
  - Production rates and schedules
  - Phasing and schedule
  - Drainage configuration – will there be sedimentation bunds and locations of discharges/ drain outlets
- Soil composition of borrow material including stiffness and percentage of fines (mud and silt fractions)

Other data requirements include the data to set up, calibrate and validate hydraulic and wave models to drive the plume modelling.

Assessment Methodology:

The way in which fine sediment particles (fines) are impacting environmental receptors depends on how the fines are distributed spatially and temporally in adjacent water bodies by waves and currents. Quantification of dredge plume dispersion requires numerical hydraulic and sediment transport modelling. Through modelling, a variety of dredge/ reclamation processes and methodologies under variable climatic conditions can be tested to quantify potential impacts as part of the assessment process.

Where sensitive receptors exist within the potential zone of impact (which may extend more than 10 km from the project site, depending on metocean or riverine conditions), numerical modelling of suspended sediment plumes during the dredging/ reclamation activity should be carried out. The accuracy of impact predictions depends on the temporal and spatial coverage and validity of input data and the ability of the models to identify and simulate the key processes. The use of quantitative performance criteria for model calibration and validation against field measurements can help regulators assess the level of reliability achieved and improve stakeholder confidence in model results.

The suspended sediment plume modelling should be based on project-specific variables (dredger type, number, production rate, properties of dredge/ fill material, placement methodology). Often, only limited project information is available during the environmental assessment stage, so a conservative, but realistic approach should be adopted.

In particular, the timing, scheduling, equipment, content and characteristics of fines are typically not confirmed during the environmental assessment stage. In these cases, the environmental consultant needs to clearly articulate any assumptions made, and the requirement for verification and/ or review when more detail is available, or during the monitoring stage. In order to capture potential adverse conditions during the assessment phase, a range of timing and production rates should be assessed. A few variations of an assumed full reclamation/ dredge plan will generally not provide a good representation of the overall environmental risks associated with the project. Therefore, a modelling strategy that encapsulates these uncertainties at the assessment phase is equally important for a comprehensive prediction of potential impacts. A scenario-based modelling approach that establishes a set of representative and conservative scenarios for key factors controlling the spill and plume dispersion and simulates all combinations of: dredge/ reclamation, climatic and spill scenarios, and others should be adopted.

The model results will give the spatial extent of the plume as well as magnitude (concentrations) of suspended solids. In order to interpret these results so as to derive impacts for various sensitive receptors, the Malaysian water quality guidelines, or, depending on the type of sensitive receptor, literature-based information on tolerance limits, should be referred to. These should generally take into account both the magnitude of the stressor as well as the duration of exposure – see also Section 5.3.4 which provides additional information on this. Based on established tolerance limits, the potential zones of impact can be derived from the modelling of individual scenarios through established impact criteria for key environmental receptors, and the overall potential zones of impact may be derived by combining all of the individual scenarios.

The zone of impact for different receptor types readily identifies receptors at risk. Particular risks associated with various combinations of dredge methodologies and climatic conditions can be extracted from the individual scenarios, to form a solid platform for taking environmental objectives into account in optimising the final dredging or reclamation plan.

In terms of sediment plume modelling associated with reclamation and dredging works, some important model features must be addressed in the assessment. They include, but are not limited to:

- Parameterisation of receptor tolerances to turbidity and sedimentation;
- Spatial resolution of the model in the potential impact area appropriate for the scale of plume generation and complexity of the flow;
- Vertical resolution dependent on the three-dimensional nature of the flow in the potential impact area;
- Simulations adequately covering both representative and worst-case climatic conditions and production rates, and being sufficiently long (typically 28 days) to ensure that both key and cumulative tidal, wind and wave effects are captured;
- Taking into account that the plume is composed of different sediment fractions with different characteristics, which also depends on, amongst other things, the anticipated dredging technique to be utilised;
- Description of the spatial and temporal variability of plume generation; e.g.
    - TSHD generate a moving source of spill in the dredging area. The turnaround time depends on the sailing time between the dredging site and material placement site;
    - Grab dredgers generate a stationary source of spill, with periodic emissions during the lift phase.

The level at which the plume generation from dredging and reclamation operations is modelled will depend on the level of accuracy required. For example, overflow spill from a TSHD often carries on after dredging stops. This and other sources of sediment suspension such as propeller wash may result in turbidity generated outside the development area. In sensitive areas where plume generation is close to coral reefs for example, a high level of detail should be included in the model.

Due to the complexities of receptor responses to impacts from reclamation and dredging works, it is essential that during the environmental assessment stage, the modelling assessment is supplemented by an experience-based approach, drawing on:

- Expertise and experience with similar scale projects in similar proximity to relevant receptors and similar met-ocean or riverine environments;
- Local expertise and experience across multiple disciplines and locations in relation to coral reefs, mangroves and other sensitive receptors; and
- Assessment and analysis of trends and sensitivities in baseline data.

5.3.4 Ecological Impacts

Many coastal developments involve the direct removal of shoreline or near-shore habitats through the location (footprint) of the reclamation or dredging site. Indirect impacts generally may be attributed to suspended sediment plumes, water quality or changes in hydrodynamic conditions which affect the habitats. These impacts have the potential to inflict a direct loss of the resource/ habitat, an indirect loss of economic and ecological value (e.g. fisheries, tourism and biodiversity) and may cause cumulative impact on adjacent habitats with interlinked functions.

Most organisms living in a water body are sensitive to any changes in their environment, whether natural (such as increased turbidity during floods) or unnatural (such as contamination arising from disturbance of sediments which can sometimes result in release of contaminants). Different organisms respond in different ways. The most sensitive of these are the primary producer benthic habitats, as these depend upon clear water to maintain sufficient light penetration for photosynthesis, while they are at the same time sessile and unable to move away from the affected area. These and other habitats/ communities are discussed further in the following subsections.

<u>Primary Producer Benthic Habitats</u>

Primary producer benthic habitats are those that require the sunlight to photosynthesise and are thus particularly sensitive to increased turbidity. These include coral reefs, seagrass and algal communities.

Key impacts to these habitats include direct loss due to dredging or reclamation over the habitat (project impacts) and suspended sediment plume and sedimentation impacts during the dredging and reclamation process.

Direct losses may be evaluated by totalling the area of habitat lost, the abundance or coverage of e.g. live coral within the area. Indirect effects are less easy to quantify, and depend on assumptions and available literature on tolerances to the various identified stressors and their predicted magnitude and duration.

Assessment Methodology:

In areas where coral reefs, seagrass or algae have been reported to occur, and/ or the aquatic environment is favourable to their presence, habitat mapping should be carried out to verify the presence, or absence, of these organisms and their habitats. Coral reef and seagrass habitat mapping can be carried out through various methods such as underwater towed video camera transects, snorkelling or site surveys during low tides.

If such habitats are found to exist around the project site and within the potential impact zone, further investigations will be required.

The significance of impacts to coral or seagrass habitats can be evaluated by assessing the importance of the community, for example through taxonomic diversity indices, and the cover of live coral/ seagrass or algae as a percentage of the substrate. Generally higher percentage cover and higher diversity are given higher importance. Qualitative, semi-quantitative or quantitative survey methods may be employed to determine these variables.

Generally for environmental assessment purposes, knowledge of the species of coral is not necessary for the impact evaluation. In known coral reef hotspots however, such as Darvel Bay where many endemic species may be found, species identification assumes more importance, as the impact significance is higher if the stressor is predicted to affect areas supporting rare or endemic species.

In less sensitive areas, information on coral genera and life-forms would suffice. Life-form categorisation is important as the different life-forms exhibit varying sensitivity to turbidity and sedimentation.

Impact Evaluation

Impacts evaluation both during the reclamation phase and after the completion of the project should include the following:

- Effects of sediment plumes and sedimentation during the reclamation phase.
- Effects of changed sedimentation and water turbidity due to changed currents and waves caused by the reclamation.

- Effects of changed water turbidity due to discharges caused by the project.

- The area and condition of benthic communities and aquatic habitat directly covered by reclamation/ dredging.

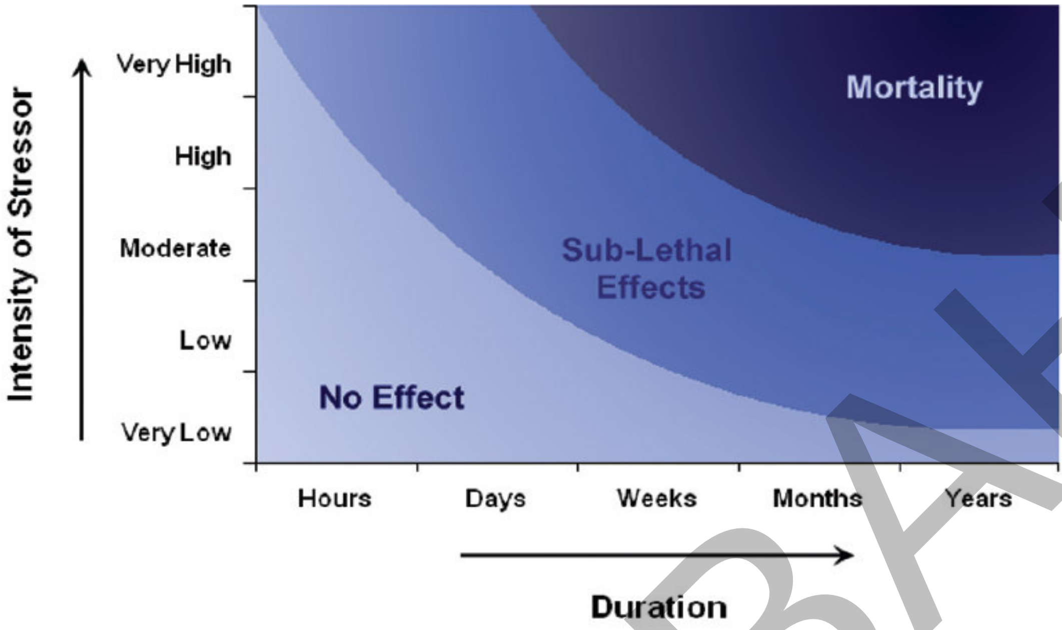
For analysis, it is necessary to use the results of the above mentioned numerical water quality, sediment plume and sedimentation modelling and in some cases flushing or eutrophication modelling.

Magnitude of Impacts

Predicting the severity of the stressor, such as suspended sediment plumes or sedimentation over the coral reef or seagrass habitat is only the first step in the impact assessment. In order to evaluate the impact to the community, the responses of the organisms in question to these stressors must be established. This is done through determination of the tolerance limits to the stressor (i.e. turbidity, sedimentation, other water quality pollution).

Establishing biological tolerance limits is complex and should ideally be based on available site specific data. However, this is not yet available or seen as practical in Sabah at this stage, and hence the environmental consultant must rely upon relevant literature values.

It is however important to select comparable studies (e.g. use of coral or seagrass species from similar tropical regions rather than say temperate species). The tolerance limits should take into account both the magnitude and the duration of the impact (refer to Figure 5-4). Most coral reefs for example are adapted to short periods of high suspended sediment loading which occur naturally during storm events, such that thresholds should not be set as absolute values (e.g. 50 mg/L), but should also look at the duration of the loading (e.g. should not exceed 10 mg/L for more than 10% of the time). Unfortunately, much of the published data on tolerance limits provide only single absolute values, and hence, the threshold durations should also consider site specific baseline conditions. For example, if a healthy reef is located in an area subject to periodic plumes from nearby rivers, the coral species and community as a whole could be assumed to be tolerant to turbidity thresholds on the high side compared to reefs that are only rarely exposed to turbidity plumes. Conversely, a poor quality reef located in a similarly turbid background environment may indicate that the community is already near the tolerance threshold for turbidity, and that community may have limited capacity to tolerate any further increases in magnitude or duration of turbidity.



Source: PIANC, 2010

Figure 5-4: Conceptual relationship between the intensity and duration of a stress event and the risk of impacts to primary producer benthic habitats

Impact Significance

The significance of the impact is related to the importance of the habitat being affected. This may be based on a range of factors, some of which are listed below:

Ecological criteria, such as:

- Representativeness – are the species and communities in the potential impact area well represented in other parts of the region or country
- Rarity or conservation status – are any of the species rare or endangered
- Resilience – what is the pre-project level of impact and stress on these habitats
- Cumulative effects

Socio-economic criteria, such as:

- Local significance – what is the cultural and socio-economic significance of these habitats
- Stakeholder needs and perceptions

Further assessment on each specific type of ecological features related to land reclamation activities are as follows:

Mangroves

The baseline information should contain a description and assessment of the present distribution and condition of mangrove forests within the affected area. Mangrove mapping can be carried out through satellite imagery or aerial photograph interpretation, combined with ground truthing. Dominant species and overall observations of mangrove health can be made based on qualitative descriptions, semi-quantitative or quantitative surveys.

The impact assessment should consider impacts both during the reclamation phase and after the completion of the project, including:

- Effects of changed sedimentation and erosion patterns due to changes to currents and waves;
- Effects of sedimentation and erosion caused by the project;
- Area and state of mangrove vegetation directly covered by reclamation; and
- Areas where mangrove vegetation is assessed to develop or disappear due to the project e.g. due to changes in tidal prism or salinity.

Soft Bottom Macrobenthos

A description and assessment of the present distribution, species composition and richness of the macrobenthic community in the impact zone should be provided together with impact during the reclamation phase including borrow areas, and after the completion of the project. Baseline data should include taxonomic identification to the lowest possible taxonomic level. In particular groups of organisms that are particularly tolerant or conversely intolerant to disturbance and water pollution should be identified, i.e. the baseline should consider life-forms, motility, and tolerance to various pollutants or stressors. The analysis shall embrace but need not be limited to areas and benthic community types where soft bottom macrozoobenthos is assessed to disappear due to the dredging, land reclamation or other impacts of the project.

For the analysis, it is necessary to use the results of the above mentioned computerised sediment spreading and eutrophication modelling.

Endangered Species

Description of the present occurrence of endangered species or commodities within the affected area such as sea turtles, dugongs, whales and dolphins should be made. These are reported to occur around many areas of Sabah, however published data on distribution and frequencies is not readily available. Rarely is it possible to launch a full survey of marine mammals or turtle nesting for a single environmental assessment, owing to the duration and seasonality considerations when designing such surveys. It is therefore important for the baseline assessment to consult with local NGOs and institutions such as the Borneo Marine Research Institute of University Malaysia Sabah and WWF Malaysia to obtain information on sightings at the project location. Consultation with local communities, in particular fishing communities is also an important source of local anecdotal information, and it is recommended that socio-economic surveys related to the environmental assessment include a line of questioning on sightings of marine megafauna in the area, their recentness and regularity.

Assessment of the present occurrence of endangered species or commodities aiming at preserving endangered species or extraordinary natural resources. The assessment shall include but need not be limited to the impact of the project in the reclamation phase as well as the operation phase on:

- Marine parks;
- Wildlife and bird sanctuaries;
- Other areas regulated for nature protection purposes;
- Sea turtles and its nesting sites; and
- Dugong feeding grounds.

5.3.5 Fishery and Aquaculture

Fisheries play an important role in the economy of the coastal populace by providing food, employment and regular income. There are two types of fisheries that need to be considered, these are capture and culture fisheries. The coastal waters of mangroves, seagrass beds, coral areas and mud flats are important nurseries for, and provide a rich harvest of economically important invertebrates and marine fish. Some aquaculture activities such as cage culture fisheries can thrive in naturally sheltered coastal waters. Many commercial species of fish and shrimps in the open waters depend highly upon the inshore vegetation along the shoreline for their early life, and the near-shore waters are also known to be crucial nursery grounds for the young life stages of marine aquatic species.

Reclamation can directly or indirectly destroy nursery grounds of juvenile fish and the habitat of shellfish. Naturally if the seabed habitat that contains the spawning and feeding grounds of the commercial fish species is destroyed then the ability of those species to reproduce is greatly affected. Additionally, pollutant loading arising from the reclamation activity may affect some pollution sensitive species of which some are either reduced in numbers or disappear and are replaced by more resistant species.

<u>Assessment Methodology</u>:

The assessment study shall provide adequate and accurate baseline data of the proposed development site and its adjacent area of probable impact (the study area) for accurate prediction and evaluation of fisheries impacts. The baseline study shall include at least the following:

a) *<u>Review and Collation of Existing Information</u>*

Existing information regarding the study area shall be reviewed. Such information includes both published and unpublished materials. Useful information could also be obtained from consulting local fishermen, non-government organisations and relevant government departments.

The accuracy and usefulness of fisheries information obtained must be carefully evaluated before adopting it in the environmental assessment report. Aspects such as time of survey (validity of secondary information), methodology and others shall be taken into account. If there are doubts, they shall be verified by on-site survey(s).

b) *<u>Field Surveys</u>*

Based on the results of (a) above, the study shall identify data gaps and determine if there is any need for field surveys. The primary aim of the field surveys is to fill the data gaps and to gather adequate information for subsequent fisheries impact prediction and evaluation, formulation of proposed mitigation measures and monitoring requirements. If field surveys are considered necessary, the study shall recommend appropriate methodology, duration and timing for the field surveys. The data obtained shall be quantified and statistical analysis shall be applied wherever appropriate.

Fisheries and aquaculture are important resources and careful consideration of the impacts in these fields are required for both the reclamation phase and the operating phase of the project. The locations of present and planned aquaculture sites should be detailed, and the assessment of these sites must comprise, but need not be limited to:

- Description and assessment of the present fishery and aquaculture resources in the study area, including type, catch and production, value, and others;
- Areas of fishing grounds and aquaculture directly reclaimed by the project and their importance to the local and regional socio-economy;
- Areas of fishing grounds and aquaculture indirectly impacted by the project either during the reclamation or operational phase due to increased noise levels in the water column or through the release of suspended sediments, increased levels of pollutant run off or changed current patterns;
- Areas of potential fishing grounds and aquaculture impacted by the project and their importance;
- Value of fishery and aquaculture impacted by the project;
- Employment in fishery and aquaculture impacted by the project; and
- Importance of the habitats or species, in terms of international, national, regional or local importance.

The following list contains some general criteria that can be used for evaluation of fisheries impacts:

Criteria	Conditions under which the fisheries impacts of a proposed development would be rated higher
Nature of impact	Impacts are permanent, irreversible or long term
Size of affected area	The area of fisheries habitats, fishing grounds or aquaculture sites affected constitutes a high proportion of the total area of fisheries habitats, fishing grounds or aquaculture sites in the area/ district/ state

Loss of fisheries resources/ production	The loss of fisheries resources/ production (including capture fisheries and aquaculture production) constitutes a high proportion of total fisheries resources/ production in the area/ district/ state
Destruction and disturbance of nursery and spawning grounds	Nursery and spawning grounds of commercially important species are disturbed or destroyed, affecting the recruitment of juveniles and hence the adult population in future
Impact on fishing activity	Large number of commercial fishing entities, fishermen, or aquaculture farms are affected

5.3.6 Dust and Atmospheric Pollutants

Emissions from construction equipment, work vessels and other vehicles used for the construction work could be a source of air pollution. Dust from construction activities is also a possible source of air pollution.

Assessment Methodology:

Air quality information and samples are to be collected and analysed as follows:

- Data to be collected from a minimum of one representative location within the project site.
- Sampling location should include areas within zone of impact.
- Parameters to be analysed: Total Suspended Particulates (TSP) and others.
- Seasonal and annual variations in meteorological information. Data on temperature, rainfall, wind speed and direction as well as meteorological phenomena such as inversions should be compiled from climate sampling stations nearest and relevant to the project site.
- Air pollutant sources from existing activities in the surrounding area.

There is no specific method to quantify the effects of fugitive dust on the surrounding areas. Good management of construction operations is crucial to minimise problems related to dust.

Air pollution assessment shall be made based on the type, activities and scale of the reclamation activity in relation to the surrounding land use, i.e. location of nearest houses, high-risk areas such as schools, religious institutions and hospitals. The predominant wind direction in the reclamation area shall be determined in relation to the nearest human settlement(s).

Ambient air quality standards are appropriate for the evaluation of impacts due to air pollutants. The recommended Malaysian Air Quality Standards may be adopted to assess acceptability of air quality. Reference may be made to the established health criteria for evaluation of health impacts from air pollution. The series of health criteria published by the World Health Organisation may be used as reference for this purpose.

5.3.7 Noise and Vibration

Construction activities may create a problem of noise and vibration generated by the dredger, other construction equipment, traffic, work vessels and other construction machineries.

Assessment Methodology:

In general, noise level information and samples are to be collected and analysed as follows:

- Noise level data collected at the site.
- Parameters to be analysed include: Equivalent Sound Level (L_{eq}); 90% of the time; or background or Residual Noise (L_{90}); 10% of the time; or Peak Sound Level (L_{10}); Maximum Noise Level (L_{max});and Minimum Noise Level (L_{min}).
- Noise pollutant sources from existing activities.

Noise from specific sources, such as machinery and equipment used, may be assessed based on the strength of the noise sources and the attenuation factor for a given situation. A simple estimate of noise for a given distance from a generator, for example, may be based on a general assumption of a 6 dB(A) reduction for a doubling in distance from the source. Consideration may be given for excess attenuation due to variation in atmospheric conditions, physical environmental conditions (such as vegetation type) and physical barriers (such as trees and walls).

For line sources of noise, such as that from boat traffic, prediction of noise is best undertaken by actual noise measurements for areas which are exposed to similar noise conditions. Noise and vibrations from boat activity are particularly important with respect to marine turtles and fisheries.

Noise impact assessment shall be made based on the type, scale and timing of the activities in relation to the nearby sensitive areas, mainly human settlements. The noise impact can also be assessed through comparison with existing noise levels in the area and/ or a comparison with acceptable noise exposure limits published by DOE Malaysia in the Planning Guidelines for Environmental Noise Limits and Control.

5.3.8 Waste Management

Wastes from construction activities are mainly spoil materials generated by dredging. Disposal of dredged material may cause destruction of vegetation, leakage of contaminated materials, odour and unsightly view and other nuisances to the local community.

Assessment Methodology:

Solid Waste

Description and assessment of the production of solid waste during the construction phase, and after the completion of the project and the impact of those operations. The study shall include, but need not be limited to:

- Planned collection system;
- Amount and type of solid waste; and
- Waste disposal operation at landfills, or other disposal measures.

Waste Water Treatment

Description and assessment of the present situation, the production of waste water during the construction phase, and after the completion of the project. The analysis shall include, but need not be limited to:

- Review of planned collection and waste water treatment system;
- Problems that may occur in the operation of wastewater treatment systems or wastewater discharge (water quality, smell, noise and others); and
- Operational demands for waste water treatment.

5.3.9 Socio-Economic

The project planning needs to demonstrate a commitment to the social consideration in land use planning, and a requirement for all development to follow the guidelines in preparing social assessment reports as part of the EIA study process.

Assessment Methodology:

Description of Existing Socio-Economic Conditions: This includes a description of the following from field studies, ground surveys and published reports:

- *Existing and Proposed Land Use*

  These include zoning for the area within and surrounding the proposed development and any designated receptors that are found during field visits.

- *Land Status/ Tenure*

  Land issues/ claims should be highlighted, if any.

- *Key Demographic and Economic Characteristics*

  This applies to the surrounding community within the zone of impact and includes:

  - Location of populations within and surrounding the project site (clearly illustrated in a map)
  - Population
  - Gender and age groups
  - Ethnic group and religion
  - Educational background
  - Socio-economic status (i.e. economic activities, income, occupation)
  - Sensitive areas (i.e. historical buildings/ artefacts, cultural sites, water catchments, archaeological sites, recreational sites and tourist attractions and others) (clearly illustrated in a map)

- *Infrastructure/ Service/ Facilities*

  Urban Area – within 500 metres radius or 5 – 10 minutes walking distance (i.e. child care centre, kindergartens, schools, clinic or hospital, shops, public transport, recreation centres and others (clearly illustrated in a map).

  Rural Area – within 3 km radius from the site.

- *Perception and Awareness/ Community Engagement*

  Consultation should, at the very early planning stage, provide the community with an opportunity to be informed and to influence decisions which may affect them. The Project Proponent must commit to this consultation by giving opportunity for community to participate in the decision making process as the project may affect the way their local area is developed.

  A consultation plan document including the following should be prepared:

  - *Objective of the consultation process*
  - *Identification of zone of impact (receptors that will be impacted by the development)*
  - *Level of communication, i.e. door to door interview, questionnaire distribution, community dialogue and others*
  - *Relevant questions that should be posed to the community can include (but are not limited to):*
    - *Have you heard about the new upcoming project?*
    - *What are your concerns related to the project?*
    - *What benefits do you perceive from this project?*
    - *What is your recommendation for improvement of the project?*
    - *What is your level of acceptance of the upcoming project?*

  The number of respondents to be consulted within the zone of impact must be determined and justified by the environmental consultant with **locations of those interviewed marked in a map**. Emphasis should be given on consultation with the village head/ local representative.

- *How issues raised in the public consultation are to be handled in the EIA report.*

Brief social survey notes describing the project concept and outlining the social consultation method including list of questionnaire must be prepared and documented in the EIA report.

Prediction of social economic impacts is an inexact exercise. To assess the significance of the impacts, the following general concerns need to be addressed:

- *Nature of the Impact*

Probability of occurrence	-	Likelihood that an impact will occur as a result of the project
People affected	-	Percentage of population affected or how it will affect different demographic groups
	-	What is the likely population change as a result of the development
	-	Will the project likely to give rise to an increase or decrease in employment opportunities in the local area
Zone of Impact	-	The extent of impact in terms of area (show on map)
Duration	-	How long will the impact last, assuming no attempts to mitigate

- *Severity of the Impact*

Local sensitivity	-	To what extent is the local population aware of the impact? Is it perceived to be significant? Has it been a source of previous concern in the community?
Magnitude	-	How serious is the impact? Does it cause a large change over baseline conditions (e.g. will crime rate double)? Will local capacity be exceeded?
	-	Will the project generate demand for increased community services and facilities (schools, health care, road conditions, shops, public transport, parks and others)?

- *Potential for Mitigation*

Reversibility	-	Is the impact reversible? Short or long term?
Institutional capacity	-	The current institutional capacity to address impacts
	-	Existing legal, regulatory structure
	-	Can local government deal with the impact or would it involve the private sector?

<u>Aesthetic and Recreational Value</u>: The study should consider the potential impacts on aesthetic and recreational values along the coastline which will be compromised during, as well as after, project implementation.

Coastal erosion and/ or siltation of fines can have severe impacts, for instance on the quality of recreational beaches, which may either erode away or transform a sandy to a silty/ muddy beach.

During dredging/ reclamation, increased turbidity may impact aesthetic and recreational values relating, potentially affecting tourism along the coastline.

Description and assessment of the effect of the project on resources that are valued by the people (i.e. beaches, coral reefs, rain forest, flora and fauna, mangrove, natural trails, recreational areas and facilities, and lifestyle in general); and on the visual impression of the shoreline, its interference with scenery and amenities that maintain the quality of life for the local population as well as for visiting tourists. The investigation shall cover, but need not be limited to:

- Computerised or artistic, visual impact assessment at important locations or facilities of public value for example existing hotels, beaches, residential areas, public parks and others;
- Polling of affected population using RRA or similar techniques to assess the perceived impacts of the project by the populace; and
- Of particular interest may be the loss of existing waterfront precinct to be replaced with a new development. Properties that become set back from the coastline in this way may suffer a loss in value, as well as in commercial activity, if that activity was based, in part, on the waterfront positioning (e.g. hotel, tourism facility).

5.3.10 Navigation

Marine traffic related to dredging and transport of dredged material will increase during reclamation activities. This may impact other marine traffic (shipping, fishing, water sports and others) in the area. The study must also consider interference with navigation channels due to the reclamation layout that may have negative impacts on marine navigation efficiency and safety.

Assessment Methodology:

Description and assessment of the present and future navigation for merchant ships, ferries and fishing vessels within the zone of impact. The assessment shall include, but need not be limited to:

- Safety requirements during construction;
- Safety requirements post-construction; and
- Post construction modifications to shipping lanes and anchorage areas.

5.4 Additional Impacts

The list of potential impacts above is non-exhaustive as the environmental consultant should extend or shorten the list of issues depending on local conditions. The discovery of particular key conservation value areas or particular sensitive habitats will require the inclusion of new issues while other issues may not be applicable for that particular project.

6 Mitigation Measures

This chapter covers identification of the major mitigation measures for the environmental impacts identified (refer to Table 6-1).

Table 6-1: Assessment Procedures – Description of Mitigation Measures

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* - *Minimise hydrodynamic and morphological impacts* - *Control sediment spill* - *Proposal for landscaping/ aesthetic features* - *Minimise air and noise pollution impact* - *Provision for habitat and wildlife protection/ conservation* - *Management of waste generated* - *Provision for land and marine traffic management* - *Reducing adverse impact on surrounding community* • *Devise and propose monitoring programmes*

The previous section included a description of methods for assessing planned activities and their impact on the environment. It also points out that there may be impacts from necessary and unavoidable activities, which were not included in the project plan and description. Mitigation measures therefore address three different scenarios:

- Proposals for improved technologies or methodologies for planned activities in order to minimise their negative environmental impact, e.g. site selection, site layout orientation; and reclamation/ construction implementation method. This is best addressed during the pre-feasibility stage.
- Proposals for management activities, which are not included in the Project Proponent's original plan of activities but which are necessary in order to

control environmental degradation, e.g. waste management, drainage, erosion control practices and others. This is mainly related to working practices such as dredging or placement methodologies, limiting working hours and water pollution control measures. Control measures often result in limiting the impact, with a residual level of impact that has to be accepted.

- Proposals to compensate for unavoidable, residual impacts, e.g. community development programmes or a specific contribution towards local conservations of valuable marine or riverine ecological resources or offsets.

The environmental consultant should assess the adequacy of the measures to alleviate or mitigate negative environmental impacts planned by the Project Proponent. Where the Project Proponent's measures can be strengthened or where they are seen as insufficient, the environmental consultant should propose mitigation in the form of proposals for alternative technologies, methodologies or scope of work. Addressing the key physical impacts prior to design finalisation is essential to the sustainability of the overall design concept. For residual impacts, the environmental consultant should, where appropriate, propose mitigation measures to compensate for the effects of the impacts. It is important to note that the recommended mitigation measures for a project in the EIA report must be based on the different stages of project implementation such as site preparation and construction.

The environmental consultant must for each foreseen impact and for each proposal for changes to scope, technology or methodology assess the risk level and magnitude of all expected residual impacts and state these clearly in the EIA report.

In addition, there are requirements, which are imposed for administrative reasons. These include employment of an environmental officer, provision of maps and other information, which may be necessary for environmental monitoring.

It is, however, important that the Project Proponent and the environmental consultant together use the latest knowledge and development in the respective fields, in order to devise a project and site specific plan for environmentally sound management and associated mitigation. The pointers included in this guideline should not be seen as a complete, ready-made, direct solutions, but rather as principles of mitigation.

At the same time, it must be stressed that any combination of site, technology and methodology will warrant a unique set of mitigation measures.

6.1 Key Mitigation Measures

6.1.1 Coastal Hydraulics

Careful site selection and design of the reclamation layout will minimise changes in current patterns and morphology. The key to the development of such a design is the numerical modelling of the physical impacts and the sound physical reasoning utilised in establishing alternatives and the selection of the final preferred project option, which results in minimum physical impacts and a reduction of consequent biological impacts.

This optimisation procedure for reduction of the physical impacts prior to design finalisation is essential to the sustainability of the overall design concept, as physical impacts (for example morphological impacts, flushing, upstream flooding, changes to salinity and water temperature) are extremely difficult to mitigate once the development plan is fixed.

Where some impacts cannot be mitigated, remedial action may be taken. For example if there is a risk of upstream flooding due to sedimentation of river and drain outlets caused by the project, a regular monitoring and maintenance programme must be established.

6.1.2 Morphological Impacts

As outlined in Section 6.1.1, morphological impacts should as far as possible be avoided or minimised through project siting and design optimisation.

Where some impacts cannot be mitigated, remedial action may be taken. For example in the case of coastal erosion impacts to adjacent shorelines, the Project Proponent may be required to construct coastal defence or beach nourishment in these affected areas. Such control structures or measures will have to take into account of the socio-economic values of the affected areas, and should as far as possible maintain or restore these values, for instance access to and quality of beaches.

For non-permanent solutions such as beach nourishment, a monitoring and management scheme must be established. Beach nourishment is a mitigation measure for erosion, or to reinstate the 'original' coastline, which may involve significant fill. In both cases nourishment must be carried out in such a way that sediment plumes will not adversely affect the marine environment. Besides the sediment plumes that may be generated from beach nourishment activities, there may be impacts on adjacent shorelines that will need to be addressed.

6.1.3 Water Quality

Project Related Water Quality Impacts

As outlined in Section 6.1.1, project related water quality impacts should as far as possible be avoided or minimized through project siting and design optimisation, taking account of water circulation and retention times in the layout design.

Reduced water quality and siltation of waterways can occur as a direct result of erosion of soil from reclamation sites. Storm-water should not be allowed to run through the reclamation site into nearby waterways and the sea without appropriate erosion and sediment control measures being in place. Further information on best practices for erosion and soil control upon the reclaimed land can be obtained from the DID Guidelines for Erosion and Sediment Control in Malaysia (DID, 2010).

Any effluent discharges from development on the reclaimed land must be treated to Standard B (minimum) of the Environmental Quality (Industrial Effluent) Regulations 2009, while sewage should comply with Standard B (minimum) of the Environmental Quality (Sewage) Regulations 2009.

Sediment Spill Management Options

Various management options can be adopted to reduce or eliminate the impact of spills associated with reclamation and dredging works. Management options are dependent on dredging and reclamation methodology, hydraulic conditions and type and distribution of sensitive receptors, and are thus project and site specific.

In the assessment of best management of sediment released into the aquatic environment from dredging/ reclamation, the following observations are important.

- Coarser sediments (sand fractions) will generally settle out relatively quickly and in the vicinity of the source. This may lead to higher sedimentation rates close to the source, but fine sediments play a major role in turbidity impacts at larger distances from the source. Typically, the coarse fractions will settle out within or in the vicinity of the footprint of the dredging/ reclamation where the bottom is directly disturbed in any case, and unless there are sensitive receptors in close proximity to the work areas, the focus for impact assessments and mitigation is normally on the fines (mud and silt) fractions.

- Sediments released into the water column will be dispersed from the source by prevailing currents, while waves may tend to keep the sediment in suspension rather than settling out. The finer the sediment, the longer it will remain in the water column, and the further it will typically disperse from the source.

- Sediment that settles out may re-suspend during events of higher current/ wave agitation. Turbidity and sedimentation impacts are therefore not restricted to the immediate effects of the sediment until it settles out on the bottom, but may also be caused by re-suspended sediment travelling further from the point of origin during subsequent re-suspension events.

- For typical dredging operations, the sediment spill of fines into the water column can be estimated as a percentage of the fines content in the borrow material. The percentage of spill will depend on both the dredge methodology and procedures and the prevailing hydraulic conditions.

Options for avoiding or minimizing impacts from turbidity and sedimentation generated from dredging and/ or reclamation can be divided into two main categories:

i. Measures to reduce the source of sediment entering the aquatic environment; and

ii. Measures to manage the sediment plumes to ensure that the risk of impacts to receptors is minimised.

Examples of both categories are provided in following subsections. The preferred management options for a given project could involve a combination of some of the listed options and/ or other measures to reduce and/ or manage spill and impacts. Whilst it has been proven possible to manage dredging and reclamation in close proximity to sensitive habitats with limited or no impacts, it is stressed that this needs careful planning and management. Predictive modelling is a valuable tool to provide the required understanding of plume dispersion under variable conditions to select appropriate mitigation options. Although, details of the dredging/ reclamation are usually not defined at the assessment stage, modelling can be used to test a variety of options and establish preferred methods and schedule, which can be used as guidance in a subsequent process. Including environmental considerations at a competitive tendering stage will ensure that these are included in the implementation plan at minimal costs to the project and therefore have the highest chance of success.

Mitigation measures planned during the environmental assessment phase can go a long way in reducing potential impacts, but as outlined above, things may change between the environmental assessment phase and implementation, for instance in respect to dredge methodology, schedule and others. Proactive and adaptive management during implementation is a key factor to avoid/ minimise construction impacts from dredging and reclamation. Components of best practice management are described in Sections 7.2 and 7.3.

If mitigation cannot reduce impacts to an acceptable level, temporary or permanent relocating (if possible) of the receptor may be considered. For residual impacts, compensation measures may be required to offset the impacts. However, compensation should not be seen as a substitute for prevention or mitigation, but as a supplement to best practice prevention and mitigation.

6.1.4 Spill Reduction

A reduction in the amount of fine sediment released into the aquatic environment will generally lower the risk of potential impacts, although it should be noted that the time and location of the releases (relative to sensitive receptors) are just as, if not more, important.

Examples of measures to reduce spills into the aquatic environment are briefly described below:

- Choice of fill source with a low percentage of fines (mud and silt fractions). This is beneficial for the quality of the fill material, and has the potential to vastly reduce the amount of fines released into the aquatic environment. In choosing a source, both the quality of the source and the proximity to sensitive receptors will have to be considered from an environmental perspective.

- As far as possible targeting areas within a borrow site with the best quality material with the lowest content of fines.

- Choice of dredging methodology. This will partly be governed by considerations of what is practicable and economic for the site, but environmental considerations should also be included if there are risks of significant impacts. If possible, direct pumping from the borrow site to the reclamation site may reduce spill as the excess water at the reclamation site can be channelled through sediment basins before release back into the aquatic environment. As outlined in the description of activities in Section 3, the use of for instance a backhoe or grab dredger may reduce the spill as there is no discharge of excess water from hydraulic transport.

It will also have to be considered whether material for reclamation can be transferred to the reclamation mechanically if dredged with a backhoe/ grab.

- Dredging equipment should be continuously monitored and well maintained to ensure that there are no unintentional spillages from for instance leaking bottom doors in the hopper/ barges, no leaking pipes and connections during pumping.

- Use of a “green valve” or “environmental valve” for TSHD dredging or on barges filled by a CSD. The “green valve” prevents air entrainment into the overflow pipe, promoting a density driven flow from the outlet of the overflow pipe to the bottom. This will increase the proportion of the sediment from the overflow that settles out within or in the immediate vicinity of the dredge area such that the proportion of the overflow fines that get suspended in a passive plume in the water column is reduced.

- Reducing or eliminating overflow of hopper or barges when dredging with a TSHD or CSD with barge filling. This will likely have a significant impact on production rates and costs, but may be an effective way of reducing the spill if required to achieve environmental objectives.

- Constructing bunds around the reclamation site prior to filling to ensure minimal spill from the reclamation perimeter. The bund wall should be protected by rock armour with appropriate rock grading and geotextile filer layer to prevent wave-induced sediment leaching (refer to Plate 6-1 and Plate 6-2). Plastic sheeting held in place by sandbags is also appropriate for temporary protection of the bund.

Plate 6-1: Construction of bund wall prior to filling with marine sand

Plate 6-2: Temporary bund wall with geotextile and rock protection at toe for protection against wave action

- If material is pumped into the reclamation area, provision of sediment basins within the reclamation boundaries to ensure that most fines have settled out prior to release of excess water back into the aquatic environment (refer to Plate 6-3).

Plate 6-3: Material is pumped into phased segments or sediment basin within the reclamation area

<u>*Spill and Plume Management*</u>

There is natural variability in the level of sediment induced turbidity and sedimentation. Increased turbidity and sedimentation will only have potential significant impacts in areas with sensitive receptors, and then only if receptor specific tolerance limits are exceeded.

Environmental impacts from sediment plumes derived from dredging/ reclamation can therefore effectively be eliminated or reduced by managing the activities such that the plume is separated from or will have minimal influence on the environmental receptors. This requires detailed mapping of the environmental receptors as well as a detailed understanding of the dredge/ reclamation induced sediment plumes and how these disperse in the environment. Apart from simpler cases, managing dredge plume and receptor separation generally requires the use of dredge plume modelling as a tool. This is described in Section 7.3.

Below are examples of how the dredge plume dispersion and intensity can be managed through management of the dredging/ reclamation procedures for the case of marine fill sourced through borrow dredging.

- Control of production rate to ensure that tolerance limits are not exceeded at receptor sites. The spill rate is generally correlated to the production rate, and extending the dredging/ reclamation period may in some cases be desirable to reduce the plume intensity and thereby the stress factor on the receptor at any given time.

- Targeting season(s) which are most favourable in terms of minimising spill and/ or carrying dredged plumes away from sensitive receptors. With the monsoon climate, there are often weak net currents which will lead to a predominant transport direction which may change with seasons (depending on location). Such planning however needs to be supported by data on actual effects of seasonal climatic conditions at the local or site scale.

- Targeting periods when receptors are less sensitive and/ or avoiding periods when receptor sensitivity is high during critical life-cycle phases. An example of this could for instance be to avoid coral spawning periods.

- At the “micro” management level, spillage may be timed with changing currents. If the sensitive receptors are predominantly located in one flow direction from the source – e.g. coral reefs in a given direction from the spill source, then dredging/ disposal can be timed with e.g. tidal currents to be carried out when the plume is being carried away from the sensitive receptor. This may for instance be combined with spill reduction through overflow management such that overflowing of hopper/ barges is only allowed during certain tidal stages – for instance flood tide, while dredging during other tidal stages would have to be carried out without overflow.

- If dredged material is disposed at a disposal site, the disposal may likewise target periods when currents will carry the plume away from sensitive receptors. To maximise the proportion of the sediment that settles out within the designated disposal site, the disposal may be managed such that disposal takes place at the “upstream” part of the dump site.

- Restricting discharges of excess water from the reclamation area to given locations (may be tidal flow dependent) or times when the transport conditions are favourable relative to the sensitive receptors.

- On each dredge cycle, the TSHD has a period of no overflow (and only minimal spill from the suction head). The initial dredging with no overflow can be targeted at the more sensitive areas of the dredge corridor where the plume has the highest probability to impact receptors.

- Silt curtains may, under some conditions be used to control the plume dispersion, e.g. limit the dispersion from a reclamation site. It is, however, emphasised that the use of silt curtains has to be considered carefully. Silt curtains are only effective in limited water depths and under calm conditions and with close to negligible currents. In general, silt curtains should be used on slow to moderate currents (0.5 m/s or less), stable water levels and relatively shallow water depths such as within a harbour or canals. Silt curtains are generally impractical in larger scale operations, and in slightly stronger current conditions they are at best ineffective and may even become detrimental as they can induce additional sediment suspension through scouring of the sea bed. Silt curtains are not considered practicable and effective for most marine dredging and reclamation projects (refer to Plate 6-4).

Other good practice management controls include:

- Reduction of the effects of propeller wash and wakes by establishing navigational restrictions (i.e. reduced speed near receptors, operating on shallow waters during higher tides only and others).

- Ensuring that borrow material is free of contaminants harmful to the ecology and or humans.

- Applying a detailed dredge and disposal management system for planning and control of the dredging and reclamation.

Plate 6-4: Use of silt curtains can be appropriate in low energy environment but needs regular inspection and maintenance

6.1.5 Spill Budget Approach

A notable challenge for dredge plume management to achieve given Environmental Management Objectives (EMOs) and/ or Environmental Protection Outcomes (EPOs) is to establish a simple system that the contractor can interpret and manage to, whilst maintaining sufficient flexibility for effective implementation. Whereas environmental considerations are becoming an integrated part of the planning process for many dredging and reclamation projects, and the large international dredging companies now have in-house environmental expertise, it takes significant site and project knowledge to for instance be able to interpret an EPO of “No coral mortality”, or “No aesthetic water quality impacts at …”.

The intent of the spill budget approach is to perform the complex assessments required to interpret the EMOs/ EPOs for the site specific conditions and derive a number – a maximum allowable spill – which is readily interpreted and understood by contractors.

Deriving the spill budget is based on the following process:

- Map out all relevant environmental receptors.

- Establish tolerance limits corresponding to the EMOs/ EPOs for the receptors. These are typically expressed in dredge/ reclamation generated turbidity and sedimentation limits.

- Conduct plume modelling to establish the connectivity between the likely spill sources and the receptors. The modelling will typically test a variety of conditions to establish both likely and worst case estimates for a number of different dredge scenarios and climatic conditions. Maximum spill allowed at the source(s) to remain at or below the threshold limits at all receptors.

- A maximum allowable spill (the spill budget) at the source(s) to remain at or below the threshold limits at the receptor(s) is established based on the model predictions for a given activity and/ or time frame. This is typically expressed in a certain mass for a given timeframe, e.g. tonnes/week.

Based on the assumptions applied and resulting predictions, spills up to the spill budget limit will achieve the environmental objectives/ outcomes, and this is what the contractor will have to manage the activities to.

The spill budget is obviously site and project specific as it depends both on the type of receptors and environmental objectives for these, the proximity of the receptors to the spill sources and the dispersion of material from the sources towards the receptors. An example of environmental objectives could be no coral mortality, and tolerance limits of the relevant species to dredge generated turbidity and sedimentation (in addition to background values) must be defined, and modelling applied to back-calculate a spill budget to meet these thresholds. Another example of a sensitive receptor is a public beach where a visible plume may be considered to have aesthetic impacts. The threshold at this area would be different than for a coral reef and the spill budget should be tailored to meet specified thresholds for that specific receptor area.

The spill budget's main function is as part of a management system during implementation where the spill budget is applied to manage dredging. A preliminary spill budget may be established during the environmental assessment stage and can serve as a useful measure during tendering of the dredging/ reclamation as it provides a first target that contractor has to manage to, and this can assist the contractor in choice of methodology and equipment that are suited for achieving the EPOs.

During the environmental assessment stage, the modelling most often relies on relatively sparse information since the contractor has not yet been appointed and details of the operation are therefore not yet finalised and available to the environmental consultant. Assumptions on dredge methodology and schedule will therefore have to be made. Information on borrow site and borrow material composition may also not be available. The spill budget should therefore be updated as part of the monitoring programme prior to start of dredging. If the spill budget is applied as part of an adaptive management system, the spill budget will further be updated during dredging when additional data on for instance sediment composition of the spill and others becomes available, and data from the site becomes available for dredge plume model validation.

The spill rate is then obtained by parcelling out the total spill volume (estimated through the steps above) over the course of the project. The distribution of the total spill over the project life-time typically requires the following information:

- Location of sand sourcing/ disposal site;
- Equipment and installation specifications (i.e. number, size and speed of dredgers/ barges and others);
- Working schedule (e.g. 12 hour/day operation);
- Period of dredging/ reclamation works;
- Time required for loading and offloading of barge(s); and
- Sailing time between reclamation/ sand-sourcing site or dredging/ disposal site.

The assumptions above can be used to determine the spill events, i.e. providing the spill rates in a time-series, which in turn will provide the overall spill. As highlighted earlier, most of the information is not readily available and hence, in most cases, the environmental consultant must base his estimate of spill events on: sparse data, empirical formulations, and/ or previous experience from similar projects, either locally or in similar locations.

An example of calculated spill rates is provided in Figure 6-1 showing a one-day snap-shot of spills from a combined cutter-head and barge operation. The operation involves two barges of different sizes that are rotating between the dredging and disposal grounds and operating continuously over 24 hours.

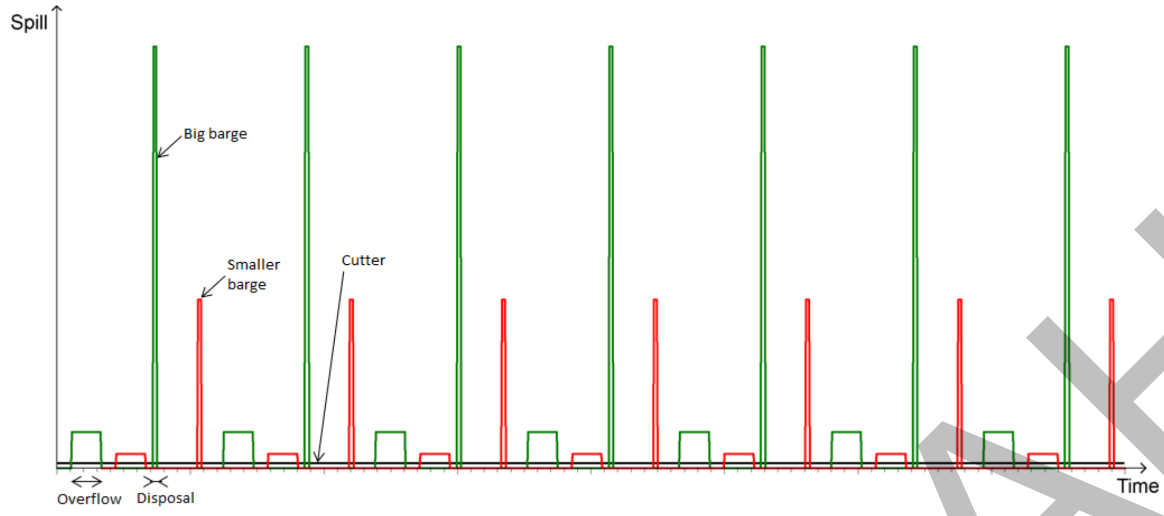


Figure 6-1: One-day snap-shot of spill from overflow, disposal and continuous cutter dredging

The spill budget can be significantly refined in the monitoring stage. At this stage the contractor has been appointed and the dredging/ reclamation operations, or at least parts of it, are often well-defined. Moreover, the spill can be monitored directly at-source providing more realistic spill rates.

This spill budget is an important component of the feedback management (monitoring stage) which is described in Section 7.3.

6.1.6 Use of Appropriate Fill

Harmful substances can leach out of contaminated fill materials when water comes into contact with these materials. The use of reclamation materials that are solid, inert and non-hazardous can prevent this impact.

6.1.7 Dust Management

Dust management is an important environmental and public health issue on development sites during the dry season. The generation of dust is dependent on the soil conditions and on the local weather conditions. Dust must be managed so as not to create a nuisance and/ or health hazard. This can be achieved through:

- Minimising vegetation clearance.
- Re-vegetating areas that are no longer required for reclamation or construction.
- Ensuring that unsealed roads and exposed areas are watered at all times.

- Applying speed limit restrictions.
- Covering of vehicle’s load to minimise dust dispersion (see Plate 6-5).
- Ensuring reclamation and construction activities take into consideration local wind conditions.
- Selection of haulage route.

Plate 6-5: Covering of truck’s load with canvas helps to reduce dust pollution

6.1.8 Ecological Impacts

Ecological impacts can be minimised by identifying, and zoning off, areas that are considered to have valuable ecological communities. This may require some adjustments to the siting and orientation of aspects of the project at the planning stage.

During the construction phase, the control of sediment spill is often the key mitigation measure to prevent impacts to marine habitats.

Other compensatory measures that may be implemented include:

- Relocation of communities, such as corals or seagrass to other unaffected areas.

- Restoration of habitats upon completion of the dredging and reclamation phase (if post-reclamation site conditions are still suitable), e.g. mangrove, coral or seagrass replanting.

- Compensatory measures – such as constructing artificial reefs or wetlands at appropriate locations.

6.1.9 Socio-Economic

The mitigation measures that can be considered for impacts on the socio-economic aspect include (but are not limited to):

Economy

- Preference for employment and business should be given to local population. This will provide some opportunities to the local people to participate in the development of the project, as well as providing them with an opportunity to earn extra income.

- Improve potential employment benefits, commerce and income for local people.

Social

- Reduce in-migration.

- Provide additional accommodation for the workforce.

Fisheries

- Compensation package to those affected.

- Establish artificial reefs to create alternative fishing grounds.

- Relocate fish landing areas with provision of facilities.

Archaeology

- Any monumental remains must be first notified to the relevant authorities, studied and relocated in another area.

- Any work on sites must be stopped if archaeological sites are discovered during construction.

- Efforts must be made to preserve the cultural remains and archaeological sites located outside the development area.

- Set up markings where cultural remains and archaeological sites are located before they are salvaged or moved.

Aesthetics

- Provide for new or enhanced recreational and/ or beach areas.

6.1.10 Others

Noise

The mitigation measures that can be considered for noise pollution include (but are not limited to):

- **Working hours** - Proper planning for construction working hours. Activities should be planned to avoid working at night and on public holidays.
- **Inform communities** - Surrounding communities should be adequately informed of the proposed project's working hours, as awareness can reduce noise-related annoyance.
- **Maintenance of machinery** - Noisy semi-mobile and mobile machinery should be well maintained to reduce noise emission. Installation of silencers/mufflers should be considered.
- **Provide hoarding -** Where practical, site boundaries should be demarcated with attractive hoarding particularly where boundaries are adjacent to nearby communities. Alternatively, the boundaries could be planted with trees/shrubs to screen visual and noise pollution from the construction site.

Vibration

Vibration impact from pile driving to establish the base for building foundation may give rise to elevated levels of ground vibration. A study on the impact of ground vibration from pile driving should be conducted if these operations occur within 50 metres of an existing building. If vibration is a nuisance, appropriate actions should be taken.

The mitigation measures that can be considered for vibration impact include (but are not limited to):

- Conducting the pile driving operation within as short a time as possible. At the same time, surrounding communities should be informed of the schedule of operation for their awareness. Awareness of such operation would make the residents more tolerant and acceptable to the elevated vibration levels.

- Consideration of changes to the foundation design and method of pile driving depending on the suitability of the site. Expert opinion may be sought. Bored piling, which hardly produces any vibration, may be an alternative.

Waste Management

The mitigation measures that can be considered for waste management include (but are not limited to):

- Construction of proper accommodation for construction workers onsite. The worker's quarters should be located at least 30 metres from the nearest natural waterway.

- Good housekeeping practice onsite, ensuring waste is properly disposed off in designated containers/ areas, etc.

- Provision for proper sewage treatment systems, i.e. septic tanks onsite for prevention of pollution of storm drains and/ or receiving streams. The septic tanks should be regularly de-sludged to maintain their effectiveness and to ensure compliance to the Environmental Quality (Sewage) Regulations 2009.

- Provision for sufficient waste bins for collection of solid waste generated onsite. These bins should be emptied on a regular basis and the waste collected should be disposed off at a local authority approved disposal site.

- Prohibition of open burning of any kind of waste.

- Provision of a dedicated area for collection and storage of non-hazardous materials for recycling purpose.

- Where possible, re-use of building materials and products is to be encouraged.

- Location of workshop (if any) should be at least 50 metres from the nearest natural waterway and installed with proper oil trap.

Navigation

The mitigation measures than can be considered for navigation impacts include (but are not limited to):

- Installation and maintenance of navigation aids such as buoys, beacons, waterway markings and signage.
- Use necessary signals approved by the Ports and Harbours Department and Marine Department when working at night.
- Warning signs indicating that there is a hazard ahead should be established.
- Maintain compliance to the Collision Regulations for vessels.

6.2 Residual Impacts

It is unavoidable that there will be some adverse impacts from land reclamation activities even if these are carried out with every intention of avoiding or minimising such impacts.

These generally include permanent, project related impacts, such as the loss of habitat or land use within the project footprint itself, hydraulic impacts; and a certain magnitude of process-related impacts such as sediment plumes or other water quality impacts, land and marine traffic disturbance, noise disturbance and others. For such impacts, the risk and the magnitude must be assessed as part of the assessment procedure.

6.2.1 Off-set of Residual Impacts

Residual impacts relating to the loss of biodiversity/ habitat may be countered by off-set activities elsewhere. Particular key conservation value habitats may be protected elsewhere. Such off-set activities may balance the impact in full or partially, but should in all cases be considered.

6.2.2 Mitigation of Residual Impacts

Residual impacts are already minimised through the choice of technologies or methodologies. Mitigation is therefore only possible through compensation or substitution. Compensatory measures in terms of replacement of habitat loss, re-planting and alternative access to livelihoods and others are among the available options for mitigation of residual impacts.

7 Monitoring Programmes

This chapter covers the recommended monitoring programmes based on the mitigation measures highlighted for the identified environmental impacts (refer to Table 7-1).

Table 7-1: Assessment Procedures - Description of Monitoring Programme

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* • Devise *and propose* monitoring programmes - *Compliance monitoring* - *Impacts monitoring*

Environmental monitoring provides feedback on the actual environmental impacts of a project. Monitoring results will assist in the judgement of whether the environmental mitigation measures proposed are successful in reducing or eliminating negative environmental impacts. An environmental monitoring programme is also used to ensure compliance to the recommended mitigation measures and environmental standards stipulated by EPD, Sabah and other relevant agencies.

Generally, an environmental monitoring programme will involve collecting data for one or more of the following purposes (Everitt, 1992):

i. To establish a baseline, that is, gathering information on the basic site characteristics prior to development or to establish current conditions;

ii. To establish long term trends in natural undisturbed systems to establish natural baselines;

iii. To estimate inherent variation within the environment, which can be compared with the variation observed in another specific area;

iv. To make comparison between different situations (for example, pre-development and post development; upstream and downstream) to detect changes; and

v. To make comparisons against a standard or target level.

Without a monitoring system, there is no mechanism for ensuring that the specified mitigation measures are being implemented and for evaluating the success of the mitigation measures undertaken.

The environmental monitoring programme will generally comprise compliance and impacts monitoring. Compliance monitoring aims to ensure compliance to the recommended mitigation measures and environmental standards stipulated by EPD, Sabah and other relevant agencies whereas impacts monitoring provides feedback on the actual environmental impacts of a project in order to confirm that a project is meeting the agreed level of impact and that the predictions of impacts made during the environmental assessment have been accurate.

7.1 Compliance Monitoring

The environmental consultant should, in the EIA report, propose means and schedules for monitoring whether the technologies and methodologies applied in the project comply with the recommended measures and methods. This compliance monitoring plan will then, by the EPD, be used as a basis for an Agreement of Environmental Conditions (AEC), which is an agreement between the EPD and the Project Proponent on how environmental management of the project shall be optimised.

The environmental consultant must, for each of the mitigation measures proposed in relation to the environmental issues that have been identified, recommend how, when and where a monitoring can be implemented to verify that the recommendations have been followed.

EPD has also established a standardised monitoring system. The system is linked to a database within EPD. This database will store all future monitoring data from all monitoring of land reclamation activities.

The frequency of environmental monitoring and reporting may be varied depending on the sensitivity of the area and the stage of project development and is specified by EPD through the AEC issued with the EIA approval.

There are requirements for submission of maps and photos to support compliance monitoring. Maps must follow standard cartographic requirements of showing geo-references, scale and north arrow, while photos must have dates and geo-reference.

7.1.1 Monitoring Techniques

Compliance monitoring will be undertaken primarily by means of the techniques listed below. This information should be submitted to EPD based on the agreed frequency of monitoring until the project is completed.

Photographs. Photographs to provide evidence of the implementation of the recommended mitigation measures. Photographs should, for example, be used to verify compliance with the following mitigation measures:

- Provision of sediment and erosion control measures such as silt curtains, sediment traps and bund walls.
- Provision of noise and dust suppression facilities onsite, e.g. water spraying activities, covering of vehicles load, condition of access roads.
- Changes to the landscape and aesthetics of the area.
- Waste management or housekeeping practices such as documentation of conditions at waste collection areas, oil storage areas, workshops, workers' quarters.
- Phased reclamation.

When photographs are submitted for compliance monitoring, the exact location should be clearly marked on a map together with a GPS reading and a direction bearing. The date and time should be noted.

Field checks. Periodic field checks at appropriate stages of the land reclamation and subsequent construction activities should be undertaken in order to ensure compliance with the following mitigation measures:

- Reclamation and construction methodology (reclamation area; period and timing of operations; equipment and methods used).
- Improved working practices/ management procedures.
- Reducing dust and noise problems.
- Proper waste handling.
- Phased reclamation.
- Proper transportation management.

Records. Records of land reclamation activities and construction progress to ensure compliance with the following mitigation measures:

- Planned schedule and actual completion of construction e.g. for phased reclamation.
- Documentation of dredging location and volume.
- Documentation of the dredged profile and depths.
- Documentation of spill from dredger.
- Maintenance of sediment plume control measures, e.g. bund wall, silt curtains and sediment basin.
- Maintenance of sediment traps.
- Daily working hours.
- Properties of dredge/ fill material used.

Maps/ Layout Plans. Maps/ layout plans to indicate locations of key mitigation measures during implementation. These should, for example, be used to verify compliance with the following mitigation measures:

- Location of installation of erosion control facilities such as bund walls, silt curtains, sediment basin and others.
- Provision of noise and dust suppression facilities onsite, e.g. wheel washing facilities, hoarding.
- Layout of reclamation phases.

Apart from these site inspection type monitoring techniques, a key monitoring requirement is compliance with the spill budget during dredging and reclamation. Best practice spill budget monitoring involves both compliance and impacts monitoring. The basic compliance with the spill budget is outlined below, while best practice feedback monitoring which combines spill budget compliance with impact monitoring and feedback/ optimisation of the spill budget is discussed in Section 7.3.

Spill budget compliance monitoring involves the following:

- Continuous monitoring of dredger overflow water flow rates and time during dredging operations at site.

- Sampling of the overflow water from the TSHD at least 4 times during each dredging cycle at the project site, with the samples being analysed for TSS.

- Sampling for TSS at each reclamation outflow: (1) at overflow outlet; and (2) within 200 m of outfall.

Based on the above parameters the spill from the dredger can be calculated and compliance with the spill budget verified.

Scheduling and responsibilities. As the EIA report covers land reclamation activities, therefore the need for images and other monitoring requirements should be planned accordingly. The monitoring programme should be formulated in advance by the environmental consultant in collaboration with the Project Proponent in accordance with the schedule of implementation, and be approved by the EPD through the Agreement of Environmental Conditions.

The EIA report should clearly state the responsibilities and actions to be taken in relation to compliance monitoring, as follows:

- Allocate institutional and administrative responsibilities for planning, management implementation and monitoring of the environmental requirements; and

- Allocate responsibilities to execute mitigation measures, including the detailed design of the mitigation measures.

Non-compliance will normally be followed by the issuance of an order to comply and a simultaneous and immediate compounding of the non-compliance offence according to the Environment Protection Enactment 2002.

The Project Proponent and/ or environmental monitoring consultant should consult the EPD for advice if there are difficulties in implementing the approved mitigation measures and monitoring programmes.

In some cases EPD may request a “re-assessment” of specific aspects of the operation related to the mitigation measures found to be in “non-compliance”.

7.2 Impact Monitoring

Impacts monitoring is concerned with the monitoring of the residual impacts or the effectiveness of the mitigation measures. The EIA report will have provided baseline data showing the situation as it was before the land reclamation and construction activities took place. All subsequent impact monitoring will relate to this baseline data. It is therefore important that the environmental consultant plans sampling points and parameters for baseline sampling to coincide with points and parameters for impact monitoring.

This section focuses primarily on marine impacts monitoring, such as hydraulic impacts, water quality and aquatic ecology. Other impacts arising from general construction activities, such as air and noise impacts should also be considered, depending on the nature of the development in question.

7.2.1 General Considerations

The environmental consultant shall provide adequate baseline data for the variables that are suggested in the monitoring programme. The programme that is expected to run during the construction of the project must be designed to make it possible for feed-back action in a short time. The monitoring programme shall comply with the following demands:

- It shall include variables that monitor the ecological and environmental status of features that have been identified to be potentially impacted by the project;
- It shall include variables that enable an immediate identification of situations where major environmental quality objectives are exceeded;
- It shall include stations in the monitoring programme in areas that are outside the impact area of the project to provide a non-effect reference; and
- It shall provide baseline data for the monitoring and control programme collected before the initiation of the project in order to enable comparison during the construction and after completion of the project.

7.2.2 Sediment Plume Monitoring

Suspended sediment monitoring should be carried out during the dredging and reclamation phase. For larger scale reclamation projects and those in sensitive areas, online turbidity monitoring at one or more locations should be considered. Fixed monitoring stations, targeted at sensitive receptors, should be established around the project area. In addition, mobile stations should be sampled to capture TSS concentrations within the plume. These will move depending on the location of the active dredging/ reclamation area.

Care must be taken in capturing plume characteristics. A few typical examples of fixed monitoring station shortcomings are shown in Figure 7-1. The first figure shows a dredger moving at a speed of 1.0 m/s dredging a channel exposed to a cross current of 0.5 m/s. The generated plume may only be in the order of 100 m wide – see example photo in Section 3.2.3. Even a 200 m wide plume only takes 6.7 minutes to drift across a given point. A monitoring station (M) that records turbidity every 15 minutes is installed near the channel. Although 15 minutes is often considered a high-frequency recording, the station has less than a 50% probability in picking up the plume, let alone its maximum intensity, under these conditions.

The second figure shows a stationary dredger with two monitoring stations installed (M1, M2) and clearly both stations are not capturing the main plume characteristics under the given current conditions.

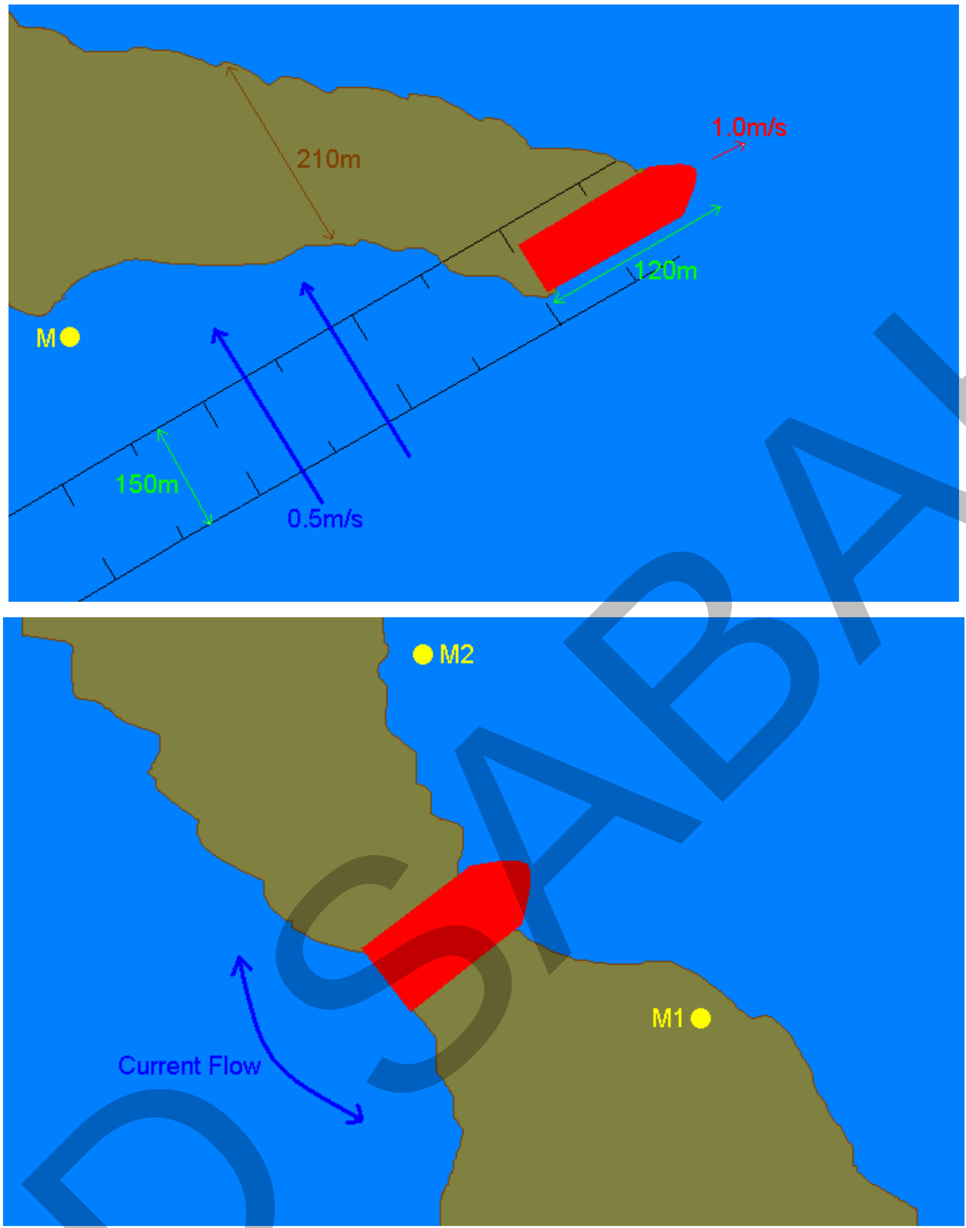


Figure 7-1: Examples of non-representative feedback from monitoring stations for dredging operations

Again, monitoring requirements are dependent on the scale of the project, the duration of the dredging and reclamation work and the site sensitivities, and can range from continuous monitoring, daily, weekly or up to monthly monitoring. Any frequency greater than monthly monitoring is not really valuable in establishing the impact of the works.

7.2.3 Morphological Impacts

For reclamation sites in the vicinity of high quality beaches or moderate quality open littoral beaches, there is a requirement to document the impact of the construction works on the shoreline and beach levels. This is generally carried out through coastal profile or riverbank monitoring, with ground levels (land and/ or bathymetric survey) taken at regular intervals along a profile perpendicular to the shoreline at a defined spacing, with the survey points taken along the profile to pick up all the important features of the beach levels. Monitoring is generally undertaken every three to six months, depending on the predicted severity of the morphological impact. This can consist of land and bathymetric survey at designated sites, photo records, and/ or aerial photography of the shoreline or river at periodic intervals, and especially following storm or flood events.

7.2.4 Flooding and Water Levels

Where impacts to a main river or stream may occur (e.g. as a result of the reclamation works adjacent to or fronting a river mouth), post construction monitoring of water levels inside the river is recommended by way of installation of water level gauge (refer to Plate 7-1). Information on water levels and records of flood events should be monitored. If impacts are identified, remedial measures may be undertaken such as dredging of the river mouth or construction of bunds along the river banks.

Plate 7-1: Continuous water level recorder can be established at potentially affected rivers and streams

7.2.5 Water Quality

During the dredging and reclamation phase, water quality monitoring (apart from sediment plume monitoring) is undertaken to determine actual impacts from release of contaminants (heavy metals) or nutrients from the dredge material and the release of other pollutants from the construction process, such as oil and grease, or coliforms from workers' quarters and others. Additional parameters may be recommended depending on site characteristics.

The number of stations should be determined based on the predicted impact area, and, as mentioned above, also include at least one station outside the predicted impact area to act as a reference station.

The frequency of sampling will depend on the scale and duration of the dredging and reclamation works. Generally, a higher frequency should be included e.g. fortnightly to monthly sampling during the dredging and reclamation phase, which can be reduced for the remainder of the construction phase when the dredging/ reclamation activity has ceased and the works are limited to onshore works upon the reclaimed land.

7.2.6 Ecology

Monitoring of mangroves, corals and seagrass may be required, depending on the predicted zone of impact and proximity of these sensitive areas to the project site.

These habitats should be monitored for signs of sedimentation and early signs of stress, such as coral bleaching, reduction in seagrass cover and shoot density. Measures of community variables such as species diversity are not generally relevant considering the time frames of most dredging projects and the response time of these organisms; i.e. these changes may occur gradually over several months and years, rather than weeks and months.

The monitoring of marine habitats should be sufficiently frequent to identify changes in the habitat components between two monitoring rounds; and to allow for mitigating actions while construction work is still in progress. The frequency will depend on the habitats and parameters in question, but in general monthly monitoring during the dredging and reclamation phase can be expected. The type of monitoring stations could be (but are not limited to):

- Sedimentation – sediment traps
- Turbidity monitoring
- Light attenuation
- Suspended sediments
- Coral and seagrass health surveys

The number of stations will also depend on the extent of the zone of impact, but a sufficient number of stations and replicates should be established to account for natural variation within the habitat. The monitoring programme should also include stations in areas that are outside the area of impact to act as a non-effect reference.

Other biological monitoring that may be required depending on the site location includes:

- Fish stocks – fish catch surveys at affected fishing grounds;
- Turtles – in the event that the environmental assessment reveals the presence of turtle nesting within two (2) km of the reclamation area, regular beach surveys should be carried out to establish the number of

landings and to liaise with the relevant authorities for the protection of nesting sites; and

- Other identified marine flora and fauna of significant importance.

7.2.7 Monitoring Frequencies

Frequencies of monitoring depend upon the timing and schedule of project activities. The monitoring frequency can be varied. If the environmental consultant finds there is a particular parameter, which should be monitored more frequently due to increased activity levels, an increased monitoring frequency should be proposed in the Environmental Assessment report. On the other hand, if little activity is on-going, and the operation is in compliance over an extended period, the Project Proponent may request a less intensive monitoring schedule. Changes in the monitoring frequency will be decided on a case-by-case basis by EPD.

7.3 Best Practice Dredge Plume Monitoring & Management

Fixed monitoring stations usually cannot cover all potential impact areas. Furthermore, measurements from fixed stations do not distinguish between sediments from the project being monitored and other projects, let alone the background concentrations. Furthermore they risk missing out on peak plume characteristics (see Section 7.2.2). Conventional monitoring campaigns are often stiff and reactive in the sense that they lack the flexibility to provide timely management responses. Introducing feedback in monitoring campaigns and using numerical modelling in combination can often overcome such shortcomings.

The main idea of introducing feedback is to have a flexible management concept that ensures that health conditions and environmental protection criteria (objectives) are met throughout the project life. Note that the flexibility gained with such a management approach may have effects on production and is likely to have cost implications to the contractor and/ or consequences to the time schedule of the project. It is essential that the necessary provisions are included in the construction contract and that the Project Proponent is committed to the economic and time schedule consequences. Feedback management is considered best-practice.

The main strength in feedback management is its built-in adaptability to accommodate critical environmental responses related to the project. The main components in feedback management are: modelling the spill budget and monitoring the spill-limit; which is the component ensuring that environmental objectives are fulfilled.

The spill-limit is adaptive. The components are combined in the following sequence:

- At-source measurements of spill rates. As described in Section 7.1 above, the measurements are often taken directly from the overflow (overflow sampling) at given frequency (f_1). The measured spill rates are then checked against the set spill-limit (at the onset of the monitoring campaign the spill-limit is taken from the spill budget given at the EIA stage). If the spill-limit is exceeded over a certain period of time (T_1) then the spill rates and the sediment budget are adjusted to compensate.

- Simulate the temporal and spatial plume excursions from the actual measured spill using modelling (the modelling established during the EIA stage can be adopted but should be subject to continuous refinements in the course of the monitoring works as monitoring data becomes available). Modelling can enter the feedback management through:

  - Hind-cast plume and impacts modelling: Compare model predictions with in-situ measurements of concentrations (fine-calibrate if necessary the model) and record predicted impacts against tolerance limits at receptors.

  - Forecast plume and impacts modelling. If tolerance limits at receptors are forecasted to be exceeded over a critical period of time (T_2) then spill may be adjusted accordingly.

- Habitat/ receptor monitoring at given frequency (f_2). Based on observed health conditions the tolerance limits for each receptor are updated which may trigger an adjustment of the spill-limit (i.e. production method and rates).

- Evaluate response times (T_1, T_2) and frequencies (f_1, f_2).

The principle mechanisms in the feedback management are illustrated in Figure 7-2. At the onset of the monitoring campaign, spill and tolerance limits and monitoring and modelling set-ups can be taken from the EIA works. The response frequencies i.e. how often limits and models are updated depend on the nature of the project (project size and complexity, sensitivity, hydraulic variability, stakeholders concern and others). The complexity of feedback management is therefore scalable and can be tailored to meet any project. See Figure 7-2.

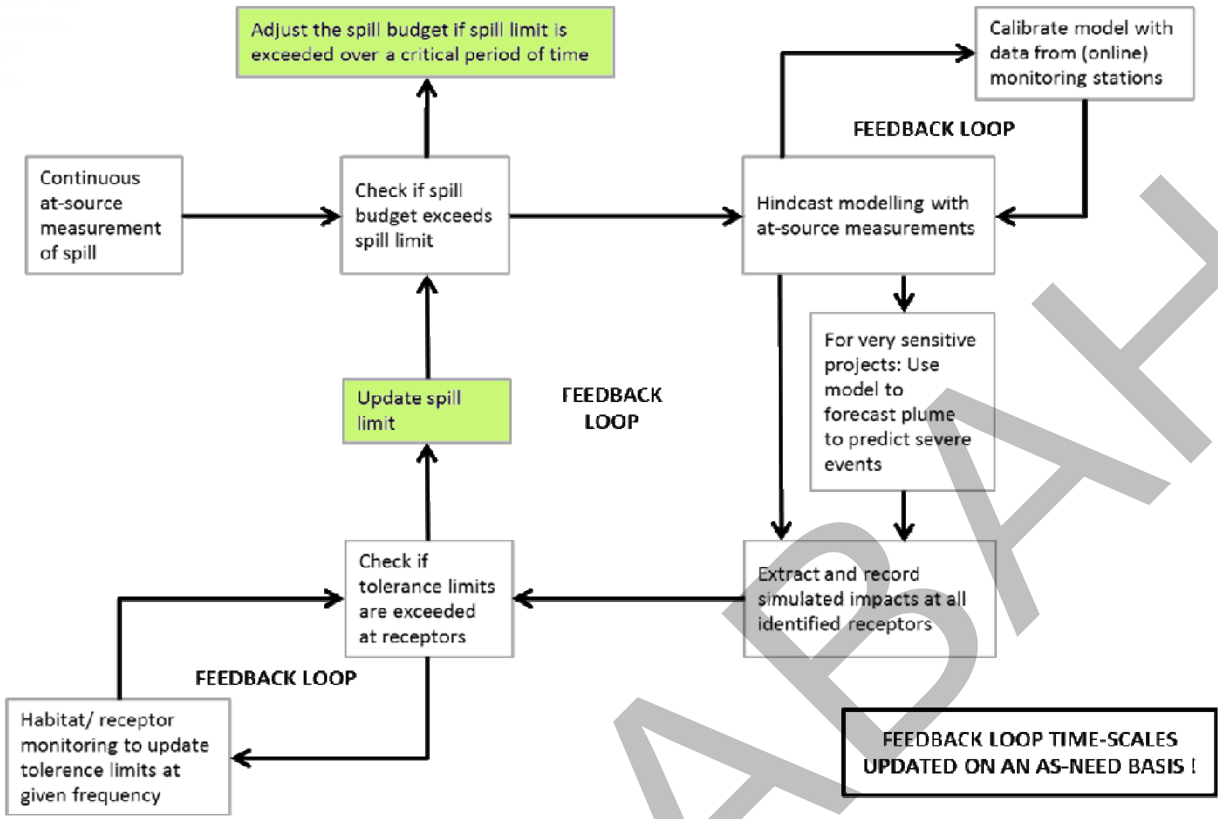


Figure 7-2: Overview chart of feedback management mechanisms

Feedback management is considered best practice as it provides the required flexibility and builds on various types of input in an integrated framework (modelling, monitoring and experience). The following main advantages can be identified:

- Spill budget control through at-source measurements forms a first level control of potential impacts. It allows segregation and management of individual work components, avoiding over-response while ensuring the tiered response targets those activities causing impacts;
- Predictive models are used extensively to hind-cast the location of the plumes from the construction operations, thereby providing a complete temporal and spatial picture of potential impacts, filling in the gaps between monitoring stations (both instrumentation and coral health) and allowing clear segregation of the impacts arising from component activities;
- Tolerance limits are used to identify potential impacts before they occur, allowing implementation of management measures to avoid the impacts, rather than respond to them;

- Tolerance limits are updated based on monitoring data collected as the works progress; and

- Results of on-line instrumentation at coral receptors and remote sensing are used to validate spill budget and numerical models, as well as proxies for potential coral health impacts.

References

In addition to the relevant laws, regulations and guidelines, the following list includes general and specific literature, which may be useful for the reader.

1. Business and Biodiversity Offsets Programme (BBOP) (2009). The Relationship between Biodiversity Offsets and Impact Assessment: A BBOP Resource Paper. BBOP, Washington, D.C.

2. Business and Biodiversity Offsets Programme (BBOP) (2012). Guidance Notes to the Standard on Biodiversity Offsets. BBOP, Washington, D.C.

3. Department of Irrigation and Drainage Malaysia (1997). Garispanduan JPS 1/97: *Guidelines on Erosion Control for Development Projects in the Coastal Zone*. Published by the Coastal Engineering Section, JPS Headquarters.

4. Department of Irrigation and Drainage (2010). *Guideline for Erosion and Sediment control in Malaysia*. Ministry of Natural Resources and Environment, October 2010.

5. International Association of Dredging Companies (IADC) and Central Dredging Association (CEDA) (1998). *Environmental Aspects of Dredging, Volume 4: Machines, Methods and Mitigation*. IADC/CEDA, the Netherlands.

6. PIANC (2010). PIANC Report No 108: *Dredging and Port Construction Around Coral Reefs*. PIANC Secretariat General, Begium.

7. Websites:

   PIANC: http://www.pianc.org

   Central Dredging Association (CEDA): http://www.dredging.org/

   US Army Corps of Engineers – *Literature Database on Environmental Effects and Dredging and Disposal* – http://el.erdc.usace.army.mil/e2d2/

Appendix 1: Glossary of Terms

Activity - basic element of a project or plan that has the potential to affect any aspect of the environment. Projects are composed of activities. Activities are often called actions.

Bathymetry - the water depths; shape of the sea bed.

Building - any building, erection or structure on any land and where the context so permits, includes the land on which the building is situated.

Central Board - the Central Town and Country Planning Board constituted under the provisions of Section 3 of the Town and Country Planning Ordinance.

Coastal Area – foreshore, inter-tidal and marine areas extending seaward up to 1.5 km offshore. The foreshore may be defined as 20 m inland of the high water mark. Refer also to definition for high water mark.

Development - any development that involves infrastructure and other structural construction activities together with related activities or changes the land and sea's natural condition.

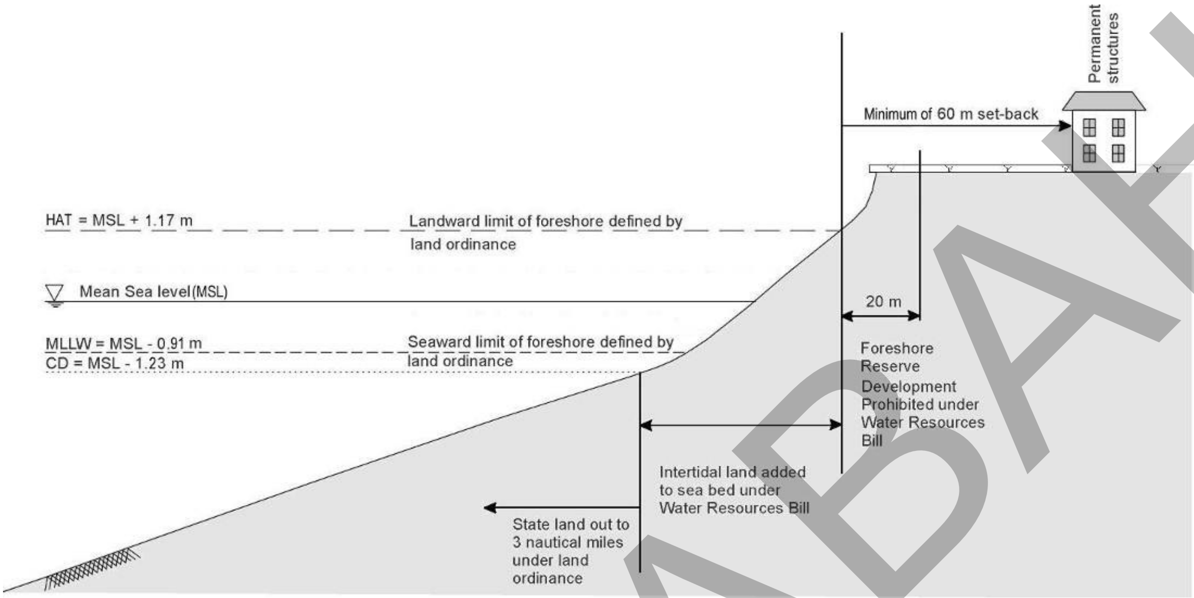
Effluent - any discharge either sewage or industrial effluent by an operation to the receiving environment.

Environment - physical factors of the surroundings of the human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants, and the social factor of aesthetics.

Environmental Impact - an estimate or judgement of the significance and value of environmental effects on physical, biological, social or economic environment.

High Water Mark - the top of a beach indicated by a debris line, i.e. the highest point on a beach where debris is deposited. It is not a well-defined level compared to a fixed datum as the debris line will vary with both tides (following the forth-nightly neap-spring tidal cycle) and wave exposure, with higher waves having the potential to move the debris line higher up on the beach. For the purpose of this guideline, the intent is to measure the distance from a line above which flooding will not occur under normal tide and wave conditions. The Highest Astronomical Tide (HAT) is a practical estimate of a fixed level that fulfils this. The HAT will not be exceeded by astronomical tidal elevations alone, and under most conditions has a small allowance for wave/ wind setup and wave run-up. HAT levels relative to Chart Datum for Standard Ports in Sabah (and Labuan due to its proximity) from the Malaysia Tide Tables are shown as follows:

Labuan	2.60 m	Felda Sahabat	2.95 m
Kota Kinabalu	2.40 m	Lahad Datu	2.54 m
Kudat	2.54 m	Semporna	2.59 m
Sandakan	2.89 m	Tawau	3.85 m



Definition sketch for foreshore and intertidal zones (with tidal variations representing Kota Kinabalu)

Matrix Method - identifies interaction between various project actions and environmental parameters and components.

Natural Resources - air, biological diversity of resources, oil, gas, forest and forest product, land, rocks, soils, animals, birds, plants, marine or aquatic life, and water of the State of Sabah.

Pollutants - any natural or artificial substances, whether in 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 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, fish or aquatic life, or to plants.

Residual Impact - the potential environment impact remaining after mitigating measures have been adopted into a project plan.

Riverbeds/ Riverbank Reclamation - includes any area of the river bed and river reserve as defined under the Sabah Water Resource Enactment 1998, i.e. within twenty (20) metres of the top of the bank of every river, where the river channel is not less than three (3) metres in width.

Spill Budget - relating to dredging and reclamation) maximum amount of spill that can be released into the environment for a given project (or stage of project).

Topography - shape of the ground, formed by highlands, slopes, rivers, swamps, coasts and river network which have their own aesthetic values.

Zone of Impact - an extent of area which will receive the greatest effect from an activity

Appendix 2: List of Abbreviations

ACLR	Assistant Collector of Land Revenue
AEC	Agreement of Environmental Conditions
BMP	Best Management Practice
CSD	Cutter Suction Dredger
DID	Department of Irrigation and Drainage
DOE	Department of Environment
EIA	Environmental Impact Assessment
EMO	Environmental Management Objectives
EPD	Environment Protection Department
EPO	Environmental Protection Outcomes
ESCP	Erosion and Sediment Control Plan
IUCN	International Union for Conservation of Nature
LSD	Lands and Surveys Department
M	Metre
MHHW	Mean High Higher Water
MSMA	Manual Saliran Mesra Alam
NRT	Net Registered Tonnage
NWQSM	National Water Quality Standards for Malaysia
PMM	Proposal for Mitigation Measures
RM	Ringgit Malaysia
RRA	Rapid Rural Appraisal
SD	Suction Dredger
Sg.	Sungai (River)
SMP	Shoreline Management Plan
TOR	Terms of Reference
TSHD	Trailing Suction Hopper Dredger
TSS	Total Suspended Solids
WHO	World Health Organization
WWF	World Wildlife Fund

Appendix 3: Contact Details

Contact details for other key government agencies related to land reclamation activities are as following:

Department	Address	Contact Details	
Lands and Surveys Department	Wisma Tanah dan Ukur, Jalan Perwira, Beg Berkunci No. 2044, 88576 KOTA KINABALU	Tel No.:	088 - 527600/ 527601
		Fax No.:	088 - 413626
		Email:	-
Sabah Wildlife Department	Tingkat 5, Blok B, Wisma MUIS, 88100 KOTA KINABALU	Tel No.:	088 - 215167/ 214515
		Fax No.:	088 - 222476/ 254767
		Email:	jhl@sabah.gov.my
Department of Irrigation and Drainage	Aras 5, Wisma Pertanian, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, Beg Berkunci 2052, 88767 KOTA KINABALU	Tel No.:	088 - 280500
		Fax No.:	088 - 242770
		Email:	did@sabah.gov.my
Department of Fisheries	Aras 4, Blok B, Wisma Pertanian Sabah, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, 88624 KOTA KINABALU	Tel No.:	088 - 235966/ 245489/ 245490
		Fax No.:	088 - 240511
		Email:	fish.dept@sabah.gov.my
Ports and Harbours Department	Ibu Pejabat, Peti Surat No. 80164, 87011 W.P. Labuan	Tel No.:	087 - 412966/ 412453
		Fax No.:	087 – 417531
		Email:	phdepts@sabah.gov.my
Town and Regional Planning Department	Tingkat 3, 4 dan 5, Blok B, Wisma Tun Fuad Stephens, KM 2.4, Jalan Tuaran, 88646 KOTA KINABALU	Tel No.:	088 - 222336/ 222337/ 222031
		Fax No.:	088 - 222557
		Email:	-
Minerals and Geoscience Department Malaysia, Sabah	Jalan Penampang, Beg Berkunci 2042, 88999 KOTA KINABALU	Tel No.:	088 - 260311/ 252494/ 252496
		Fax No.:	088 - 240150
		Email:	jmgsbh@jmg.gov.my
Marine Department	No. 2, Kompleks Jabatan Laut, Teluk Salut, Jalan Sepanggar, 88450 KOTA KINABALU	Tel No.:	088 - 401111
		Fax No.:	088 - 401182
		Email:	pjlwsb@marine.gov.my
Department of Environment, Sabah	Aras 4, Blok A, Kompleks Pentadbiran Kerajaan Persekutuan Sabah, Jalan UMS-Sulaman, 88450 KOTA KINABALU	Tel No.:	088 - 488166
		Fax No.:	088 - 488177/ 488178
		Email:	sabah@doe.gov.my

Appendix 4: List of Environmental Consultants/ Study Team

The following list includes the expertise, which in most cases should form part of the assessment team for land reclamation EIAs depending on site characteristics and environmental issues identified. Some team members may cover two or more of these fields of expertise:

- Hydraulics, coastal or riverine morphology
- Hydrology
- Water Quality
- Ecology
- Geology
- Socio-Economics

Each member of the team, involved for their specialist subject(s), should be involved in the entire EIA cycle from scoping, baseline data collection, impact prediction and evaluation, and identification of mitigation measures.

The list of registered environmental companies related to environmental report preparation can be referred to on the website of EPD: http://www.sabah.gov.my/jpas/

Appendix 5: Standard List of Content

The content of the EIA report shall consist of the following:

CHAPTER 1:	**EXECUTIVE SUMMARY**
	Project Description
	Findings
CHAPTER 2:	**GENERAL INFORMATION**
	Project Title and Project Proponent
	Environmental Consultant
	Public Hearing (for Special EIAs)
CHAPTER 3:	**PROJECT DESCRIPTION**
	Statement of Need
	Concept and Phases
	Description of Location
	Project Status
CHAPTER 4:	**IMPACT PREDICTION AND EVALUATION**
	Significant Environmental Impacts
	EIA Matrix
	Impact Assessment
CHAPTER 5:	**RECOMMENDED MITIGATION MEASURES**
	Recommendations
	Additional Mitigation Measures
CHAPTER 6:	**RECOMMENDED MONITORING PROGRAMME**
	Compliance of Mitigation Measures
	Residual Impacts
ANNEXES	Annex 1: Baseline Environmental Data and Information
	Annex 2: Methodologies and Analysis of Data
	Annex 3: List of References
	Annex 4: Terms of Reference