READING INSTRUCTIONS

Skim Chapters 1-4

See pp. 2-1

ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR COASTAL AND LAND RECLAMATION

Published by

Department Of Environment
Ministry of Science, Technology and the Environment
13th Floor, Wisma Sime Darby
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TABLE OF CONTENTS

List of Tables

List of Plates and Figures

** Courtesy of Kuantan Port Authorithy*

LIST OF APPENDICES

Appendix 1	Some Relevant Legislation With Regards to Reclamation in the Coastal Zone
Appendix 2	Other Definitions of the Coastal Zone
Appendix 3	Engineering Aspects
Appendix 4	Standard Water Sediments
Appendix 5	Methodology

ABBREVIATIONS

APHA	American Public Health Association
COD	Chemical Oxygen Demand
CVM	Contingent valuation method based on social surveys designed to elicit willingness to pay values
DID	Department of Irrigation and Drainage
DO	Dissolved Oxygen
DOE	Department of Environment
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPU	Economic Planning Unit
EQA	Environmental Quality Act
ESA	Environmental Sensitive Areas
ESI	Environmental Sensitivity Index
GIS	Geographical Information System
GNP	Gross National Products
GPS	Global Positioning System
GRT	Gross Tonnage
HD	Hydrodynamic
HPM	Hedonic pricing, based on land/ property value data
IADC	International Association of Dredging Corporation
IGBP	International Geosphere Biosphere Programme
IOC	Indirect Opportunity Cost approach, based on options foregone
IS	Indirect Substitute approach
IUCN	International Union for Conservation in Nature
JPS	Jabatan Pengairan dan Saliran
KHz	kiloHertz
LCD	Liquid Crystal Display
LKIM	Fisheries Department Board of Malaysia
LOICZ	Land Ocean Interaction Coastal Zone
MARPOL	International Convention for the Prevention of Pollution for Ships
MHWS	Mean High Water Spring
NTU	Naphthalene Turbidity Unit
OECD	Organisation for Economic Corporation and Development
PERHILITAN	Department of Wildlife and National Parks
PIMMAG	Petrol Industries Malaysia Mutual Aid Group
ROV	Remotely Operated Vehicle

SCUBA	Self-Contained Underwater Breathing Apparatus
SIRIM	Standards Industrial Research Institute of Malaysia
SSMO	Surface Shipboard Meteorological Observation
TCM	Travel Cost Method, based on recreationalist expenditure data
TOC	Total Organic Carbon
TOR	Terms of Reference
TSS	Total Suspended Solids
UNESCO	United National Educational, Science and Cultural Organisation
USEPA	U.S . Environmental Protection Agency

CHAPTER 1

INTRODUCTION

1.0 *BACKGROUND*

This guidelines document is to be used as a comprehensive and user-friendly reference for the preparation of an EIA report for any proposed project development pertaining to this activity as required under the Environmental Quality Act, 1974.

1.1 *OTHER GUIDELINES RELATED TO RECLAMATION WORKS*

References for reclamation activity such as guidelines issued by the Asian Development Bank, the World Bank, those prepared by DOE as well as those from other countries such as Korea, United States, Canada and International Association of Dredging Corporation (IADC), have been referred to in the preparation of this document. DOE has also issued various guidelines that are widely referred to, which include EIA guidelines for coastal resort development projects, Buku Panduan Kawasan Sensitif Alam Sekitar (1993), and those of other agencies such as the DID Guidelines (Drainage Works Ordinance, 1 (Revised 1972)) and related references.

1.2 *OBJECTIVE OF RECLAMATION GUIDELINES*

The main purpose of the guidelines is to integrate and establish procedures to aid in evaluation for implementation of EIA studies involving coastal and land reclamation in Malaysia as stipulated under the Environmental Quality Act, 1974 (Amendment 1985). This amendment provided as Section 34A of Part IV of the principal Act requires that a report on impact on the environment resulting from prescribed activities be prepared before the project is approved.

Subsequently, the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987, P.U. (A) 362 was gazetted and became effective in April 1 1988. This Order specified 19 activities requiring EIA report prior to project approval for implementation. Land reclamation is under Prescribed Activity 4 that states:

"Coastal reclamation involving an area of 50 hectares or more"

However, there are other prescribed activities that have indirect connection to reclamation. Examples among them are:

5(a) Construction of fishing harbours.
5(b) Harbour expansion involving an increase of 50 per cent or more in fish landing capacity per annum.
5(c) Land-based aquaculture projects accompanied by clearing of mangrove swamp forests covering an area of 50 hectares or more.
6(d) Conversion of mangrove swamps for industrial, housing or agricultural use covering an area of 50 hectares or more.
6(e) Clearing of mangrove swamps on islands adjacent to national marine parks.

Crucial or central issue of concern is to ensure that the guidelines provide objective and reliable perspective pertaining to evaluation of coastal reclamation projects in order that the various interested parties may plan and conduct proposed project activities judiciously with minimal adverse impacts on the environment. Additionally, the information should also be synchronized or congruent at the state, national and regional levels.

The guidelines are aimed at improving the effectiveness of the present EIA procedure through:

a) Assisting the project proponents in better defining the scope of an EIA study. The guidelines can assist specifically the project proponents in the following matter:

- Create for the project a distinct image and identity;
- Plan a unique and quality development concept that will enhance the image and attraction for the proposed development;
- Maximise the advantage of the site's coastal location for recreation, tourism, housing and industrial use;
- Enhance existing low-end section of coastline development;
- Create an environmentally friendly development;
- Ensure that the existing marine water quality does not further deteriorate as a result of the project; and
- Minimise the overall impact of such large-scale project; and produce a commercially viable and implementable project.

b) Enhancing the quality of an EIA study and its report by ensuring a focus on aspects relevant to the project, and

c) Ensuring the integration of environmental considerations early in the project planning and development cycle.

1.3 PURPOSE OF THE GUIDELINES

The purpose of the guidelines is threefold:

- To set up standards for the future regulations pertaining to reclamation and related activities,

- to provide guidance in the conduct of reclamation projects which incorporate reduction and/or mitigation of significant impacts; and
- to ensure and maintain sustainability of coastal resources.

The target users of the guidelines are:

- project proponents and their consultants;
- contractors and sub-contractors;
- specific government agencies interested or involved in reclamation projects;
- EIA review panelists; and
- interested parties and the general public interested in or affected by the project.

1.4 *USAGE OF THE GUIDELINES*

The contents of the proposed guidelines are specific for conducting an EIA study on coastal and land reclamation activities and to enhance the uniformity and quality of the EIA report. Based on evaluation and prediction of potential impacts of the projects, it is hoped that the prospective project proponent will be able to conduct his proposed reclamation project judiciously, incorporating the best options to control and mitigate significant impacts due to the project development.

The chapters are arranged in a successive sequence of priorities, beginning with laying out the rationale of reclamation projects and the need for guidelines pertaining to this particular prescribed activity. The legal aspects and various definitions of coastal zone as perceived by interested parties are given in Chapter 2 to provide insight into various major issues and conflicts currently besetting coastal zones development and their management. The procedural

stages for setting up of an integrated EIA study is given in Chapter 3. Site selection and project options are described in Chapter 4.

The scoping process, elements, parties involved and the importance of scoping are briefly underlined in Chapter 5.

Chapter 6 discusses the various baseline considerations for physical, biological and socio-economic systems in some details. This is followed in Chapter 7 by the prediction and evaluation of impacts pertaining to reclamation projects. Aspects of control and mitigating measures are broadly discussed in Chapter 8 with emphasis on selected issues of main concerns.

Chapter 9 is the Environmental Management Plan and Chapter 10 is the Recommended Checklist for the Reclamation Projects. Supplementary information is presented in the References and Appendices, which also include elaboration of relevant legislation with regard to land reclamation in the coastal zone, other definitions of the coastal zone, engineering aspects, phases of land reclamation projects, flowcharts for processing various coastal development projects, work schedule and suggested format for an EIA Report, among others.

The guidelines in this report are complementary to other existing guidelines, associated and supplementary documents both international and local for these prescribed activities. For more exhaustive treatment, the user is urged to refer to specialised texts, qualified practitioners, other resource persons and recognised authorities in this field.

CHAPTER 2

LEGAL AND OTHER RELATED ASPECTS

2.0 *COASTAL RECLAMATION - A PRESCRIBED ACTIVITY*

The development of coastal reclamation project is subjected to an EIA under the EIA Order, 1987 and the relevant item under the schedule of Prescribed Activities is quoted below:

4. LAND RECLAMATION: Coastal reclamation involving an area of 50 hectares or more. *(Schedule of Prescribed Activities, EIA Order, 1987)*

Other Malaysian Laws governing coastal zone and associated development are:

- Federal Constitution (as at 10th August 1995);
- Environmental Quality Act 1974;
- Environmental Quality (Prescribed Activities) EIA Order 1987 (subject to Natural Resources and Environment Ordinance (Sarawak) 1949 (Amended 1994));
- Local Government Act 1976;
- Land Acquisition Act 1960;
- National Land Code 1965;
- Town and Country Planning Act 1976;
- Land Conservation Act 1960;
- Street, Drainage and Building Act 1974;
- Municipal and Town Boards (Amendment) Act 1975;
- Continental Shelf Act 1966;
- Exclusive Economic Zone 1984 (EEZ);
- National Forestry Act 1984;
- Fisheries Act 1985;

- Antiquities Act 1976;
- Protected Areas and Protected Places Act 1959;
- Protection of Wild Life Act 1972; and
- Port Authorities Act 1963 (Revised 1992).

Other relevant national and international legislations with regard to land reclamation in the coastal zone is given in Appendix 1.

2.1 *COASTAL ZONE DEFINITION*

The term coastal zone is used extensively in recent literature with some variations as to its exact meaning. Some definitions refer to the zone as a narrow area of land and wetland immediately adjacent to the shoreline - the line where the sea and the land meet. Some refer to it as the area extending inland approximately 1 km from the mean low tide level and seaward to the outermost limit of the state boundaries (Resource Agency of California, Section 17 of Chapter 2 of the Statutes of the 1975-1976).

Coastal zone has also been defined as an area of variable width, which extends seaward to the edge of the continental shelf, but which has no distinct landward demarcation. It is within this zone that man's activities can interrupt or destroy ecosystems and natural processes whether they be biological, chemical or physical (Hail, 1977).

LOICZ Science Plan (IGBP, 1993 in Pernetta and Milliman, 1995) defines Coastal zone as "extending from coastal plains to the outer edge of the continental shelves, approximately matching the region that has been alternately flooded and exposed during the sea level fluctuations of the late Quaternary period".

The Organisation for Economic Cooperation and Development Environment Directorate (OECD, 1993a in Turner and Adger, 1995) argues that the coastal zone can be defined according to the nature of the problem being examined, particularly the objectives of management. Thus marine boundary of a coastal zone can be taken as the Exclusive Economic Zone (EEZ) limit, while on the landward side, the boundary can be fixed in terms of existing local government administrative areas of the potentially more extensive natural drainage basins.

The EIA Guidelines for Coastal Development Projects by Department of Environment (1987) gave a definition of Coastal Environment as comprising four landscape units, viz., marine, intertidal, foreshore and backshore zones:

- Marine zone is the seaward zone beyond low tide. This zone is also known as the offshore zone.

- Intertidal zone is the zone between low tide and high tide.

- Foreshore or supra-tidal zone is the zone bordered by high tide and extending inland subject to the processes of accretion and erosion from wind or water. It can be defined on a project basis from landform (inland limits of active dune formation and saline pools, mangrove, etc.) and vegetative classification. Estuary environment also applies to the physical limits of salt-water intrusion in the river.

- Backshore zone is the zone of stable coastal landform not subject to coastal processes of accretion and erosion. The backshore zone on the mainland can also be defined as the inland side beyond the Highest High Water Mark (HHWM) and extending at least 1 km landward from the coastline. Any development beyond the HHWM but within 1 km from the coastline is therefore within the coastal environment. The backshore zone of an islet near the mainland is the lagoon-side land.

Other definitions of coastal zone are given in Appendix 2. For the purpose of this Guideline, the existing DOE definition is adopted.

2.2 *COASTAL CHARACTERISTICS*

In Malaysia the coast can be broadly categorised into sandy, muddy and cliff coast. All beaches are subjected to the influence of the dominant prevailing winds namely, the Northeast and Southwest Monsoons. Most sandy beaches in Malaysia suggest that a close process-form-relationship between energy input and available material has been established and that a state of dynamic equilibrium probably exists. Equilibrium is suggested because the detailed form shows little tendency to change significantly through time: dynamic because erosion and transport are still possible, but are experienced more or less equally across the whole area, thus avoiding morphological change. This type of sandy beaches in plan form is sometimes termed headland bay beaches, zeta form bays or long spiral bays as they all describe asymmetrically curved bays joining one headland to the next. This type of sandy beaches is common in the eastern coast of Peninsular Malaysia and some parts of Sabah. A typical profile of sandy beaches is given in Figure 2.1. There are many terminologies and associated boundaries assigned to the coastal profile. It is, therefore important that the choice of the typical profile is relevant to Malaysia and its referred content is understood.

Another type of beach common in Malaysia is the process-form-sediment data, which appears to be more complex. Such beaches are sometimes related to the complex offshore pattern of submerged banks that control wave and current activities. Sediments from the rivers feeding the beach can also influence it. Its coastal geomorphology may well be time dependent and it may be dominated by historical sequence of change in the controlling variables. Of potential significance also is the possible variation in sedimentation rate from terrestrial sources resulting from major types in land cover and land use change. Beaches of the western coast of Peninsular Malaysia and in some parts of Sarawak exhibit this type of muddy beaches. Mudflats are typical coastal landform with abundant presence of mangrove; while in some other stretches with combination of sandy and muddy material, ridge and runnel formation are common.

The mudflat beaches are the most common ones that have been earmarked for large-scale reclamation project in Malaysia. A typical profile of muddy beaches is given in Figure 2.2. These mudflat beaches contain wide intertidal zone that can vary from a few metres to a few hundred metres. These types of beaches are common in the west coast of the country and stretches throughout the coastlines of West Johor, Selangor, Kedah, Perak and Perlis.

The majority of the shoreline areas along the west coast of the Peninsula are vegetated by mangrove forests. These areas are associated with muddy beaches and extend up to 1110 km long. In Sabah, the 1800-km coastline is characterised by rugged formation with many bays of various sizes. Almost half of the 1040 km of the Sarawak shoreline is made up of muddy beaches. The muddy coast of the west of Peninsular Malaysia is so formed largely due to the protection provided by the island of Sumatra. This protection creates a low energy area as compared to the exposed ones due to limited fetch, thus allowing the mud to settle on various stretches of the coast. The characteristic of the stable mud and mangrove coastlines is that the slope at the nearshore region is quite flat at 1:400 to 1:1000. Most incident wave energy is dissipated on this slope and usually not on the slope at the mangrove line.

2.3 *COASTAL RESOURCES*

Coastal zone is rich with coastal resources. Figure 2.3 shows resources associated with coastal area, offshore zones and brackish area. Table 2.1 shows recent estimates concerning various characteristics and properties of the coastal zone demonstrating quite

clearly the global importance of the coastal domain for both humanity and geo-chemical cycle despite its comparatively small surface area and volume.

Table 2.1: Characteristics and Properties of the Coastal Zone

Coastal Domain (200m above and 200m below sea level):

- Occupies 18% of the surface of the globe;
- An area where around one quarter of the global primary productivity occurs;
- Where about 60% of human populations live;
- Where two thirds of the world cities with populations of over 1.6 million are located; and
- Supplies approximately 90% of the world fish catch.

The coastal zone accounts for:

- 8% of the ocean surface;
- <0.5% of the ocean volume;
- Around 14% of global ocean production;
- Up to 50% of global oceanic denitrification ;
- 80% of the global organic matter burial;
- 90% of the global sedimentary mineralisation;
- 75-90% of the global sink of suspended river load and its associated elements/pollutants; and
- In excess of 50% of present day global carbonate deposition.

Source: IGBP 1994. Land-Ocean Interactions in the Coastal Zone Implementation Plan Report, No. 33, Stockholm.

Figure 2.3 and Table 2.1 show clearly the many resources that are interrelated and often very fragile and sensitive in nature. Very often some of these resources especially coastal wetland are being traded off in the reclamation activities. This trade-off should not be taken lightly by the approving authorities, neither can the wetland be assumed to be uneconomical. Coastal wetlands are among the most valuable of coastal resources. Their main functions are to filter pollutants from water and trap suspended materials. Wetlands reduce coastal erosion by absorbing and dissipating wave energy, binding and stabilising sediments and increasing sediment deposition. Wetlands also protect upland areas from flooding by storing floodwaters and reducing, capturing and retaining surface water runoff with the added benefit of allowing water to infiltrate underground recharge zones. Wetlands provide valuable habitat for wildlife and plant life, a relatively safe environment for threatened and endangered species for many commercially and recreationally valuable fish species.

The coastal zone provides gateways for world commerce, inland trade, port facilities, industry, oil wells and power plants. As indicated in Table 2.1 and Figure 2.3, coastal zone provides the most bio-productive area for marine and associated life, varieties of fish and wildlife. It provides an attractive area for dwelling, recreational, commercial and sport facilities and has high aesthetic value. It also provides an area for educational activities and training. It is therefore understandable that coastal zone generates high monetary interest and emotion among the people in Malaysia.

Any changes in the coastal zone, whether due to man-made activities such as large-scale reclamation projects or due to long-term natural changes to the earth system such as global warming (resulting in a rise in global mean sea level), will lead to major impacts in the coastal zone. Arguably, such impacts can be more intense as coastal zone assets contain high monetary value. This is all the more reason why reclamation activities need to take into consideration other coastal assets that are likely to be affected. Trade-off items must be clearly spelt out to the public and decision-makers. The framework of reclamation activities and associated problems concerned and decision reached must be flexible. The implementation of the reclamation project must be designed in such a manner that it is an acceptable compromise to other coastal activities.

2.4 *CONFLICT IN THE COASTAL ZONE*

Figure 2.4 shows that gains obtained from reclamation are very lucrative. The gains can be quantified in terms of monetary values; while on the other hand, the trade-off and loss to other resources are not easily quantifiable. In implementing reclamation project, it is therefore, pertinent that the project proponent and decision-makers must address various aspects. The negative impacts have to be mitigated to minimise damage while trade-off (in monetary and other forms) to the environment must be made clear. The trade-off is the total loss of those particular resources due to the implementation of the reclamation project.

As discussed previously, coastal resources are characterised by multiple resource systems and multiple users. Competition of resource use among multiple users inevitably leads to conflicts. If left unmanaged, competition among coastal resource users may lead to over-exploitation of resources and thus causing negative environmental effects in that area.

Figure 2.5 shows the main issues arising from reclamation projects. The overlapping of areal extent and multiple nature of the issues complicate matters further. Figure 2.6 indicates the economic activities that can give rise to conflicts. The most relevant point to note here is, which of these development projects should be given priority over the others. Questions may arise as to how planners and relevant authorities can wisely judge the optimum benefit of any chosen development.

In making decision on reclamation activities, extensive information must be acquired to evaluate trade-off between no development and reclamation. Economic analysis normally deals with costs and benefits related to decision on coastal resources use. But very often this analysis does not take into consideration the benefits of conserving coastal resources, which are not tangible and not easily quantifiable in monetary term. Currently, there is an economic valuation methodology, which is termed as non-market valuation that takes into account non-quantifiable resources. Even so, such valuation is often misunderstood or at best accepted with reluctance.

Some of the shortcomings of the valuation for coastal resources are given in Table 2.2.

Table 2.2: Economic Valuation System of Coastal Resources

- Present methods of evaluating resources in the coastal zone are inadequate since they often fail to take into account the dynamic nature of coastal system;
- Undervalue or ignore some natural resources and services;
- Externalise some environmental costs;
- Generally do not consider long term environmental trends;
- Non-existence of effective enforceable property right ;
- The market does not set accurate values due to market failures; and
- These failures often result in planning decisions that are unsustainable in the long term, leading to undue dependence on one project development (single-sector development), thus increasing the vulnerability of the community to long-term changes in environmental parameters.

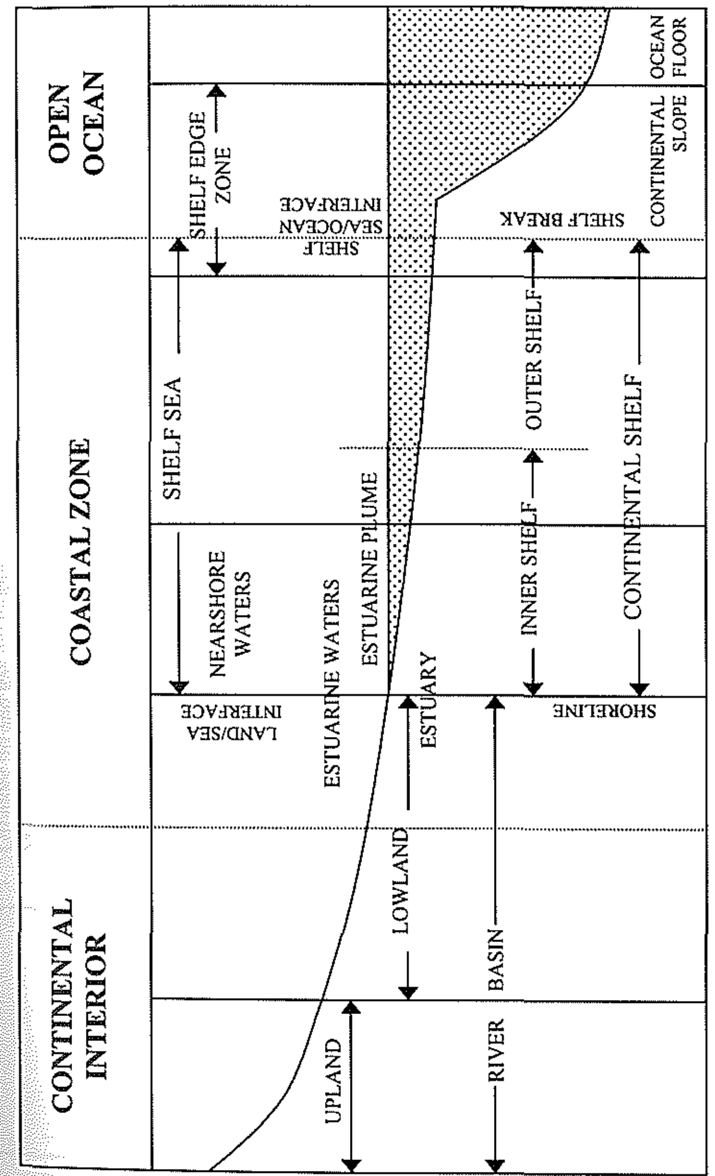


Figure 2.1 : Diagrammatic Representation of the Coastal Zone, Continental Shelf and Other Features of the Land-Ocean Boundary. *(Source : LOICZ Science Plan, Pernetta and Milliman, 1995)*

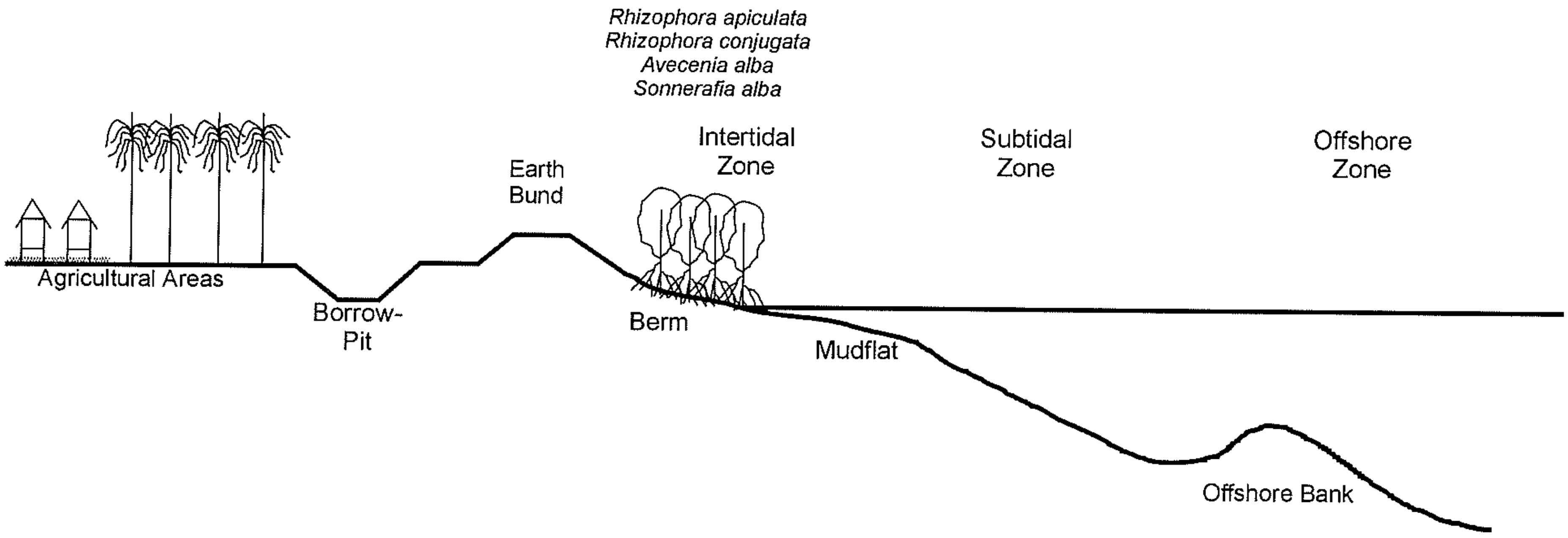


Figure 2.2 : Typical Profile of the Muddy Coastal Zone in Malaysia that is Commonly Used for Reclamation Project

EIA Guidelines for Coastal and Land Reclamation

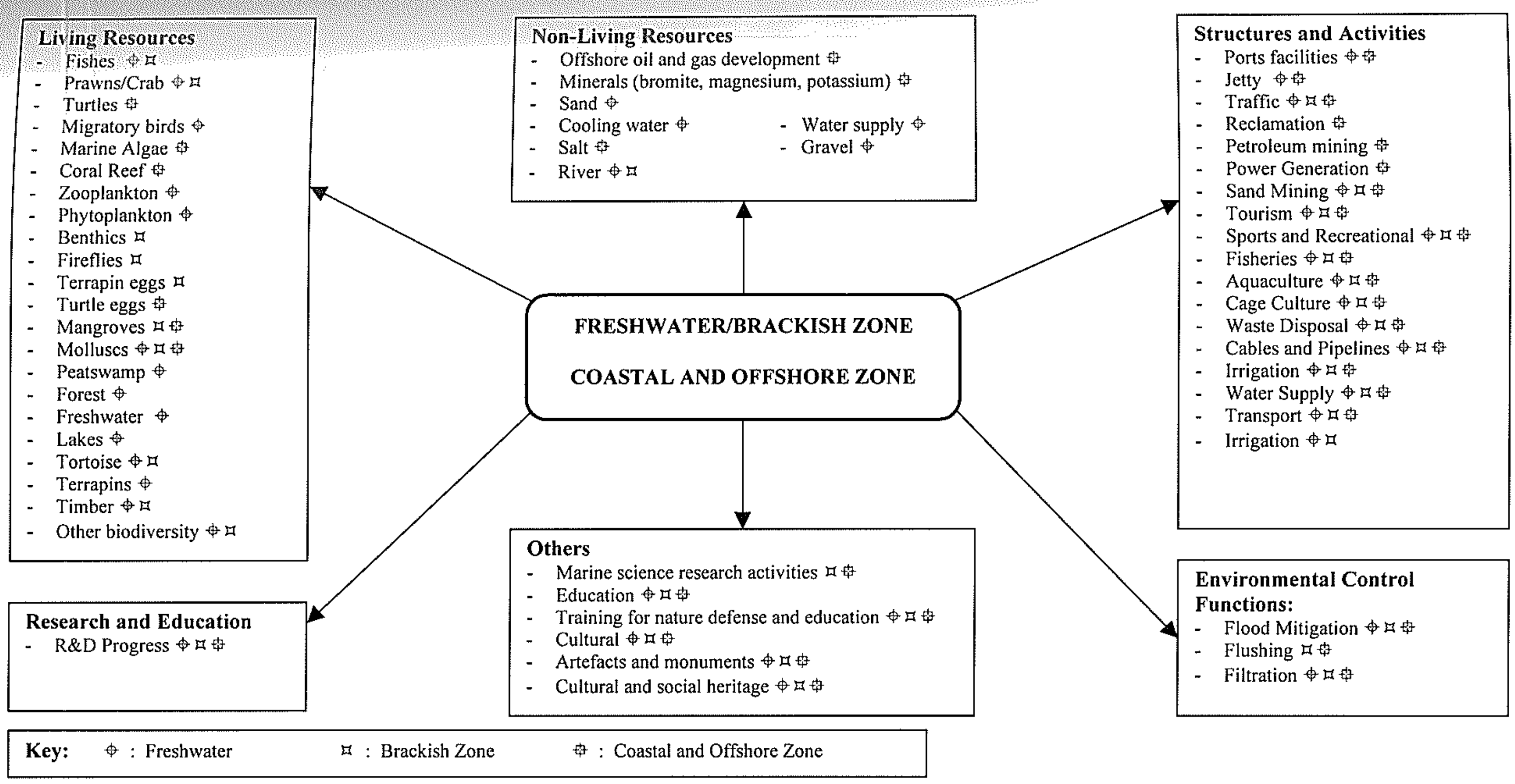


Figure 2.3 : Resources, Activities and Structures Within the Land-Ocean Interaction

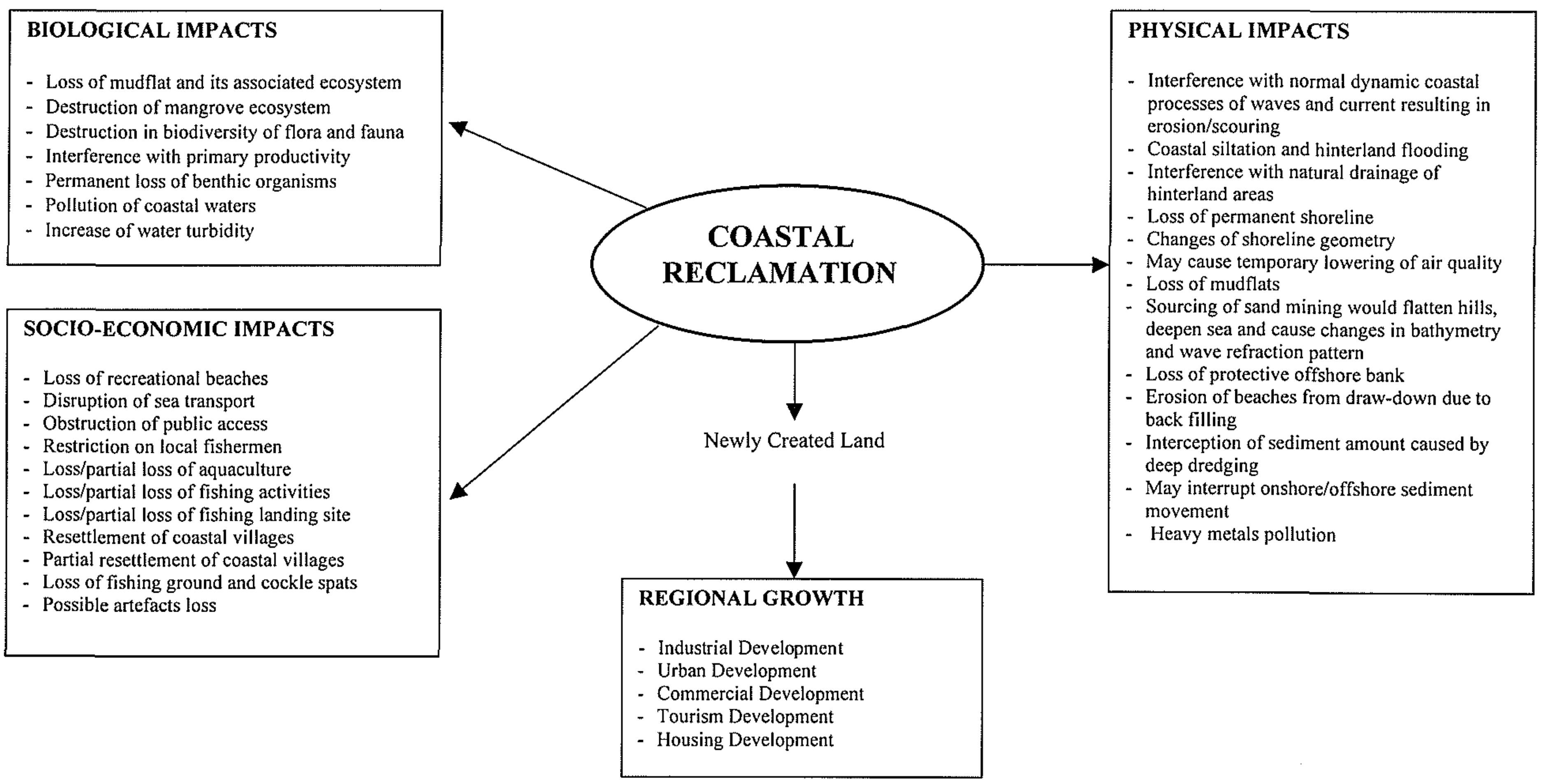


Figure 2.4 : Cascade Effect of Reclamation Project

EIA Guidelines for Coastal and Land Reclamation Legal and Other Related Aspects

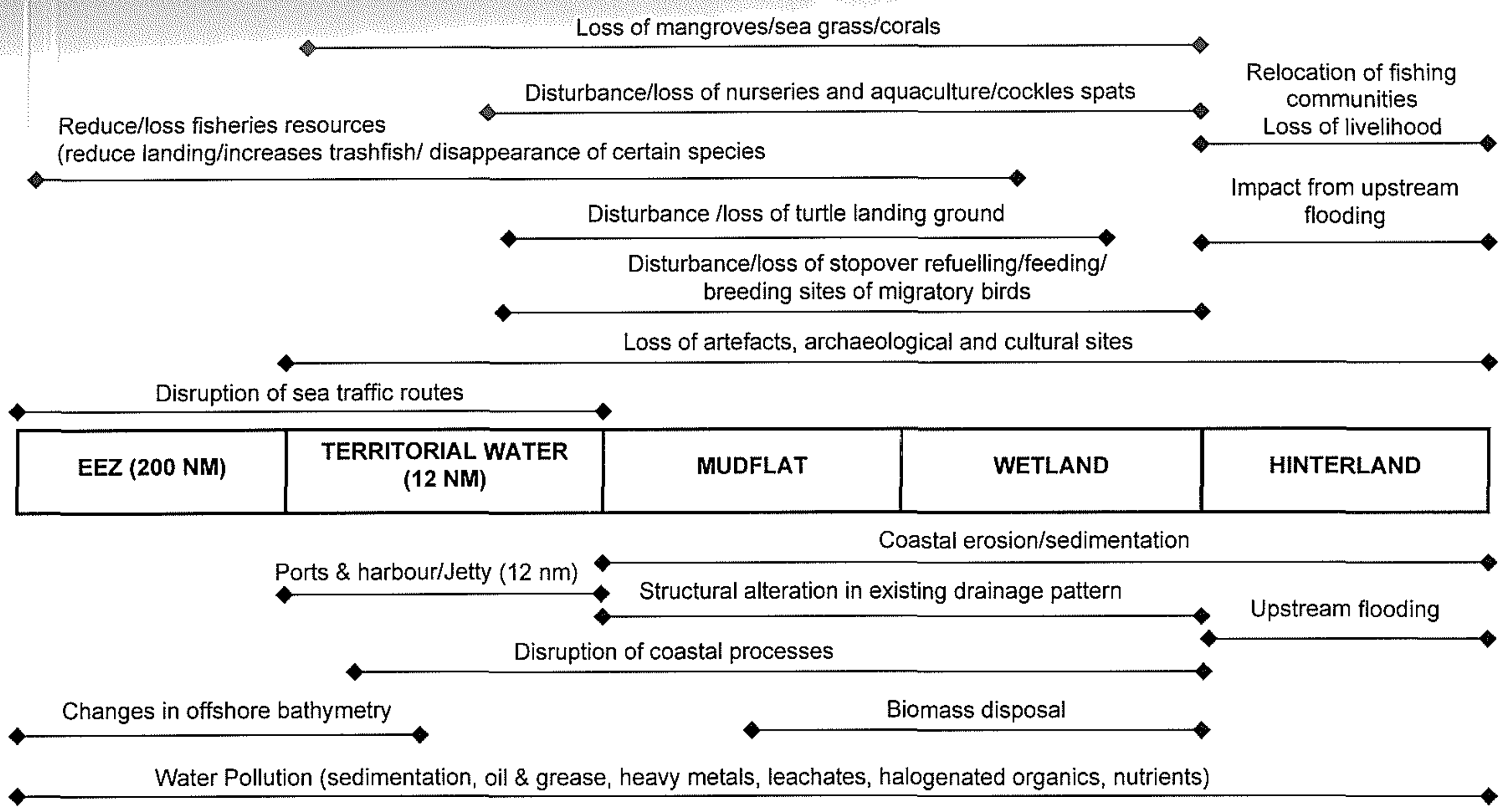


Figure 2.5. Main Issues and Areal Extent of Impacts of Reclamation Project

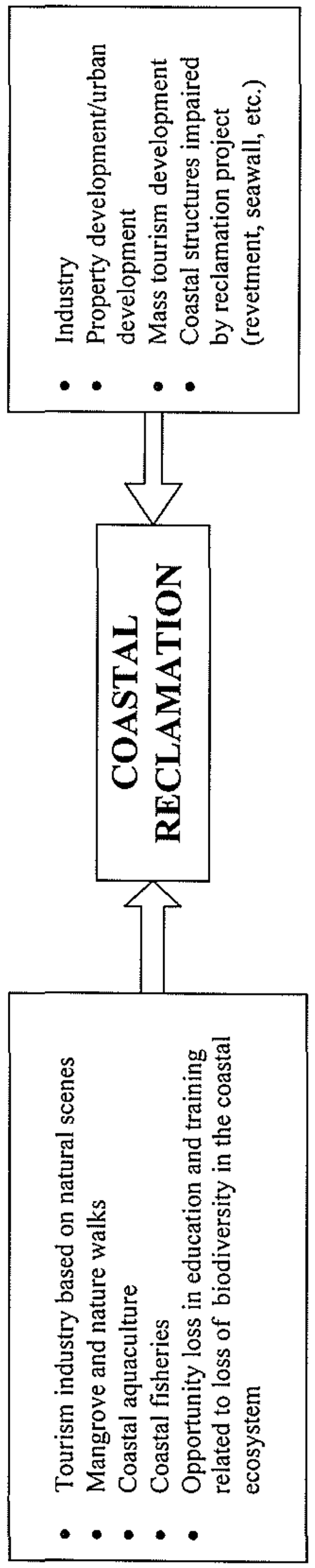


Figure 2.6 : Conflict Arising From Reclamation Project

CHAPTER 3

INTEGRATED PROJECT PLANNING CONCEPT

3.0 *THE EIA IN THE PROJECT CYCLE*

The integrated project planning concept which includes the EIA process as summarised in Figures 3.1 and 3.2, comprises the following interactive stages:-

- the initial environmental screening or preliminary assessment;
- initial evaluation by the regulatory agencies;
- the full assessment or study following inputs from the regulatory agencies;
- evaluation and revision of EIA report by DOE for preliminary report or the *ad hoc* Review Panel for detailed EIA; and
- approval of the EIA report with stipulated conditions, amendments, regulations, etc.

3.1 *THE EIA PROCESS*

The sequential steps in an EIA process can be summarised as follows:-

- Project justification and needs;
- Identification of the main environmental issues;
- Scope of work;
- Baseline data collection;
- Environmental impact analysis;
- Identification of mitigating measures; and
- Environmental monitoring recommendation.

Throughout the process, public consultation and inter-agency/department coordination are needed and are to be sought after.

Definite plans can be formulated for conducting an EIA of the proposed project once the most viable alternative, or alternatives, have been established through the pre-feasibility process. Generally, this is done through the formulation of a "Scope of Work". A proposal to conduct the study should include the following:

a. An outline of the report format elements (Table 3.1);
b. An elaboration of the general activities under each section of the scope of work outline (Table 3.2); and
c. A schedule for completion of all activities to be undertaken in the EIA study (Table 3.3).

Tables 3.1 - 3.3 are brief examples of the above-mentioned three items for a reclamation project. However, it must be considered that these examples are brief and parameters can vary due to site specific considerations.

These items should be compiled into a document to be used as the primary management tool for controlling completion of the feasibility studies in an organised and efficient manner. The incorporation of inputs from interested parties, public comments and approval regarding sensitive environmental issues would be useful for expediting the acceptance of the completed EIA study. The organisation structure for processing Detailed EIA reports and approval procedures is given in Figure 3.3.

The project should be implemented within two years of approval date of the EIA report. The project proponent, regulatory agency and other relevant authorities will ensure that mitigation and control measures recommended in the EIA report are implemented. Monitoring and auditing key activities should be incorporated in the various stages of construction and operation of the project. The monitoring and auditing programmes would enable verification of predicted impacts in the EIA. It would also provide the basis for long-term monitoring

or trend monitoring of significant impacts associated with the prescribed project activities.

Table 3.1 : Outline of Suggested Report Format Elements for a Coastal and Land Reclamation Project

1.0 EXECUTIVE SUMMARY

2.0 INTRODUCTION
- 2.1 Objectives of the Detailed EIA
- 2.2 Legal Requirements
- 2.3 Scope of Study
- 2.4 Outline of Report

3.0 BACKGROUND
- 3.1 History of Project
- 3.2 Approval Process

4.0 PROJECT INITIATOR
- 4.1 Project Proponent
- 4.2 EIA Consultants

5.0 STATEMENT OF NEED
- 5.1 Background
- 5.2 Development Objectives
- 5.3 Conclusions

6.0 PROJECT DESCRIPTIONS
- 6.1 Locations
  - 6.1.1 Proposed Project Development
  - 6.1.2 The Reclamation Project
  - 6.1.3 The Subsequent Proposed Development
- 6.2 Reclamation Design Concept
- 6.3 Project Activities
  - 6.3.1 Access Roads
  - 6.3.2 Sourcing and Transportation of Rocks
  - 6.3.3 Construction of Containment Structures
  - 6.3.4 Sand Sourcing (Offshore) - Dredging
  - 6.3.5 Reclamation Works
  - 6.3.6 Landscaping
  - 6.3.7 Shore Protection Structures
- 6.4 Provision of Utilities, Services and Other Requirements
  - 6.4.1 Access roads (Island Concept)
  - 6.4.2 Water Supply
  - 6.4.3 Drainage
  - 6.4.4 Power Supply, Communications
  - 6.4.5 Sewerage and Solid Waste Disposal
  - 6.4.6 Labour Force and Employment Structure
  - 6.4.7 Landscaping / Visual and Aesthetic Significance
- 6.5 Project Schedules

The following activities will be taken into consideration for assessing and predicting impacts to the environment. Mitigating measures are then proposed to reduce/minimise/eliminate the impacts.

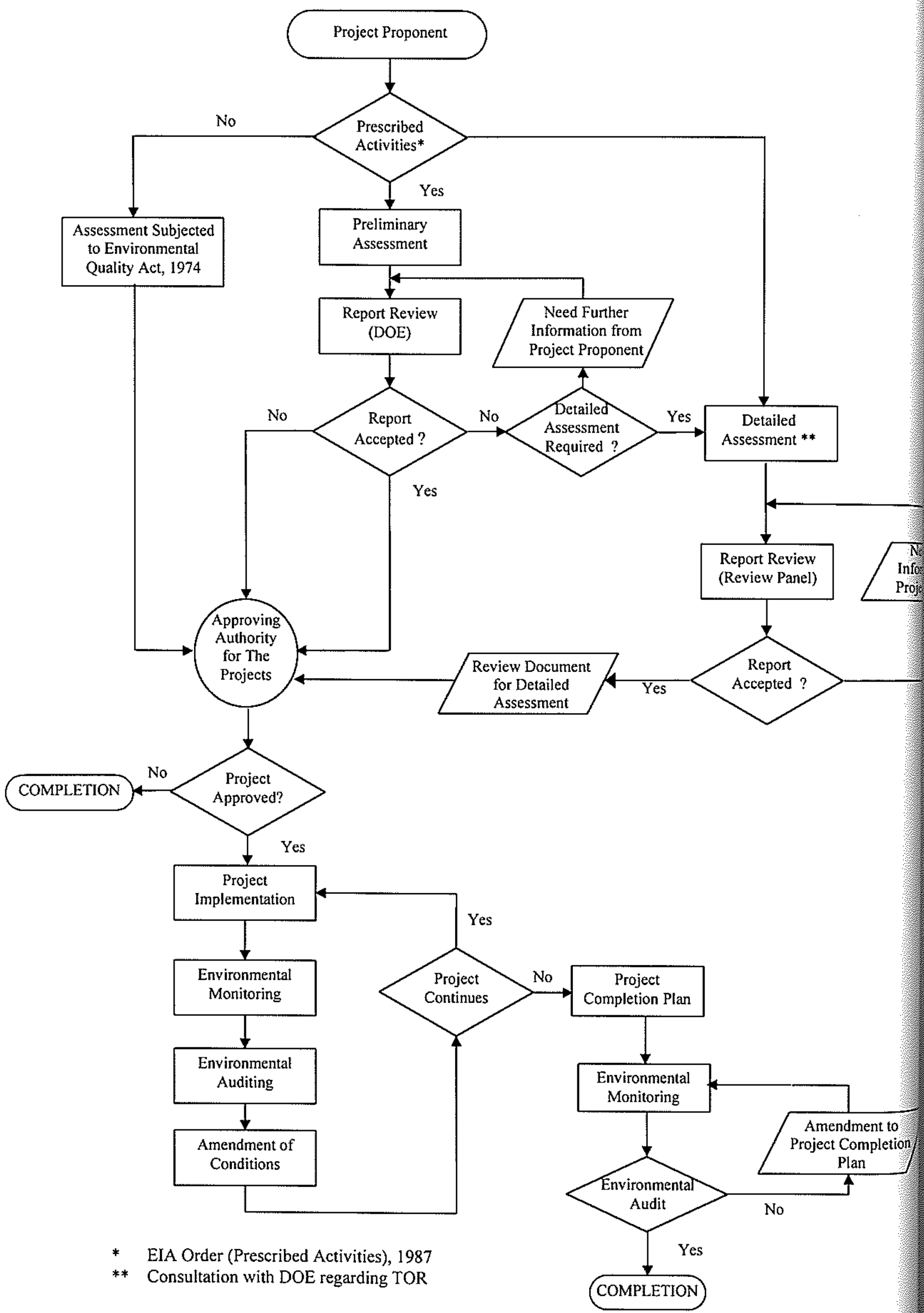
Table 3.2 : An Elaboration of General Activities of the Scope

General activities during site preparation and construction	
• Access roads and tracks	• Construction of containment structures
• Stream crossing	• Pipelines
• Transportation of materials	• Tunnels and culverts
• Hydrological survey	• Landscaping
• Drilling and Blasting	• Surfacing and Paving
• Site Clearing	• Revegetation
• Erosion control	• Fertiliser application
• Drainage alteration	• Pest Control
• Earthworks	• Labour force
• Dredging	• Base Camps
• Reclamation	• Abandonment
• Equipment	• Waste Disposal and recovery

Table 3.3. An Example of A Schedule Plan for an EIA Study of Coastal Reclamation

TIME SCHEDULE	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
SITE VISIT AND SURVEY	■					
PROJECT SCOPING						
- Project description	■	■	■	■		
- Project site	■	■	■	■		
- Engineering considerations	■	■	■	■		
- Infrastructure	■	■	■	■		
BASELINE ON PHYSICAL ENVIRONMENT						
- Geology and Soils	■	■	■	■		
- Hydrology	■	■	■	■		
- Coastal Geomorphology/Hydrodynamics	■	■	■	■		
- Water Quality	■	■	■	■		
BASELINE ON BIOLOGICAL ENVIRONMENT						
- Terrestrial Habitats and Communities		■	■	■		
- Flora and Fauna		■	■	■		
- Marine Habitats and Communities		■	■	■		
- Marine Flora and Fauna		■	■	■		
BASELINE ON SOCIO-ECONOMIC ENVIRONMENT						
- Socio-economic		■	■	■		
- Archaeology		■	■	■		
DATA ANALYSIS AND MODELLING			■	■	■	
PREDICTION AND IMPACT ANALYSIS			■	■	■	
MITIGATION CONSIDERATION			■	■	■	
WORKSHOP/MEETINGS			■	■	■	■
REPORT PRODUCTION				■	■	■

* (Note: The duration of the various activity components varies according to the scope, size and location of the project)



* EIA Order (Prescribed Activities), 1987
** Consultation with DOE regarding TOR

Figure 3.1 : Flowchart for EIA Procedures in Malaysia

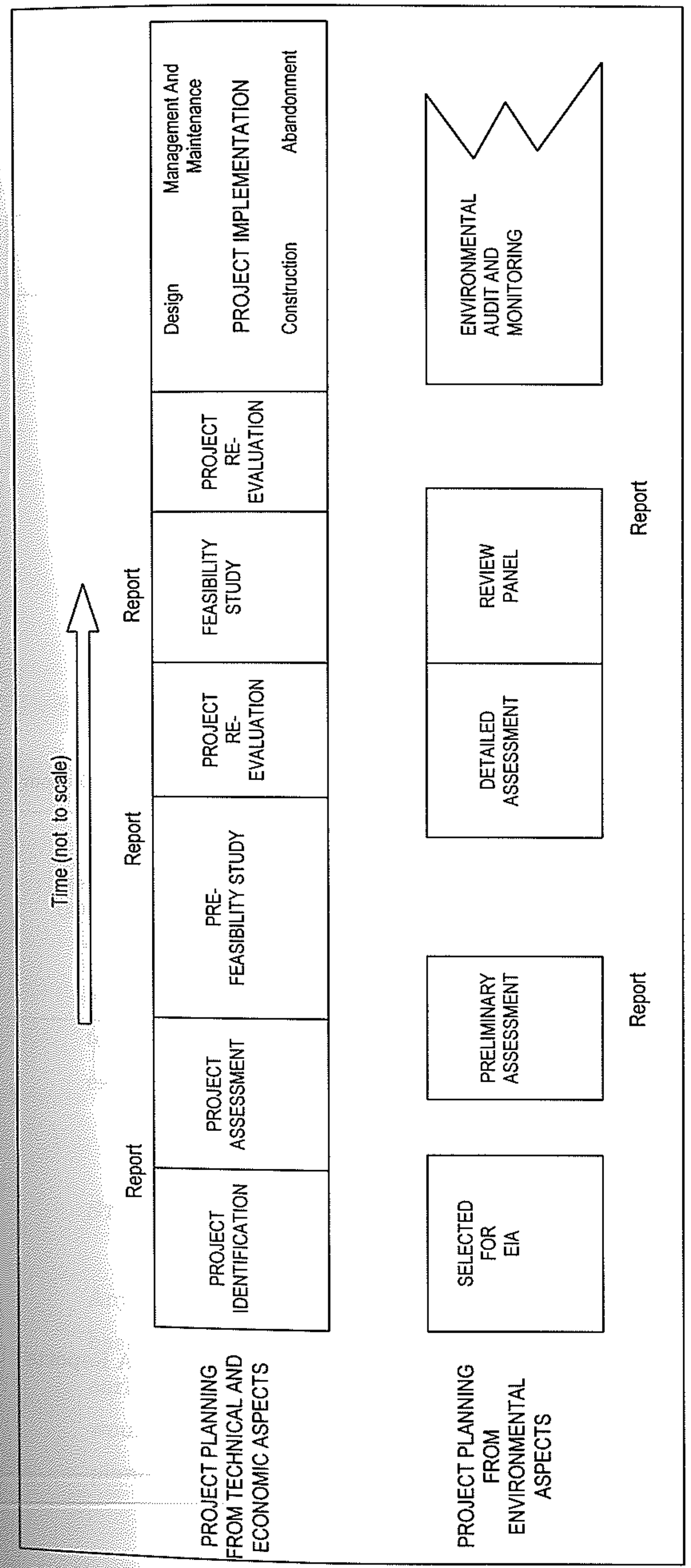


Figure 3.2 : Integrated Project Planning Concept

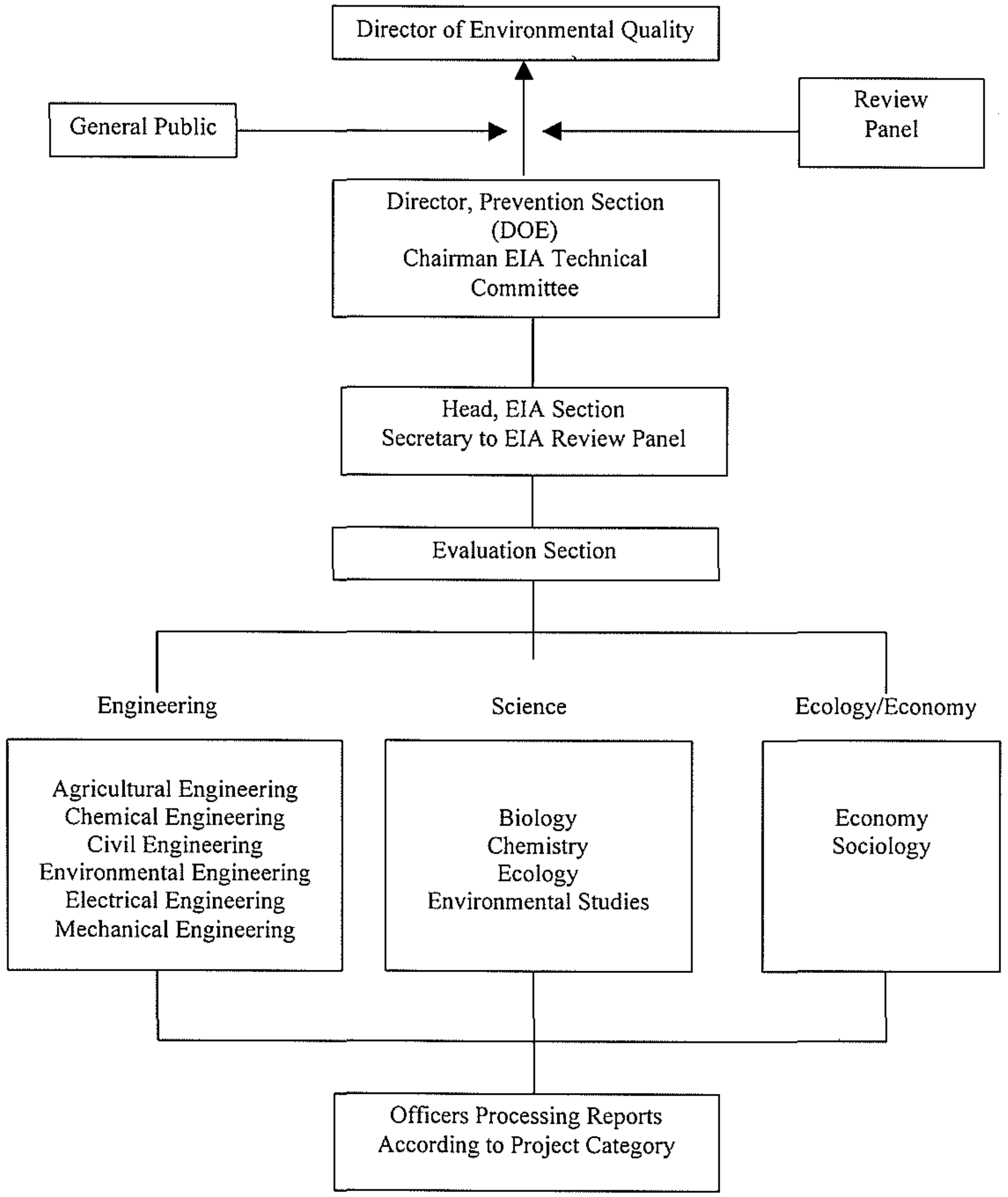


Figure 3.3 : Organisation Structure for Processing Detailed EIA Reports and Approval Procedures

CHAPTER 4

SITE SELECTION, PROJECT OPTIONS AND PROJECT ACTIVITIES

4.0 *INTRODUCTION*

Realising that there is a need for an integrated approach in the design of coastal reclamation works, inputs from environmental scientists, coastal and geotechnical engineers are essential to ensure that the project will be carried out successfully. Serious consideration will be given to the hydraulic, environmental, geotechnical and coastal engineering aspects.

In planning and implementing any large scale reclamation project, consideration should be made on the existing coastal regime and features, offshore bathymetric conditions, river estuaries, water quality, land use, type of development, etc. Responses to the coastal features will fundamentally influence the land shape and deposition of any reclamation and consequently determine the basic plan outline.

The plan should accommodate the diversion of existing drainage outlets across any created extension to the existing coastline. It needs to address the inter-relationship of the new development with the existing area both in social impact and physical juxtaposition.

4.1 *STATEMENT OF NEED*

Any proposal mooted for a project would have been made on certain basis. The basis or need for a project should be clearly established early in the project planning. Basis and rationale for the proposal would reflect the objective of a project and provide direction during planning. A statement of need also highlights the various benefits such as social, economic, cultural and aesthetics that may accrue from the project.

4.2 *SITE SELECTION*

For reclamation projects, site selection in particular refers to fill material sourcing, disposal site for dredged material and the reclamation site itself. Identification of suitable sites may be aided by various techniques such as best options or best alternatives, and constraint mapping. The latter generally involves mapping out all ecological constraints within the selected area, perhaps with the aid of overlays or Geographical Information System (GIS) and computer modelling.

If two or more sites are being considered, the sites should be compared with each other against the set guidelines or criteria. The most acceptable site should be selected.

Site selection for the reclamation purposes is very important to ensure that the natural habitats of the coastal, marine and benthic communities are maintained and that these habitats receive minimum impacts or otherwise, their trade-offs are fully understood. This step must constitute the first stage in the assessment process.

Attention must be given to the natural habitats such as mangrove and marine benthic area during any decision making. Fish and prawn juveniles spend most of the time in these areas to grow. Attention should also necessarily to be given to some of the marine organisms that are classified as endangered or rare species, such as the turtles, dolphins, whales and dugong. The loss and the damage to natural habitats such as corals and fragile island ecosystems should also be understood fully and quantified as proposed in the justification section of this report.

The physical environmental components that are expected to receive serious adverse impacts from reclamation activities are seabed and

the water column. The seabed alteration and siltation are expected to be the major problems. Water currents or waves can cause more severe dispersion of suspended particulates, which can reduce the light penetration into the sea bottom. The sunlight plays a major role in the photosynthetic process that is essential for the marine coastal production and food chain. Intertidal and sub-tidal corals, marine vegetation and plankton rely totally on this energy to produce food, which will be transferred to other forms through the food web.

RECOMMENDED LOCATIONS

The Guidelines on Erosion Control For Development Projects in The Coastal Zone, Garispanduan JPS 1/97 (1997) and related guidelines should be used to guide for the selection of the reclamation site.

It is suggested that a dredging prohibition zone of not less than 1.5 km from the mean low water line or 10 m depth, whichever is further from the shore, be specified.

In the marine tropical ecosystem, extensive hermatypic coral reefs and vegetation are recorded to grow to 30 m depth, where light can still reach the sea bottom, although many physical factors may influence light penetration. Therefore, it is recommended that the sand mining spoil disposal from dredging activities should be at 30-m depth or 1.5 km from mean low water whichever is further from the shore. However, this recommendation is suitable only if there are no existing fishery associated (fish lure and artificial reef), or fishing activities in the surrounding area. If it is not possible to comply with this regulation due to the technical, practical or economic reasons, scope of impact evaluation study should be conducted to determine whether or not the proposed site would lead to adverse impacts on the coastal processes.

Generally, criteria that may be used for recommended site selection could be summarised as follows:

a. Coastal physical characteristics that may be affected during site preparation, site clearance, construction and operation;
b. water quality that may deteriorate due to many activities;
c. mangrove deforestation for site preparation; and
d. biological characteristics to determine whether there are temporary loss or significant and permanent loss of resources.

Environmental trade-off as discussed in Section 2.3 is an important aspect of site selection and project option. Two recommended methods for site selection are weighted rating decision and screening using matrix, some examples of which can be referred in the EIA Guidelines for Dams and/or Reservoir Projects prepared by DOE. For the reclamation project, coastal erosion, seabed damage, pollution of coastal water, siltation, mangrove productive zone and marine habitat loss may be used as criteria for site selection. Table 4.1 shows factors considered useful for site selection.

4.4 *PROJECT OPTIONS*

In general, there are two options that can be considered for planning and implementing the proposed reclamation project:-

a. Strip (Land Based) Reclamation Concept.
   The reclamation for the land-based concept involves a simple extension of the existing coastline.

b. Island(s) Concept.
   The creation of an island or multiple islands would provide the commercial advantage of greatly increased water access and frontage, improved general amenity and a clearly self-contained reclamation staging and development phasing. It would create a strong image but permit an individuality of character and purpose for each island.

In any case, detailed planning is required to optimise the land configuration.

Table 4.1: Factors Considered Useful for the Evaluation of the Recommended Location

Factors	Consideration	Standard/Guidelines/ Legislation
Mangrove habitat	• Nursery and spawning area • Larvae and juveniles habitat • Food chain/production • Present/absent protected species	Wildlife Protection Legislation
Coastal characteristic	• Status and character of habitat	
Coastal water pollution	• Sunlight transparency • Changes in physical and chemical qualities • Brackish water mixture (fresh and marine water)	Interim National Marine Water Quality Standard for Malaysia
Fisheries	• Fisheries activities area • Fisheries material (fish lure, artificial reef) • Fisheries resources (spawning/nursery grounds, larvae and juveniles)	Fisheries Act, 1985
Scenic/aesthetic value	• Natural beautiful beach	Protected Areas And Protected Places Act 1959
Archaeology	• Significant cultural or archaeological sites (e.g. shipwreck sites)	Antiquities Act, 1976

4.5 RECLAMATION PROCESS

Prior to the commencement of any reclamation projects, it is essential that technical feasibility and economic studies be carried out to ensure that the projects are economically viable and can be implemented successfully. The major components during these studies are:

- Determination of sand source areas within economic haulage distance;
- Soil investigation to assess the settlement and stability;
- Cost-benefit analysis; and
- Preliminary design analysis to establish the design parameters.

In normal practice, the primary activities are to compile and elaborate the existing information so that the following can be carried out:-

- Identification of sources of borrow materials, availability of material, particle size distribution, quality, method of extraction and transportation;
- Method of filling, type of equipment to be used and other related preparatory works. Rehandling basin for fill material may be required but not normally recommended.
- Type and methods of containment structures;
- Proposed coastal protection system;
- Appraisal of cost implementation;
- Planning and phasing of the project development;
- Project implementation schedule;
- Identification of possible constraints and expected performance level; and
- Assessment of the impact on the project development.

4.6 SAND SOURCING

4.6.1 *Introduction*

Fill material sourcing (almost exclusively sea sand) is perhaps the most important consideration insofar as coastal reclamation project is concerned. The general viability of the project depends very much on the availability of suitable and easily accessible source of sand. It therefore forms an integral component of coastal reclamation activities.

Sand dredging which involves an area of 50 hectares or more is a prescribed activity under Environmental Quality (Prescribed Activities) (EIA) Order 1987 mandating a separate EIA study. Nevertheless, as per normal practice for project involving more than one activity requiring an EIA study, sand dredging may be integrated within the main coastal reclamation project, hence necessitating only a single report.

The major issues pertaining to sand sourcing, extraction and filling are summarised in Figure 4.1. The subsequent description within this section will discuss the criteria, activities and issues involved in locating and sourcing suitable sources of sand. Activities and issues related to sand sourcing are discussed in detail in Appendix 3.

4.6.2 *Sand Sourcing Criteria*

The following criteria are considered while locating suitable source of sand:

a. Material Availability

The location chosen as potential sources of sand shall contain the volume of suitable sand materials required completing the reclamation project.

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y due to the lack of information with
shipwreck sites. Archaeology should
re the sand dredging and mining go
:ically associated with possible sites

b. Legal and Statutory Considerations

Before embarking on the physical sand prospecting, it is prudent to carry out desktop studies with respect to legal and statutory implication. These aspects have to be looked into on a case to case basis. Typically, no-go areas may include close vicinity to naval bases, gazetted ports limit, corridor along cables, gas and water pipelines and international waters. For imported filling materials, the Customs Act requires them to undergo specific quarantine procedures.

On the other hand, guidelines by DID recommend sand-dredging activities at a minimum distance of 1.5 km from the coast and at a minimum depth of 10 m, whichever is further away.

Laws and regulations that apply to coastal reclamation and which are also relevant to sand dredging activities are listed in Chapter 2 and Appendix 1.

c. Distance and Economic Considerations

Haulage distance is an important factor in considering the appropriate location of sand source. This is due to the fact that haulage normally makes up one of the major cost components of sand filling and reclamation.

d. Ecological Disturbance

The proposed location of sand source should not be sited within known ecologically sensitive habitats such as coral reefs, mangrove, seagrass areas, stopover/refuelling sites for migratory birds and turtle landing/nesting beaches. It is recommended that a seabed SCUBA investigation be carried out.

e. Archaeological Considerations

Very often archaeology is overlooked while determining suitable sand source. This is generally due to the lack of information with regard to possible historical shipwreck sites. Archaeology should be considered especially where the sand dredging and mining go beyond certain depths historically associated with possible sites for shipwrecks.

f. Traditional Fishing Grounds

It is a common traditional practice along the east coast states of Peninsular Malaysia for coastal fishermen to install traditional artificial reef and fish harvesting devices (traps) called *unjam* and *bubu* respectively. These devices help to attract and congregate fishes, thus enhancing fish harvest. Apparently the sites of *unjam* and *bubu* are "owned" and are inherited over the generations.

4.6.3 *Sand Sourcing Activities*

Sand sourcing investigation and prospecting normally includes the following activities:

a. Hydrographic Survey

Hydrographic survey is necessary to verify and enhance the standard bathymetric maps, thus forming the base map of the area. Hydrographic surveys (carried out by licensed surveyor in consultation with the Navy), would help the designer to check underwater slope stability and to determine safe dredging depth.

b. Hydrodynamic Modelling

Hydrodynamic modelling is often required to check sediment dispersion pattern due to dredging works. This will help to predict the extent of sediment suspension and drift, hence impact on the water quality of the surrounding area.

Hydrodynamic modelling is also required to predict changes to waves and currents characteristics and their impact to coastal morphology due to changes in seabed levels brought about by the dredging activities. The modelling will help to delimit depth and extent of sand mining activities within the designated area.

The modelling should also consider the continuous release of pollutants based on the number of dredgers used, frequency of trips made by each dredger and the mode of operation. Procedures for suitable reclamation work are given in Appendix 3.

Other considerations include intensity of the point source pollutants used in the model and related parameters such as standard for tolerable limits of suspended sediment concentration and other pollutants. Example of the standard tolerable limit based on the Netherlands Standard is given in Appendix 4.

c. Soil Investigation and Particles Size Distribution

Soil investigation will involve underwater boring to determine sand and bedrock depth. At equal intervals soil and sand samples are brought to the surface for laboratory sieve analysis. Suitability of the soil and sand as land filling materials primarily depends on their particles size distribution.

d. Sampling and Elutriation Test

In conjunction with the soil investigation, additional quantity of soil samples should be taken for an elutriation test to determine whether or not the soil contains toxic or hazardous contaminants (Figure 4.1).

EIA Guidelines for Coastal and Land Reclamation Site Selection, Project Options and Project Activities

e. Seabed Investigation (Biological)

Depending upon the advice of the marine biologist, seabed investigation (SCUBA diving) shall be commissioned in order to investigate/confirm the presence or absence of sensitive, rare or endangered species, seagrass beds and corals. This investigation should include photographic evidence and collection of pertinent samples. Appendix 5 gives further elaboration on this subject.

f. Archaeological Investigation

Archaeological investigation is well described in Appendix 5 (Archaeological and Cultural Sub-Study).

4.7 *SPOIL DISPOSAL ACTIVITY*

Spoil disposal will entail the following activities:-

- Detailed soil investigation of the dredge site;
- Dredging equipment selection and techniques;
- Mobilisation and demobilisation of dredger;
- Identification and selection of dredged spoil disposal ground; and
- Operational methods of transportation of spoil from the dredge area to the disposal ground.

Careful considerations therefore must be given to the disposal activities in order to minimise adverse effects to the water regime. Selection of optimum techniques for dredging and disposal, choice of mitigating measures and the planning of appropriate monitoring programmes must be given due consideration during the planning stage.

4.8 *LIST OF SITE DEVELOPMENT AND IMPLEMENTATION ACTIVITIES*

Typical activities during site development and implementation of reclamation project are listed below:

1. Pre-construction phase
   1.1 Project identification;
      a. Reconnaissance Survey
      b. Screening
   1.2 Feasibility study;
      a. Identification of sites(s)
      b. Site selection
      c. Identification of sand sourcing and selection of dredgers (options listed in Table 4.2)
      d. Identification of rock sourcing (if applicable)
      e. Identification of disposal ground
      f. Scoping
      g. Conceptual plan(s)
   1.3 Environmental Impact Assessment (EIA) study;
      a. Reports to be submitted and approved by DOE
      b. Recommendation(s) and design modification(s) as documented in the EIA report and the approval condition(s) imposed by DOE need to be incorporated in the final design.

2. Construction phase
   2.1 Construction of access road(s)
   2.2 Site clearing
   2.3 Setting up storage area and base camps
   2.4 Construction of containment structures (dykes)
   2.5 Coastal reclamation works;
      a. Dredging – material extraction
      b. Reclamation – material filling
   2.6 Soil improvement works – soil compaction, dewatering: sand drain and/or geosynthetic drain

   2.7 Landscaping
   2.8 Coastal protection work; options include:
      a. Soft Approach – Beach Nourishment, Sand bypassing etc.
      b. Hard Structures - Revetment/Seawall, Groins, Breakwaters, etc.
   2.9 Dredging of channel waterways; and
   2.10 Construction of tidal gates and drainage outlets

3. Post Reclamation Phase
   3.1 Subsequent development

Examples of material filling activities during coastal reclamation project are shown in Plate 4.1-4.4.

Table 4.2 : Dredgers' Classification and Method of Operation

Main Classification	Individual Types	Method of Extraction	Method of Transportation	Method of Disposal
Mechanical	Dipper Dredger	Face Shovel	Barge	Bottom discharge, Grab or Suction Pump
	Backhoe Dredger	Backhoe Bucket	Barge	Bottom discharge, Grab or Suction Pump
	Stationary Bucket Dredger	Bucket Chain	Barge	Bottom discharge, Grab or Suction Pump
	Self Propelled Bucket Dredger	Bucket Chain	Barge	Bottom discharge, Grab or Suction Pump
	Self Propeller Hopper Bucket Dredger	Bucket Chain	Own Hold	Bottom discharge, Grab or Suction Pump
	Dragline	Drag Bucket	Barge	Bottom discharge, Grab or Suction Pump
	Stationary Grab Dredger	Grab	Barge	Bottom discharge, Grab or Suction Pump
	Self Propelled Grab Dredger	Grab	Own Hold	Bottom discharge, Grab or Suction Pump
	Pipeline Bucket Dredger	Bucket Chain	Pipeline	Pipeline
Hydraulic	Stationary Suction Dredger	Suction Head * Centrifugal Pump**	Pipeline or Barge	Pipeline, Bottom Discharge, Grab or Suction Pump
	Jet Pump Suction Dredger	Suction head * Jet Pump **	Pipeline or Barge	Pipeline, Bottom Discharge, Grab or Suction Pump
	Hopper Suction Dredger	Suction Head * Centrifugal Pump**	Own Hold	Pipeline or Bottom Discharge
	Cutter Suction Dredger	Cutter Head * Centrifugal Pump**	Pipeline	Pipeline
	Bucket Wheel Excavator	Bucket Wheel * Centrifugal Pump**	Pipeline	Pipeline
	Trailing Suction Hopper Dredger	Draghead * Centrifugal Pump**	Own Hold	Bottom Dump or Pipeline
	Trailing Suction Sidecasting Dredger	Draghead * Centrifugal Pump**	Natural Process	Natural Process
	Dustpan Dredger	Dustpan head with Water Jets * Centrifugal Pump **	Pipeline	Natural Process

Note: * Primary,
** Secondary

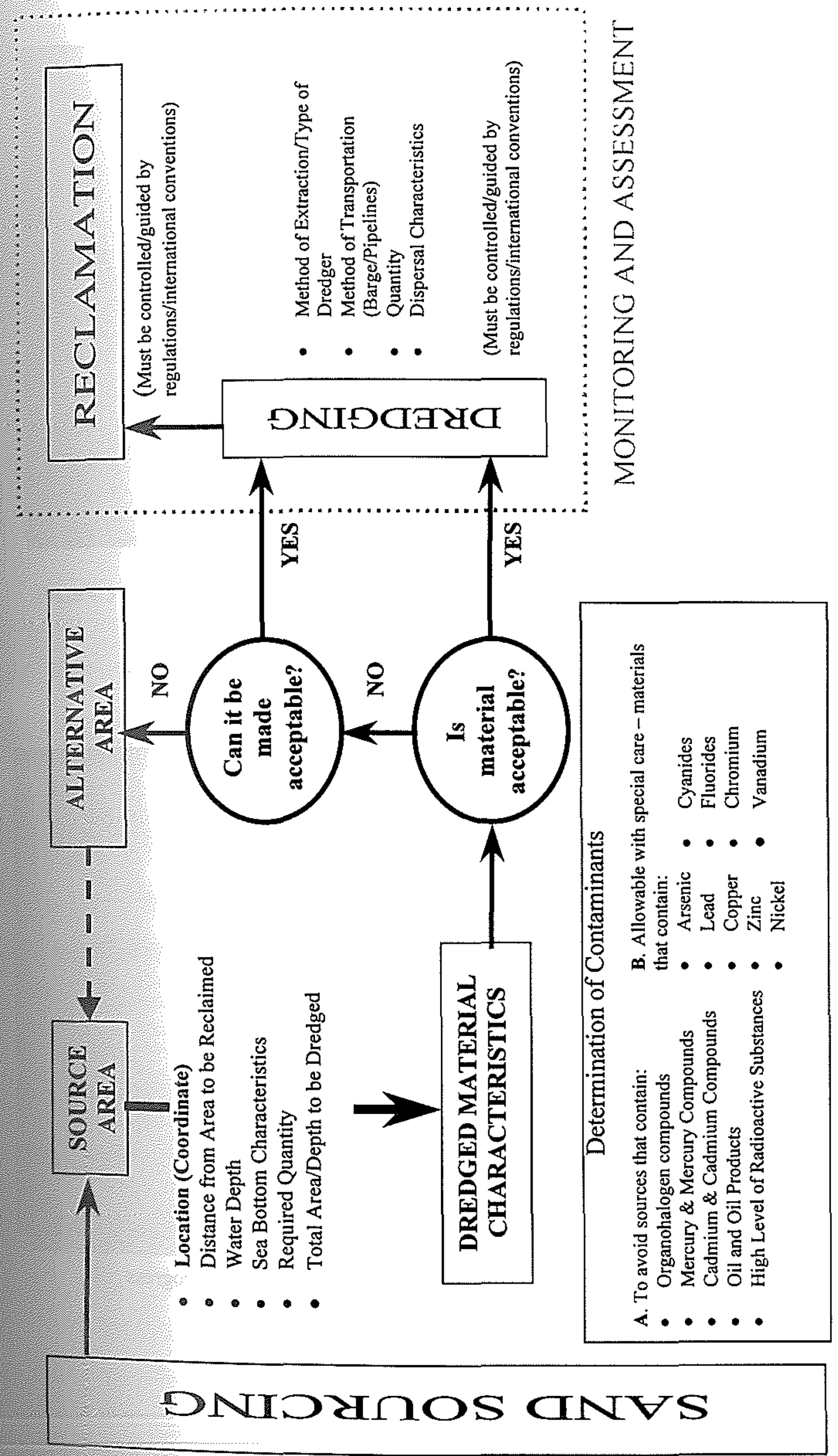


Figure 4.1 : Issues Pertaining to Sand Sourcing, Extraction and Filling

PLATE 4.1 : An Eroding Coastline

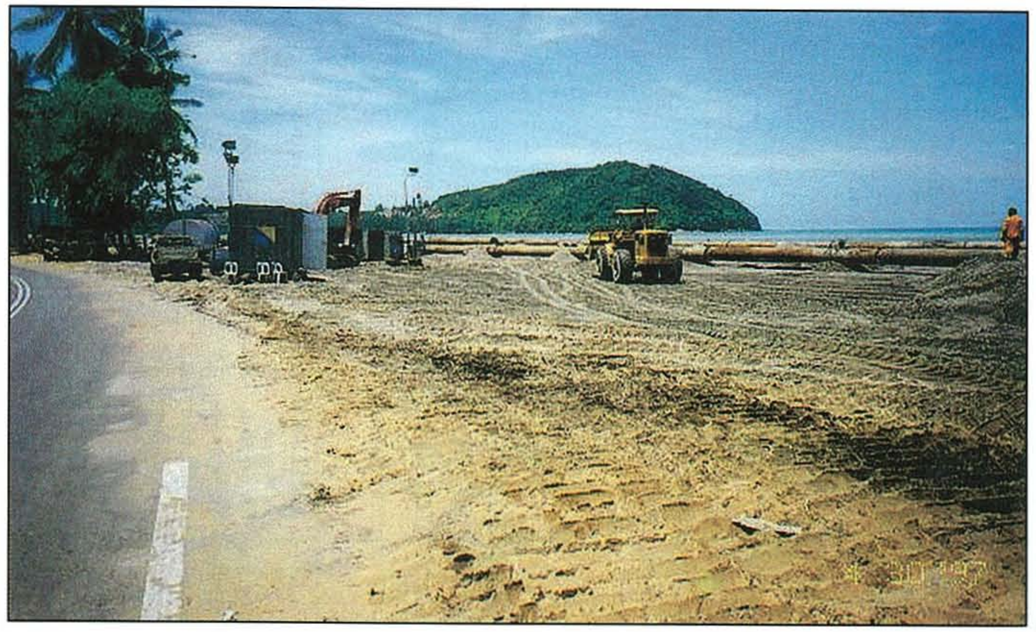


PLATE 4.2 : Site Preparation and Pipeline Laying in Progress

Plate 4.3 : Filled Material Being Pumped Directly Into the Beachfront via Pipeline

PLATE 4.4 : Levelling of Filled Area

CHAPTER 5

SCOPING

5.0 *DEFINITION OF SCOPING*

In defining project scoping one seeks to identify at an early stage, all of a project's possible impacts and all the alternatives that can be addressed and mitigated. Normally scoping incorporates the key significant issues within that project.

5.1 *IMPORTANCE OF SCOPING*

The scoping will help to define all issues for the reclamation project. Scoping should be used as a guide for the EIA focus of study. Important issues relating to activities and environmental components that will be affected by the project activities can be obtained from secondary data, field studies or from similar project reports. All identified issues must be listed, and the interrelationship of the activities and environmental factors must be well defined. Target potential and significant impacts will be determined in the relevant chapters on prediction and evaluation of the impacts and their mitigations.

5.2 *INPUT ELEMENTS OF SCOPING (PARTIES INVOLVED IN SCOPING)*

There is no mandatory requirement in Malaysia for a final scoping by which the developer, DOE and other interested parties agree on what should be included in the reclamation project (with an exception of Detailed EIA Procedure). Scoping exercise should help the project proponent to determine the extent of the study. However, there is no requirement for any kind of formal consultation between the developer and other bodies before submission of the reclamation

activities and planning application. The DOE guidelines merely stress on the benefits of an early consultation and agreement on the scope of the project. Scoping may not be a mandatory procedure especially for small reclamation activities.

The procedures of scoping for the reclamation entail discussions between the developer, the DOE or other competent authorities (such as DID), other relevant agencies and ideally the members of the public. It is an important step in the reclamation process as it ensures that limited resources of the project team are used to the best efforts and to prevent misunderstanding between the relevant affected parties within the project.

Scoping identifies issues that should be monitored later. Very often the developer of the reclamation project appoints environmental consultants to draft the scoping and there is very little or no consultation with other relevant authorities in preparing this. The lack of early discussion in scoping is recognised as a major limitation in producing an effective internal report.

Scoping in reclamation project includes impact identification techniques. It should include comprehensive coverage of a full range of impacts, which include the social, economic and physical aspects of the project. It must also ensure compliance with existing regulations. Other impact identification techniques include the following:-

- to distinguish between :
  - positive and negative impacts;
  - large and small scale impacts;
  - long term and short term impacts; and
  - reversible and irreversible impacts.
- to identify secondary, indirect cumulative impacts as well as direct impacts;
- to distinguish between significant and insignificant impacts;
- comparison of alternative development proposals;

- to consider impacts with the constraints of an area's carrying capacity;
- incorporate qualitative as well as quantitative information;
- to enlist mitigating measures that are easy and economical to use and cost effective;
- to be unbiased and consistent; and
- relevancy to structure plans, local plans, government policies and guidelines.

Finally, a successful scoping work should be able to:

- identify key issues and impacts;
- explain why other issues are not considered significant; and
- explain the key impacts that are well defined in terms of spatial boundary, within defined time frame and with which all the impacts are measured.

5.3 *SIGNIFICANT ISSUES IN SCOPING*

Significant marine coastal issues related to the reclamation activities are summarised in Table 5.1. For reclamation work, scoping must cover the various important component issues as follows:-

5.3.1 *Significant Physical Issues*

The significant physical issues pertaining to coastal zone are as follows:-

- Rates of natural erosion and deposition:

  Increase in erosion along the coast may cause significant coastal recession within a reach. This may cause long term coastal adjustment and may increase deposition in other places downstream.

- Rates and amount of sediment transport from river catchments to nearshore zone:

  Sediment from river may cause deposition along the coast. Sediment may also silt up river mouth.
- Variations in sediment composition and distribution offshore/nearshore:

  Degrade water quality in littoral zone area in terms of suspended sediments.
- Sand sourcing (issues pertaining to sand sourcing are highlighted in Figure 4.1).
- Importation of sand :

  Countries of origin from which the fill material (sand) was imported need to be identified and international regulations must be adhered to. Custom Act requires imported sands to undergo quarantine.
- Landform analysis:

  Offshore landforms such as sandbanks and shallow area must be identified.
- Long term shoreline geometry:

  Reclamation changes shore geometry, impinging on new shoreline, may impact on long term adjustment of the shoreline.
- The effects of sea defenses adjustment on shorelines:

  Structure may cause erosion and accretion, and therefore long term adjustment.
- Sediment disposal offshore and effects of dredging on water quality, seabed morphology, sediment transport and wave refraction:

  Disposal may often cause turbidity, leaching, changes in sea landform and depth changes, which may influence sediment transport offshore-onshore, wave parameter and distribution of energy along shore.
- Effect on estuaries (flushing/sluggishness of movement of estuaries):

The reclaimed land may to a certain extent narrow down the natural streams, thus hindering the flows to the sea. During periods of heavy rainfall this will inevitably slow down discharge into the sea, causing backup of water and flooding upstream. Blockage of the river mouths (estuaries) by reclaimed land may also result in sluggishness of drainage to the sea or affect the flushing system of the natural coastal ecosystem.

- Seabed slope stability/coastal stability:

  The slope of the dredged area must be designed for long-term stability and the depth of the dredged areas must not change offshore wave climate, and therefore coastal stability.

5.3.2 *Significant Biological Issues*

The following are some of the main biological components and resources pertaining to coastal zone:

- prawns/crab, shellfish;
- turtles, tortoise, terrapins (feeding/ nesting grounds and eggs);
- migratory birds ;
- fishery;
- marine algae;
- coral reef ;
- phytoplankton and zooplankton;
- benthics;
- fireflies;
- mangroves; and
- peatswamp forest

Significant biological issues that may occur during the site selection, site preparation, construction, and post reclamation are summarised as follows:-

- Loss of mudflat and its associated ecosystem:

  Mudflats act as erosion barriers, breaking wave energy and enriching the coastal zone through accumulation of mud and binding of the sediment. Damage to mudflat ecosystem can reduce fishery catches for fisherman, birds and other predators, and threaten roosting, feeding/stopover and refuelling area for migratory birds.

- Destruction of mangrove ecosystem:

  Mangrove is a fragile ecosystem. Reclamation works in mangrove area can damage mangrove trees and reduce fishery catches by disrupting food chain of sea-life, spawning area of fishes, prawns, crabs and cockles.

- Destruction in biodiversity of flora and fauna:

  Coastal zone is an area of rich biodiversity, particularly in estuaries, where silt-laden and nutrient-rich river water meets the sea. Destruction of such habitat and associated biodiversity can be a direct result of reclamation activities involving dredging and infilling.

- Permanent loss of benthic organisms:

  Placement of fill material will bury or smother bottom dwellers and cause permanent loss of habitat for benthos.

- Pollution of coastal waters:

  Dredging activities will cause disturbance to bottom sediments, resulting in resuspension of organics, heavy metals and other pollutants into the marine water. These may have deletrious effects on marine life. Likewise, the use of dredged materials or contaminated materials for land filling will release the contaminants with subsequent adverse effects on marine organisms.

- Increase of water turbidity:

  Increase in water turbidity resulting from reclamation works can interfere with primary productivity, affecting food web and stability of natural ecosystem.

5.3.3 *Significant Socio-economic Issues*

Socio-economic issues of significance to reclamation activities and which should be identified at the scoping stage are those that pertain mainly to human settlement, source of livelihood and coastal landuse structures. This is because the latter may be directly impacted by the reclamation works. Issues that may arise include :-

- Relocation of economic activities such as business premises and the like:

  More often than not, reclamation particularly that of strip type may render the relocation of economic activities such as business premises when the latter are within the development area. This may lead to loss of employment and earning capacities of those affected.
- Loss of recreational beaches:

  Reclamation, whether that of strip or island type, may lead to loss of recreational beaches. The former, due to extension of the coast seaward and the latter, due to being blocked by the row of created islands, which may induce the existing beaches to change in character.
- Safety: ship/dredger collision:

  The deployment of sea transport such as barges and other equipment (e.g. dredger) required for reclamation may increase the sea traffic in the area. These are sources of threat to collision and safety of workers and others plying the area.
- Disruption of sea transport:

  The activities generated from reclamation works may render the affected area and its vicinity to be out of bounds to other sea transport.
- Restrictive access/obstruction of public access and longer route to the sea:

  Extension of beach front due to reclamation and the outcome of coastal development on the reclaimed land would create obstruction to public access (hence restrictive access) and longer route to the sea.

- Restriction on local fishermen:

  Restriction on local fishermen due to reclamation will be seen in the form of restriction to taking direct or shorter route to the fishing area and reduction in productive fishing ground, to name a few.
- Loss of fishing activities/livelihood:

  Reclamation may either lead to temporary disruption of fishing activities, thus affecting fishermen's livelihood, or total loss of both, particularly to small-time fishermen.
- Partial/total resettlement of coastal inhabitants:

  Similar to that of relocation of business premises, reclamation especially strip reclamation may necessitate partial or total resettlement of coastal inhabitants.
- Cultural Impacts:

  Cultural impacts such as clash of cultures and social values between the locals and the outsiders may occur both during construction and operation.
- Loss of fishing ground and cockle spats:

  Land filling to create new land at the waterfront would destroy existing cockle spats and breeding ground as well as fishing ground.
- Possible artefacts loss:

  Land filling without conducting prior study to establish the existence or non-existence of artefacts and sunken treasures may lead to their permanent loss.
- Industrial, urban and commercial development:

  The new reclaimed land may generate numerous benefits from subsequent developments such as in uplifting of the local economy, in urbanising the area and many others.
- Tourism development:

  The newly reclaimed land offers potential opportunities for tourism development such as marinas, eco-tourism, etc.

These issues should be identified at the outset in order to determine whether or not the proposed reclamation site or area will have the potential impacts mentioned. The latter will determine the extent of the socio-economic study to be carried out.

Identification of issues at the initial stage will also help in realising potential impacts that will ensue and appropriate mitigations considered. Such realisation would enable the project proponent to take appropriate measures to minimise impact from the very beginning especially over sensitive issues such as relocation.

5.3.4 *Significant Archaeological Issues*

Pertinent issues from archaeological and historical perspectives in reclamation works are as follows:-

- loss of archaeological and cultural remains that are meaningful to national heritage; and
- cultural/historical remains as well as sunken treasures.

Identification and determination of whether or not areas to be reclaimed are rich with such archaeological remains will have to be carried out by conducting surveys using known and accepted methods.

5.4 *CONTENT OF SCOPING FOR RECLAMATION PROJECT*

Taking into account the above criteria, scoping for reclamation should include the following:-

a. Various alternatives that should be considered:

   i. No action option
   ii. Alternative location
   iii. Different scales of development
   iv. Alternative processes and equipment

b. Typical example of scoping content for reclamation activities:

Section A1: Physical Environment
- Topography
- Landuse
- Soil and Geological condition
- Oceanographic data
- Drainage and hydrology
- Meteorological information
- Water quality
- Air quality
- Noise

Section A2 : Biological System
- Coastal habitats and communities (estuarine, mangrove and mudflats)
- Coastal and marine flora and fauna
- Fisheries
- Corals and associated biota
- Phytoplankton and zooplankton
- Macroalgae and seagrasses
- Macro and micro benthos

Section A3 : Socio-economic System
- Demography
- Settlement pattern
- Economic activities (farming, aquaculture, etc.)
- Infrastructure (services, amenities, facilities, etc)
- Awareness and perception
- Resettlement
- Archaeology

c. Prediction and Evaluation of Impacts and Mitigating Measures
   (These are discussed in Chapters 7 and 8 respectively)

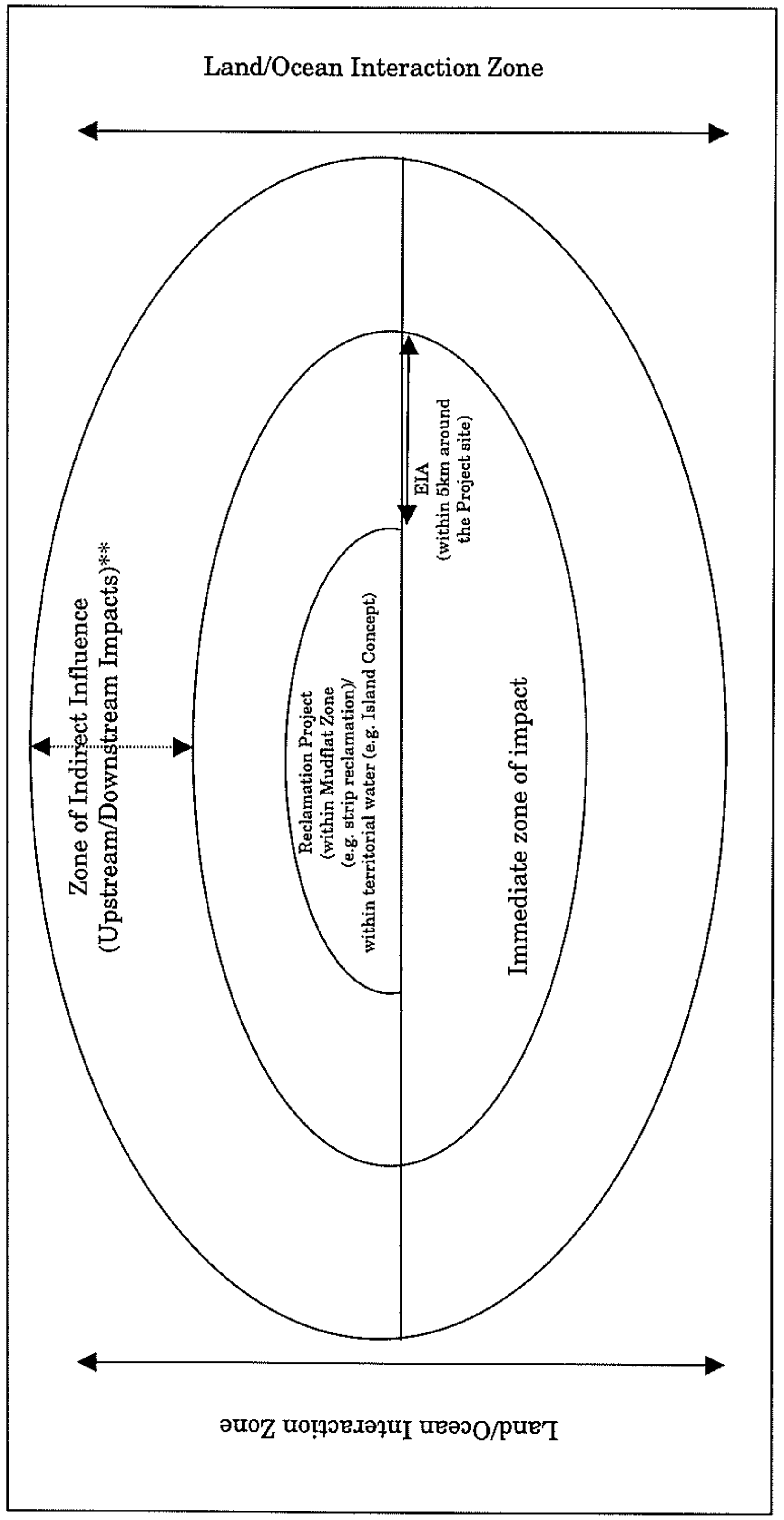
5.5 *MULTILEVEL ANALYSIS OF PARAMETERS*

The above scoping should be viewed as a multilevel process. Thi refers to a hierarchy of analysis based on stages of projec development and zones of influence which include hinterland wetland, territorial waters and the EEZ, with respect to direct an indirect impacts from the proposed project.

Diagrammatically, the multilevel approach may be summarised as i Figure 5.1. In practice, the immediate zone of impact is taken to b within 5 km around the project site for the various EIA components However, due to the nature of some of the socio-economic impacts which may go beyond the zone of immediate influence, impac assessment can extend beyond the 5-km study area.

Table 5.1: Significant Marine Coastal Issues Related to the Reclamation Activities

Activities	Marine Component	Interrelation/impact
Site Investigation:		
Base camp Site clearing	• Water quality • Intertidal zone	• Siltation • Habitat damage
Site Preparation and Construction:		
Stream crossing Site clearing Drainage alteration Earthwork Coastal works Dredging Dams, barrages and bund Canalisation Pipelines Revegetation and reforestation Fertilizer application Pest Control Waste disposal and recovery Base camp	• Water quality • Biological Habitat *Intertidal and subtidal* *Pelagic* *Mangrove* • Biological components *Coral* *Coral fishes* *Fisheries* *Marine vegetation* *Benthic fauna*	• Siltation/chemical and biological waste • Habitat destruction • Micro and macro fauna lost • Tree cutting/ sedimentation/ nursery and spawning ground lost • Damage and communities lost • Resources lost (spawning and nursery ground) • Damage and habitat loss
Operation and Maintenance:		
River works Stream crossing Alteration of drainage Coastal works Dredging Reclamation Irrigation Impoundment of water Pipelines Barrier and fences Accidents Erosion control Fertilizer application Waste disposal and recovery	*as in site preparation and construction phase*	*as in site preparation and construction phase*



**Note: Extent of this zone is site specific (depending on interplay of various parameters and factors)

Figure 5.1. The Multilevel Approach

CHAPTER 6

ENVIRONMENTAL BASELINE DATA

6.0 *INTRODUCTION*

Environmental impacts are the outcome of the interaction between the characteristics of the project/development actions and the characteristics of the host environment. As a starting point, the baseline information on both sets of characteristics must be assembled. Only with sufficient information and knowledge of both the project characteristics and the existing environment will the implications of the impacts or the impact prediction be carried out on a sound basis.

The usual basic questions for optimisation of effort to acquire baseline data include judicious choices of what to sample, where to sample, when to sample and how many samples to take. Standard protocols and methodology in field techniques should be fully supported by experience and expertise of the study team in ensuring the applicability of baseline data for subsequent impact assessment of the proposed project on the physical, biological as well as socio-economic system.

6.1 *PROJECT DESCRIPTION AND PURPOSES*

The EIA should contain a detailed description of the project, which should include the following elements: -

- Description of the preferred project option or if more than one option still remains;
- Location maps that show both general and specific location, project boundaries and site layout;

- Precise coordinates (latitude and longitude) should also b included to enable DOE to update their GIS database; Diagram and photographs (preferably aerial with proposed layou superimposed) will enable reviewers to clearly understand th nature of the project and the location of all the proje components;
- Existing site conditions;
- Expected site configurations after development;
- A general statement of need;

  This includes justification for the project and the rationale as t why the project is designed the way it is.
- Project activities;
- Implementation schedule;
- Benefits to people, both positive and negative; and
- Abandonment plan;

  This should include measures for mitigating impact of proje abandonment and other alternative measures to salvage the area

This section intends to give any lay reader with some sort of intere in the proposed project the ability to fully understand what proposed. Such individuals might include government administrator farmers, business owners, fishermen and project area landowner Should the occasion arise, these individuals will then have the abili to comment on, or express opinions about the proposed project. A such, the project description should be written in plain and simp language that most laymen could understand.

6.2 *BASELINE ENVIRONMENT*

There is a very real need for a good database to evaluate the impac of proposed development activities on the coastal environment. Da information collection effort should be restricted to information direct relevance to the study and it should be ensured that stora

and retrieval are fully geared to the practical needs of the project. Determining what specific information is required for the management of reclamation project and how such data should be gathered, stored and retrieved is a difficult task. The choice of the scope, comprehensiveness and type of database to be created should be guided by various factors such as existing information, availability of skills, actual management needs and financing capability or magnitude of the study.

Consultants should select from a wide range of information, only those items that serve their needs, i.e. related to the issues studied which need to be resolved. Other information may help the consultants, project proponent or management to be aware of future problems and be more appreciative of coastal phenomena. Management needs to focus on issues that must be clearly comprehended so that the money and effort are not unnecessarily wasted.

Accessibility to good baseline data is crucial to evaluating impacts of the proposed project on coastal features and coastal habitats. Further consideration should be given to the formatting of baseline data and level of detail required. Massive data gathering is costly and time-consuming, hence the need for limiting it to relevant data only.

Studies must be conducted as indicated in the scope of work to solicit data that can be analysed and utilised in the evaluation process. Collecting baseline environmental data is usually the lengthiest process in EIA and therefore, should be initiated first. The data can then be used for technical engineering design consideration and impact assessment.

Items to be included in baseline environment for coastal reclamation project studies should include the following: -

- Physical characteristics;
  - topography and bathymetry
    - geology
    - sediment structure
    - soils and fill materials
    - wave climate
    - tides
    - currents
    - meteorology
    - air quality and noise
    - fresh water quality
    - marine water quality

- Biological components;
    - flora and fauna
    - coastal wetlands
    - coastal marine biology
    - benthic biology

- Socio-economic and land use components.

Each of the above should be considered, where applicable, for eve project activity as described in Section 4.8. Further studies have to b conducted where information is incomplete, and data collected shoul be presented in descriptive, graphical and/or tabular forms. A baseline data, scientific and engineering analysis, and detaile engineering designs can be in the form of Appendices for eas reference.

A brief description for each of the above baseline environment are a follows:-

EIA Guidelines for Coastal and Land Reclamation

6.2.1 *Physical Components:*

a. Topography and Bathymetry:

Topography and bathymetry of the surrounding areas should be described and maps provided.

The bathymetry for the area is normally obtained from the Admiralty Charts. Hydrographic survey is sometimes necessary to verify and enhance the standard bathymetric maps, thus forming the base map of the area. Hydrographic surveys (carried out by licensed surveyor in consultation with the Navy), would also help the consultant to check underwater slope stability and to determine safe dredging depth.

b. Geology:

The geology of the area should be provided and understood for engineering and environmental considerations. Specific geological information on the project area will be needed for project design and EIA costing. Geological information should be gathered to identify suitable borrow areas for the construction of revetments, dykes, roads and final covers.

A geological map should accompany the report.

c. Sediment Structure:

Coastal reclamation projects are generally carried out in shallow areas. Most of these areas are formed by deposition of eroded materials brought down by rivers that discharge into the sea. Therefore, the structure and porosity of these sediments should be thoroughly investigated before fill material is placed on top of them. Soil investigation using deep boring technique should be carried out at various intervals within the project site and immediate vicinity of the project area. From these bore logs, sediment and soil stability, plasticity and porosity indices can be determined. Sediment profiles showing cross-sectional transact have to be constructed and presented in the reports.

d. Soils and Fill Material:

Quality of soils is important if revegetation of reclaimed areas i planned. In this case, soils with respect to certain nutrient conten should be examined. Good topsoil should be stockpiled for eventua reuse. The structural suitability of the soil in terms of physica properties should also be analysed to determine the final stabilit of fill ground.

In areas where the soil type is likely to be problematic (such a peat soil), disposal of soil is likely to be an issue that needs to b considered within the project scope.

Rehandling basin for fill materials may be required but no normally recommended. If required, then full impact assessmen and suggested mitigation measures should be looked into.

e. Hydrology:

Surface hydrology includes natural water drainages, streams an irrigation canals. These are to be mapped and marked on th topographical map of the area. In addition, a 100-year flood flo runoff (based on Hydrological Procedure of Jabatan Pengairan da Saliran) should be determined. The data is an importan consideration in engineering design of the reclamation project an is indirectly associated with upstream flooding.

f. Wave Climate:

Wave climate includes wave predominant directions, significan wave height, wave period and wave transformation processe (wave diffraction, refraction and reflection). The wave data can b obtained from either the Surface Shipboard Meteorologica Observation (SSMO) database, hindcasting techniques or othe

sources. If the data is in the form of raw data then the consultant should carry out :

i) a statistical analysis of all the incident waves in the area to determine the deepwater wave characteristics; and
ii) carry out wave transformations to determine the near-shore wave characteristics.

Whereas if a hindcasting technique is used, then the consultant should:

i) obtain wind rose diagram;
ii) determine the critical fetch lengths;
iii) employ suitable hindcasting techniques to determine the deepwater significant wave; and
iv) carry out wave transformations to determine the nearshore wave characteristics.

Data of wave conditions should be presented as wave rose diagram.

g. Tides:

Amplitude of tides is an important consideration when determining engineering designs of containment structures, platform level of the newly created land and coastal protection.

Tidal data are obtained either from tide tables published by the Royal Malaysian Navy (or other reputable sources) or by carrying out actual measurements at predetermined locations.

If the tide data is obtained by measurements, then these measurements should be carried out for at least two weeks to include the spring and neap tides. The following data should be clearly shown:-

i) location /Co-ordinates of tidal stations;

ii) type of tide gauge used; and

iii) time series observation of tide levels

Graphical presentation of data interpretation is to be provided an presented in the report.

h. Currents:

Detailed studies should be conducted on nearshore currents tha are generated by tide and wave conditions within and in th vicinity of the project area. This data should be readily availab for engineering design of containment structures and/or coasta protection structures. Particular attention should be given t potential current changes in the presence of "in water" physica structures and the resultant erosion effects of nearby areas due t altered currents. Under certain conditions, minor changes in loca currents can cause extensive damage to nearby shoreline an bottom configurations.

Data of current conditions should be presented in the form of char and graphs as well as vector diagram.

i. Meteorology:

Seasonal meteorological data and worst case storm data should b presented. Consideration should be given to include precipitatio and prevailing wind directions. If required, a temporary rainfa station is set up on site to generate rainfall data, which essential in engineering design for water runoff, dispersion of du and other pollutants.

Reliable estimates of water level changes under storm conditio are also essential for the planning and design of coast engineering works. Determination of design water elevatio during storm is complex involving interaction between wind an water, differences in atmospheric pressure, and effects caused b

other mechanisms unrelated to the storm. Winds are responsible for the largest changes in water level when considering only the storm surge generating processes. Severe storms may produce surges in excess of 8 meters on the open coast and even higher in bays and estuaries. Abnormal rises in water level in nearshore regions will not only flood low-lying terrain, but provide a base on which high waves can attack the upper part of a beach and penetrate further inland. Flooding of this type, when combined with the action of surface waves can cause severe damage to low-lying land and backshore improvements. Knowledge of the increase and decrease in water levels that can be expected during the life of a coastal project is necessary to design structures that will remain functional.

Precipitation graphs and wind roses should be provided.

j. Air Quality and Noise:

Air quality should be measured periodically to determine baseline data for parameters such as dusts, hydrogen sulphide and carbon monoxide. In most coastal areas this might be limited to hydrogen sulphide while dust sampling can be measured with high volume samplers.

Hydrogen sulphide data is required due to the possibility of its release in tidal land filling as a result of pressure from fill material. Hydrogen sulphide is normally trapped in anaerobic sediment with high organic content. Therefore it is necessary to have baseline data for comparison. Baseline data on vehicle emissions and noise can be calculated based on known traffic volumes.

k. Marine Water Quality:

Baseline conditions for marine water quality should be determined. Resultant data can be presented graphically in the text and briefly summarized. The water quality results should be compared to the Interim National Marine Water Qualit Standards (Malaysia), for compliance to support the marin aquatic resources and recreational activities. Detailed baselin data should be tabulated. Water quality parameters required to b measured are listed in Table 6.1 while methods of sampling an analysis are given in Appendix 5.

l. Fresh Water Quality:

Water quality becomes important when there are streams flowin through the proposed project areas. Sampling should be carrie out at least three times during the EIA study. Parameters to b measured are listed in Table 6.1. These data can then be briefl summarized in the EIA report and discussed with reference to th Interim National Water Quality Standards for Malaysia.

Table 6.1: Parameters for Water Quality

Parameter	Fresh water	Marine water	Brackish/ Estuarine water
Physical	Temperature, pH, conductivity, turbidity, DO, TSS	Temperature, salinity, pH, conductivity, turbidity, DO, TSS	Temperature, salinity, pH, conductivity, turbidity, DO, TSS
Anions	Ammoniacal nitrogen, phosphate, sulphate , chloride, fluoride, nitrite, nitrate	Ammoniacal nitrogen, phosphate, nitrate	Ammoniacal nitrogen, phosphate, nitrate
Cations/ Heavy Metals	Cr, Cd, Cu, Ni, Fe, Pb, Mn, As, Hg	Cr, Cd, Cu, Ni, Fe, Pb, Mn, As, Hg	Cr, Cd, Cu, Ni, Fe, Pb, Mn, As, Hg
Organics	BOD, COD, TOC, oil and grease	BOD, TOC, oil and grease	BOD, TOC, oil and grease
Microbial	Faecal coliform	Faecal coliform	Faecal coliform

6.2.2 *Biological Components:*

a. Flora and Fauna:

Baseline studies for flora and fauna involve compilation of speci diversity and their relative abundance. Some species may b recorded through simple observations such as primates and bird

while others that are less visible or nocturnal may need to be surveyed by more specialised techniques. If existing data of biological components are not available, field data need to be acquired early in the study to provide sufficient time for subsequent sampling, sorting, analysis and identification work. Survey data for coastal vegetation, wildlife and fisheries may include inputs from well-informed persons such as local residents, rangers, fishermen, hunters and personnel from related agencies such as from the Department of Wildlife and National Parks (PERHILITAN), Forestry Department, Agriculture Department, LKIM etc. Additional data may also be obtained from various published and unpublished documents and records.

The tropical ecosystem contains a rich biodiversity of flora and fauna. Many animal species are directly associated with specific vegetational types, although other abiotic factors such as soil type and climatic factors also play an important role in their relative abundance and distribution. Project description on existing environment pertaining to biological system may require compilation of species listing, including conservation status, whether each is totally protected, protected or not protected, rare and endangered, endemic or common/typical. Listing for flora may include lifeform, habit and importance value. Identification to genus or species level may require the service of subject specialists or technical support. Invertebrates such as insects are more tedious and time-consuming to sample, analyse and identify judiciously.

b. Coastal Wetlands:

Vegetation may be important particularly in wetlands adjacent to tidelands. Wetlands with unique assemblages of vegetation forms are often of very high ecological significance as they are so important to the maintenance of different types of aquatic and terrestrial animal species.

Surveys should be conducted particularly during the growing seasons and ecological characterisations of the area should be made. Results should be briefly discussed in the EIA. In some cases developing vegetation maps may be useful.

Mangrove swamps are heavily vegetated littoral wetlands comprised of trees and shrubs belonging to the terrestrial angiosperms. The swamps are drained into inshore or near shore waters by small tidal creeks called mangrove creeks. The submerged sublittoral habitat in the mangrove swamps like mangrove waterways and tidal creeks provide breeding, nursery, shelter and feeding grounds for various aquatic organisms, fishes, prawns and crabs.

c. Coastal Marine Biology:

Basically, intertidal and subtidal biology refers to any organisms that are inhabitants of the intertidal and subtidal zones. Intertidal components comprise mollusks, arthropods, crustaceans, corals and polychaeta, and subtidal components comprise some burrowers, free-swimming and surface dwelling organisms. Marine vegetation may occupy both areas depending on the physico-chemical factors. Primary and secondary data on marine ecological resources can be obtained by standard methods.

A pilot study (preliminary sampling) is recommended for the primary data collection to indicate variations in the ecosystem that may require further samplings or investigations.

i. Benthos

Benthic biology refers to the organisms that live in or on the seabed. These organisms are rather inactive (sessile), being adapted to living in close association with the substrate. Coastal zone support very rich benthos, which serve as a food and energy supply in the food chain. Seventy-five percent of the total number of marine species lives on firm substrate, 20% occur on sandy and

muddy bottoms, and only 5% of the total area are planktonic. Benthic organisms are described on the basis of their size and position in the sediment relative to the surface. Infaunas are organisms of any size, which live within the sediment. Epifaunas are animals that are either sessile or capable of moving between the substrate layer and the water column.

ii. Coral and Coral Fishes

Corals are well known for their spectacular beauty and uniqueness, and are perhaps the most diverse and ecologically complex of marine benthic communities. Corals are included within the three main classes of the phylum Cnidaria, viz.: the Hydrozoa (hydrozoans), the Scyphozoa (jellyfish) and Anthozoa (corals and anomones). The tropical coral reefs are the result of massive deposits of calcium carbonate laid down by the corals over geological time. Fish comprises the dominant vertebrates of coral reefs, and many of the reef fishes are brightly coloured and visually conspicuous.

iii. Marine Vegetation

Seaweeds and seagrass (marine angiosperms) communities are located seawards in the shallow sublittoral water and often in association with coral reefs and mangroves. They serve as nursery grounds and shelter for a wide range of marine animals. They support a rich assemblage of fish and shrimp larvae that in turn support the coastal fisheries.

iv. Plankton

Plankton refers to the organisms that are unable to maintain their distribution against the mass movement of the water. Some plankters are very weak swimmers but generally, almost all plankton are very small (microscopic) except for some jellyfish, which can reach up to several meters in length. Microscopic plankton includes bacterioplankton, phytoplankton and zooplankton. There is no clear boundary between plankton and other marine groups such as nekton. Some of the nekton larvae are considered plankton with reference to their capabilities for movement, and large zooplankton can also be considered as micronekton.

Plankton plays a major role in the coastal ecosystem. Through the CO_2 fixation in the photosynthetic process, phytoplankton supports the marine food supply through primary production. Herbivorous and carnivorous animals provide the secondary and tertiary productions. Any changes or disruption to the close relationships between these groups or communities will affect the ecosystem balance. Relevant and sufficient information (based on secondary and primary data) on the marine coastal ecosystem should be provided during the EIA study and report preparation.

v. Fisheries

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, capture and culture fisheries. The coastal waters of mangroves, seagrass beds, corals areas and mud flats support a rich harvest of economically important invertebrates and marine fishes. Some aquaculture activities such as cage cultures 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 nearshore waters are also known to be crucial nursery grounds for the young life stages of marine aquatic species.

Coastal zone ecosystems are among the most productive ecosystems in the world, serving as breeding, nursery, feeding and shelter grounds for various aquatic and terrestrial organisms. Fisheries stock can be depleted not only by overfishing, but also by shoreline modification and reclamation works, which may cause pollution, siltation, habitat loss, etc. An assessment of fisheries

resources in and near the proposed project site is an essential guide for remedial measures on these resources. Deterioration in fisheries can occur directly as a result of reclamation in shallow coastal waters by mining huge amounts of sand and dumping them at the nearby area. This is because a large area of bottom substrate that is rich in meio- and macro benthic fauna has been disturbed, changed and encroached upon. If large amounts of vegetation in the inshore waters are reduced or destroyed, then a corresponding decrease in the commercial species in the open sea can be expected. Migration of the whole commercial population and a replacement by less important non-commercial species are possible.

The nearshore or coastal fishing industry is more predominant than offshore fisheries in Malaysia. Coastal fisheries refer to all fishing activities (< 70 GRT sized vessels) confined to within 12 nautical miles of the coast, while deep sea fisheries refer to fishing operations carried out by large vessels (>70 GRT in size) beyond the 30 nautical miles zone. Marine fishes are divided into demersal, pelagic and benthic groups. Fishery stock should be consistently monitored through a significant body of updated data and catch inventories. The interrelations between causal impacts and fisheries components should be clearly identified to guide in the prediction and evaluation of impacts of project development. Some recommended methods used in collecting data for marine biological components are given in Appendix 5.

6.2.3 *Socio-economic and Land Use Components*

Major projects have a wide range of impacts, both biophysical and socio-economic and the trade-off between such impacts is often crucial in decision-making. Socio-economic impacts can be very significant for particular projects and thus should not be ignored.

The assembling of relevant information on the characteristics of the project would appear to be a more straightforward process than data on the host environment, whilst that of the host environment area depends to some extent on the nature of the project. Some projects may have significant national or even international implications, whilst many others have regional or sub-regional impacts and almost all have local impacts. Nevertheless, they have to be executed and a comprehensive information about them has to be gathered and analysed before a sound impact prediction can be made.

In order for a sound impact prediction can be executed, it is important to recognize the different levels that the host environment may be impacted. Within the constraints of the EIA study, a two-level approach is considered as sufficient, one that pertains to the area outside of the immediate area of influence and the other, the area within the immediate zone of influence.

The extent of parameters covered between the two areas of influence may differ, with greater detail being concentrated in the area facing direct impacts.

Considerations of likely parameters outside of the immediate area of influence are:

- demographic characteristics;
- socio-economic attributes;
- facilities and amenities available; and
- settlement pattern.

Considerations of likely parameters within the immediate area of influence are:

- demographic characteristics;
- socio-economic parameters;
- land use;
- land tenure;
- minerals;

- settlement pattern, facilities and amenities;
- recreation;
- aesthetics;
- displacement of people and business; and
- awareness and perception.

Each one of these parameters should be considered, where applicable. Where existing information is incomplete, studies should be conducted and an overview of each should be incorporated or presented in the EIA report as an existing environment, thus giving some background of the study area or the area of influence.

A brief description of what should be considered for each of the parameters is given below.

a. Demographic Characteristics/Profile:

The human makeup of the social environment has to be known to an assessor before an attempt can be made of the project's impacts on the demographic and social environment. Of pertinence are the population size, sources of population growth, population age structure, sex ratio and household size. Each of these demographic parameters has its own way of measurement, meaning and implication. Both the official census and self-generated data gathered from a field survey may prove to be useful in the exercise. It is the understanding of these characteristics that will enable an assessor to predict the likely demographic impacts that the project may bring to the society within its zone of influence.

b. Socio-economic Attributes:

The aspects of socio-economic attributes of the host society considered pertinent with respect to EIA are the homogeneity versus racial mix of the society, its social fabrics and organisation, its educational status, economic pursuits and income structure. These parameters may give an insight into the type of community that one is dealing with as well as the level of social and economic well being that the host society is enjoying. The latter knowledge will be useful in determining the type of impacts that the project may bring to the society both socially *albeit* culturally and economically. The types of impact can be both direct and indirect.

c. Land Use:

Present land uses may include type of agricultural (farming and aquaculture); built-up areas which include township, residential, commercial and industrial areas, open spaces, vegetation cover which include mangrove, dipterocarp forest and water bodies.

Besides current land uses, it is also pertinent to find out whether the said area has any parcel or parcels of land earmarked for future use (proposed land use) as well as those already earmarked for development (committed land use). This information is useful in identifying whether or not there is any conflict of uses or interests.

d. Land Tenure:

The nature of land tenure in the area is important to detail out in order to identify the status of land in the area. The aspects that need to be determined pertain to the nature of leaseholds and ownership of land within the project area. Information can be obtained from appropriate government agencies such as the Land Office, the District Office, the Town and Country Planning Department, etc. The exercise will enable one to get information of the extent of public and private land ownership and the nature of lease that each piece of land holds.

The knowledge is important in case land acquisition has to be carried out and compensation to be paid out. However, the detailed list of land titles and landowners affected as well as the compensation exercise will have to be handled separately outside the scope of the EIA study.

e. Minerals and Other Resources:

Rights for minerals and other resources, both under and above the ground may be ascribed to other people or groups of people other than the actual landowners. Searches should be made of appropriate agencies to determine if such instances occur. This information is relevant in determining the extent of land matter and the rights to land based resources that may be affected by the proposed reclamation project.

Appropriate agencies have to be approached in order for searches to be made and the existence of titles determined. Information and data may be presented on an overlay in conjunction with land use and land tenure.

f. Settlement Pattern:

Some background of the settlement pattern of the area has to be known to the assessor as this may throw some light as to how the future settlement pattern would be shaped out with the potential change in population size and attributes. This knowledge is essential as it will assist in predicting the rate of urbanization or otherwise that will be experienced by the locality.

Settlement pattern may either be linear, sparse or nucleated and can be disrupted with the potential change in shifting or immigrant population taking up residence in the area due to the development of a project. The impact may lead to an intensification of some of the existing pattern or may even change it depending on the ensuing process of settling down and the nature of housing provision available and planned in the area.

g. Facilities and Amenities:

Information of community support facilities and amenities must be gathered to determine their availability. This is pertinent in lieu of the effect of population change that the project development may incur to determine their adequacy.

Among others support facilities should include schools, hospitals and clinics, religious buildings (mosques, *surau,* temples, churches, etc.), businesses, government services (postal, policing, fire fighting, garbage collection, etc), electricity, water and local road network. Data should be discussed, summarised and presented in table(s).

h. Recreation:

Information on recreational facilities should also be gathered in conjunction with the other community support facilities. This is to determine whether or not they exist and the nature of their variability established. Such information may assist in determining their adequacy for future potential changes in population requirement. Data should also be discussed and tabulated.

i. Aesthetics:

The aesthetic values of an area should be assessed *albeit* qualitatively. Aesthetics is of pertinence to the area as it is closely related to an aspect of quality of life. Aesthetics may include views (scenic), trees, water bodies (lake), parks and any other that may be of sensory pleasure to people.

j. Displacement of People and Business:

A right-of-way effect may lead to displacement of people or business. A detailed study of the affected people and business should be made. This will have to be carried out by directly consulting the appropriate social agencies, the people themselves and by field counts. The issue will have to be discussed at length and a displacement map provided.

k. Awareness and Perception:

In order to find out the locals' response to the proposed project and their awareness towards it, a study of their awareness and

perception as to the project's advantages and disadvantages as well as their perceived impacts on the various components of the environment have to be carried out. This exercise will somehow reveal to the project proponent and other decision-making authorities of the extent of receptiveness or otherwise of the impending project to the locals. The information may be utilised by the proponent to adopt a plan of action best suited to iron out the areas of public concerns.

6.3 *ENGINEERING CONSIDERATIONS*

Besides acting as a tool to evaluate the environmental feasibility of a project, an EIA study also acts as a means to minimise all adverse impacts likely to result from project implementation. More often, practical mitigating measures would involve engineering inputs. Thus, to achieve the objectives of EIA study, engineering considerations and preliminary design of the project should be done at the earliest stage possible, probably in concert with the baseline environmental assessment. By doing so, the need to redesign can be much reduced if not abrogated altogether. The project-planning concept graphically demonstrates how this might work in terms of project flow and organisation (see Figure 3.2.)

With respect to coastal reclamation project, the most important consideration would be sourcing, mining and transporting fill and containment structures materials. Due to the general restriction of acquiring land-based materials as reclamation fill, sand from seabed will be the most likely and logical choice, the mining of which will inevitably involve dredgers of various types and capacity.

Typical processes involved in reclamation project are listed in Chapter 4.

6.4 *Infrastructure Considerations*

It can be generalised that the objective of coastal reclamation is the creation of new landbank meant for development, mainly industrial, commercial and residential. As such, availability of basic infrastructures such as water supply, power supply, communication and road networks are very important. Ample supply of these infrastructures within easy reach of the reclaimed area will be a pre-requisite for the intended development. It is therefore pertinent that these be given due consideration during project planning and in the EIA study.

Among the details that should be available are:-

a. Location and source of existing infrastructures;
b. Capacity of existing infrastructures;
c. Estimate of future demand as a result of development;
d. Ability of existing infrastructures to meet such increase in demand;
e. Possibility of upgrading existing infrastructures to meet increased demand;
f. Effects of increased use of existing infrastructures on existing loads;
g. Effects of increased use of existing infrastructures on peripheral environment;
h. Engineering designs and details of proposed new infrastructures including sources of materials;
i. Routes of proposed new infrastructures;
j. Environmental effects of new infrastructures, if any; and
k. Construction times and schedules for upgrading old and building new infrastructures.

These data should be summarised in the main text of the EIA. Additionally, detailed maps and overlays should be included (showing all pertinent details). All detailed baseline data, engineering and scientific evaluations should be included in the appendices.

6.5 *Carrying Capacity and Sustainability*

The concept of carrying capacity encompasses the critical minimum area of habitat needed to maintain a viable population of a particular species or assemblage of species. If part of the habitat is destroyed or lost by a proposed project development, then assessment should be conducted as to whether there is sufficient area remaining to sustain key species or communities on the site. In the coastal zones, most invertebrates that occupy the lower tropic levels are normally dependent on small-scale habitat features due to their restricted mobility or life habits. Sensitive communities, which may include sentinel species, may be reduced or lost by habitat change or damage.

Ecosystem complexity may be destroyed irreversibly by project activities such as dredging and material filling during land reclamation. Disturbance or destruction of any one of these habitats may affect species that require more than one type of habitats to complete the various stages of their life cycles. For example, reclamation of mudflats may disrupt stop-over/refuelling sites along the migration route of birds, dredging in mangroves may affect nursery grounds for molluscs, finfish and crayfish. When a habitat is already at its maximum carrying capacity for a particular species, translocation of threatened species from a project site into this habitat may not be a viable or successful option. This is because of possible interactive adverse impacts of the newly introduced species on existing community, leading to interspecific competition for food, living space and other resources.

From socio-economic point of view, carrying capacity is the maximum number of users that can be sustained by a given set of land resources, for example, the turnover of tourists visiting a recreational area or island resort. It is a relative concept depending on land management and other factors such as existing land use, resources, users, etc.

Estimation of carrying capacity is complex and depends on arbitrarily selected thresholds beyond which environmental modification through overuse is undesirable. Population carrying capacity is the number of members of a given species or people which the habitat or ecosystem has biological capacity to sustain. This is associated with the maximum environmental limits or critical levels, which indicate the population ceiling beyond which the system breaks down due to overshooting of saturation level, overuse or the exhaustion of existing resource capacity.

Some of the available methods (techniques) that can be adopted for evaluating carrying capacity are given in Daily and Ehrlich (1992), Therivel *et al.* (1992) and Wackernagel *et al.* (1993).

6.6 *CULTURAL AND ARCHAEOLOGICAL SITES AND ARTEFACTS CONSIDERATIONS*

Under the provision of the section 34A in the Environmental Quality Act (1974) Amendment (1985), any person intending to carry out a prescribed activity faces the legal requirement to submit to the Director General of DOE, for approval, a report containing an assessment of impact such activity is likely to have on the environment. In view of the fact that heritage sites and other forms of archaeological sites are part and parcel of the environment, the impact of any activity on them must therefore be assessed. However, the majority of archaeological remains are buried underground or underwater and it is almost impossible to determine their presence without applying any of the primary and secondary methods applicable and suitable for such purposes. In order to achieve

maximum result in the search for archaeological sites, proper guidelines must be adhered to.

By archaeology, we mean the interpretation of any physical traces left by past ways of life. It could reveal valuable information in terms of history, culture, ecology and the physical environment. In today's rapid developing age of science and technology, Malaysia cannot afford to lose these resources of national identity especially when their availability is very much limited, fragile and definitely not renewable. Although development is necessary for the country, it should be achieved with the least destruction of other resources namely heritage as one, so that an equilibrium exists between both the physical and spiritual aspects in nation building. The implementation of archaeological impact assessment in the preparation of the EIA report prior to development must be seen as a precaution rather than deterrent for development works and that it will be quite flexible to a certain extent, constructive and suggestive in nature.

Since Greeco-Roman civilisation, history had been regarded as an important element in the mental development of the people. This is based on the facts that moral value and nationalistic sentiments can be learnt from history. Therefore, history is not only important in nation building but also for the social well being of the nation.

Cultural heritage and archaeological sites and monuments are the main witnesses to the historical past. It is therefore impertinent to let them be destroyed by physical development. The locations of cultural heritage and archaeological sites and monuments must be ascertained before physical development takes place. Assessment of the impacts must be made and strategies developed to soften the impacts.

CHAPTER 7

PREDICTION AND EVALUATION OF IMPACTS

7.0 *INTRODUCTION*

Impacts prediction is made based upon basic methodologies and appropriate mathematical models. The use of these models, however, shall be exercised with care due to their limitations and the accuracy of the results depends upon the accuracy of the input data. The results of such modelling indicate certain degree of potential impacts of the environment and shall be evaluated against the applicable law, standards, regulations, rules, guidelines, handbooks, etc. Methods of assessment of impacts are given in Table 7.1, while a summary of the main impacts of reclamation according to activities is given in Table 7.2.

7.1 *PHYSICAL SYSTEM*

7.1.1 *Geology and Minerals, Erosion and Sedimentation*

Overall stability of the area and the superstructure resulting from filling of materials and borrowed earth must be addressed. Possibility of slope failures due to surcharge from the landfill, occurrence of slumps and sink holes as well as disturbance to the existing geological stability need to be looked into.

Geological materials (e.g. massive granite) are more resistant to coastal erosion or the frequent flooding compared to the reclaimed land that is made up of sandy soil, thus the latter is more prone to future coastal erosion.

Increase in erosion along the coast may cause significant coastal recession within a reach. This may cause long term coastal adjustment and may increase deposition in other places downstream depending on the rates and amount of sediment transport from river catchments to nearshore zone. Sediment from river may cause deposition along the coast. Sediment may also silt up river mouth. For the assessment of soil erosion and soil loss, various soil loss models such as the Universal Soil Loss Equation may be utilised.

Table 7.1. Methods for Assessment of Impacts

Impacts	Methods of Assessment
Soil Erosion, Geology and Minerals	Soil loss models such as Universal Soil Loss Equation (USLE), Excavation, Geological Information Data, Boring Log
Flood	Urban Drainage Design Standards and Procedures for Peninsular Malaysia
Water Quality	Streeter-Phelps technique (modified for estuarine analysis and crude estimates of BOD load in the river system)
Marine Quality	Hydrodynamic/Sediment transport model, Chemical/geochemical model and Biological/ benthic model
Coastal Processes	Erosion/accretion model, Sediment Dispersion Model and Hydrodynamic/sediment transport models
Air Quality	Air Dispersion model (e.g. Gaussian Plume)
Noise	Noise Impacts from Traffic
Transportation	Traffic generation and flow models
Socio-economic	Cost Benefit Analysis
Archaeology	Archaeological survey and possible salvage work
Ecology	Ecological models; comparative evaluation
Land Use	Map overlay techniques; comparative evaluation against structure/local plans
Aesthetics	Judgmental assessment

Note: This table is only a guide. Methods of assessment that may be used are not confined to those listed here. Methods of assessment may be obtained from various sources, a few of which are listed here as references.

7.1.2 *Climate, Air Quality and Noise*

Climate and air quality changes are important during the construction phase of the reclamation project particularly during site clearing and earthworks. The climate aspect should consider the micro-climatic changes due to the land clearing as well as changes in albedo, thermal conductivity, heat distribution and temperature.

The possibility of future global climate change or global warming due to the greenhouse gases can cause potential climate effects, which may have an effect on temperature and precipitation, and the possibility of an accelerated sea level rise. A rise in sea level (due to potential global warming climatic effects) will induce deepening of near-shore waters and increase wave height, all of which can initiate or accelerate coastal erosion and cause submergence around estuaries. Thus scarce resources are needed to meet the costs of protective structures and adaptation (constructing sea walls offshore and claiming further land near shore and inter-tidal areas).

The occurrence of extreme events such as more frequency and severity of storms and squalls over the sea, with accompanying changes in the wind and wave strength variability may be a potential risk and vulnerability to the coastline and its inhabitants. Severe storms may produce surges in excess of 8 meters on the open coast and even higher in bays and estuaries. Abnormal rises in water level in nearshore regions, would cause potential physical impacts in the hinterlands such as flood low-lying terrain, backwater impact, wave action during monsoon, seawater intrusion, flooding and littoral transport. Flooding of this type, when combined with the action of surface waves can cause severe damage to low-lying land and backshore improvements. These impacts are likely to be long-termed and should therefore be assessed to cover the duration before and after reclamation. Knowledge of the increase and decrease in water levels that can be expected during the life of a coastal project is necessary to design structures that will remain functional.

In-situ temperature is expected to increase over the reclaimed area, due to the albedo change from the green vegetation to the sandy land. The short wave radiation at the ground will be increased, causing an overall increase in the temperature. Thus, a local heat island effect would be expected to be generated over the reclaimed area.

The wind friction will be altered compared to the surface roughness of the mangrove vegetation. Evaporation and momentum transfer will also be changed, thus changing the internal boundary layer. This can affect the pollution dispersal efficiency of pollutants.

The land and sea breeze circulation that plays a dominant role besides the prevailing monsoon winds would affect the reclaimed coastal land. Diurnal heating and cooling that generate the local breeze conditions would affect the transportation and dispersion of emissions from the surface and elevated sources. Pollutants would be transported downwind from the source area inland during the sea phase. In relatively flat terrain, the pollutants can be transported up to 100-km inland. As the breeze transports the plume of pollutants from industrial sources, solar radiation causes the chemical reactions between pollutants like nitrogen oxides and hydrocarbons to be transformed into photochemical smog. However, recirculation of pollutants during the land breeze phase would advect the daytime emissions back to the coastal areas at night, when the mixing height would be lower. Pollutants could be trapped in the stable atmospheric layers overnight and could be fumigated to the surface, increasing the ground level concentrations by the following day.

Noise generated during construction that will impact on workers and nearby residential areas shall be considered. Traffic noise due to transportation of earth materials may be predicted using traffic noise models.

Table 7.2: Summary of Main Impacts by Activities

Activities	Main Impacts
Construction Phase 1. Construction of access road	• Soil erosion • Increased runoff • Increased turbidity into nearby waterbody • Loss of flora and fauna
2. Site clearing	• Soil erosion and siltation • Increase in suspended particulates • Increase in noise • Loss of flora and fauna
3. Setting up storage area and base camps	• Increase in dirt and dust • Generation of sewage, sullage and garbage • Enhancement of employment and commercial opportunities • Increase in communicable and parasitic diseases
4. Construction of containment structures	• Increase in turbidity • Interference with primary productivity • Restriction to local fishermen • Limit access to the beach • Loss of present shoreline • Discouragement on the use of the beaches • Enhancement of employment opportunities
5. Coastal reclamation works - dredging	• Beach slumping or drawdown • Interruption of sediment movement to the shore • Removal of natural barriers • Changes in wave refraction pattern • Introduction of pollutant load from dredged material into water column
- reclamation	• Air, water, noise pollution • Loss of benthic organisms • Loss of flora and fauna • Enhancement of employment opportunities • Threat to health and safety • Creation of new land • Loss of artefacts/archaeological remains
6. Spoils disposal	• Alteration of seabed profile at disposal area • Change in water quality • Dispersal of pollutants contained in spoils • Loss of benthic organisms • Disturbance of soil compaction • Stress on marine organisms

Table 7.2 (*continued*)

Activities	Main Impacts
7. Soil improvement works	• Soil stabilisation
8. Landscaping	• Increased aesthetic value • Reduced erosion • Increase in vegetation • Enhances air quality
9. Coastal protection works - Beach nourishment and sand bypassing	• Changes in wave energy distribution • Changes in surface current • Odour pollution • Threat to health and safety • Changes in coastal seabed topography • Changes in water quality • Increased aesthetic value
- Breakwater, groins, revetment	• Reduction in littoral drift • Salient development behind structure • Changes in wave refraction pattern • Changes in coastal current pattern • Long term shoreline adjustment
10. Dredging of channel waterways	• Increased oil concentration in cases of oil spillage • Interference with primary productivity • Increased noise • Restriction of navigation • Alteration of wave path
Post reclamation phase Subsequent development	• Regional development • Increase in population • Increase in commercial activities • Increased urbanisation/industrialisation • Infrastructural development • Increased utilities/amenities

7.1.3 *Coastal Hydraulics*

Impacts due to the newly created landmasses or island(s) in the foreshore zone may occur due to the alteration of beach dynamics, wave activities and coastal current circulation. These may lead to erosion and/or sedimentation. At an estuary, dredging of channel may also influence the coastal and riverine processes e.g. riverbank subsidence and obstruction to river flow.

Computer models need to be employed to determine, assess and predict the impact of the reclamation project on the coastal hydrodynamics. The hydrodynamic simulations for both existing conditions and the proposed reclamation are compared to assess the potential impacts. Several coastal hydrodynamic softwares are commercially available and proven to be reliable in simulating the impacts.

The computer simulation should include among others:

- Modification to tidal current distribution;
- Shoaling processes : wave refraction, diffraction and reflection;
- Suspended sediment transport distribution due to river discharge;
- Sediment dispersion resulted from land filling (without containment structure) and dumping of disposed materials at designated disposal site;
- Dredging impacts due to deepening of the waterways or channels;
- Morphologic changes along adjacent coastline – indication of possible erosion and accretion (qualitatively); and
- Simulated water quality.

The short-term and long-term impacts of the coastal protection strategy (soft and hard approach) proposed must also be evaluated *via* computer modelling.

The study should also include hydraulic modelling (hydrodynamic and sediment transport modelling) investigation to evaluate the hydrodynamics of the water regime and potential fate of sediment dispersion due to the dumping activity.

Hydraulic parameters pertaining to waves, currents, tides, bathymetry, winds and the surface soil must be analysed so as to give indications of its qualitative and quantitative assessments for the existing site conditions. Once this condition has been established and initial condition achieved, a forecast of the expected changes due to the effects of the proposed disposal works, if any, are performed

through computer simulation. Outputs obtained from the computer modelling works enabled the impacts of the after-disposal condition to be determined in the area of interest.

Detailed information on the various parameters involved in the hydraulic modelling is given in Appendix 5.

7.1.4 Water Quality

The most pertinent impacts on water quality during reclamation and post-reclamation are shown in Table 7.3.

a. Turbidity/Suspended Solids

It is anticipated that the suspended solids concentrations and hence the turbidity of the water bodies will increase due to earth disturbances, erosion and water runoff. Sediment dispersion and associated impacts in the water within the zone of influence of the reclamation project should be assessed using suitable modelling.

Some of the activities during reclamation and post reclamation that contribute to the increase of suspended solids and turbidity are shown in Table 7.3.

Rehandling basin for fill material may be required but not normally recommended. Should a rehandling basin be employed, a full impact assessment (via hydraulic modelling) must be carried out.

b. Oil and Grease

Increase in oil and grease in water would also be expected due to oily wastewater discharge from tugboats and sea vehicles and accidental oil spillage.

If the base camp also function as a station for construction equipment and fuel storage, then improper handling of fuel can lead to spillage. This will contribute to the increase in oil and grease level of the receiving water bodies. The other most likely activities which will contribute to oil and grease pollution are as given in Table 7.3.

c. Wastes (solid waste, effluents and wastewater)

Generally, base camps will only affect water quality if sewage, sullage and garbage are improperly discharged leading to increase in BOD level of the receiving water bodies. The predicted load of sanitary wastewater from the camp should be estimated with respect to the number of workers accommodated. It should be noted that all preventive measures related to base camps would be the responsibility of the contractor undertaking the project.

Improper disposal of various construction wastes will lead to the increase of debris in surface run-off, resulting in pollution of the receiving water bodies. Leachate from disposal point for wastes and effluents may lead to surface and ground water pollution.

d. Nutrients

Any activities that involve dislodging of soil sediments will lead to sudden release of products from biochemical breakdown of organics to the water bodies such as sulphides, ammonia and other reducing products besides sulphates and nutrients such as phosphates and nitrates. The release of chemically reducing compounds to the water bodies will also exert an immediate oxygen demand, i.e. lowering DO and has the potential to cause some damage to the ecosystem.

Nitrogen, silicates and phosphates released to the water bodies will become available to promote algal growth, i.e. as opposed to the effects of suspended sediments/turbidity. However, the effects of

suspended sediments are relatively localized compared to nutrients which may be dispersed longer in the water bodies and have a more significant effect on algal growth.

Table 7.3. Impacts on Water Quality

Activities	Turbidity	Oil and Grease	Wastes	Nutrients	Heavy Metals
Construction phase:					
Construction of Access Roads and Tracks	✓				
Base Camps			✓		
Site Clearing/Earthworks	✓		✓	✓	
Sourcing of Sand and Dredging	✓	✓		✓	✓
Transportation of Fill Material via Barge	✓	✓		✓	✓
Rehandling Basin (if required)	✓				✓
Drainage Alteration	✓	✓		✓	
Bund Walls Construction	✓	✓	✓	✓	
Laying of Geotextiles	✓	✓		✓	✓
Material Filling	✓	✓		✓	✓
Vertical Drains	✓	✓			
Soil Compaction	✓	✓			
Revetment	✓	✓	✓		
Coastal Works / Protection	✓	✓			
Landscaping	✓			✓	
Post reclamation phase:					
Coastal Protection: Replenishment and Revetment	✓	✓			
Coastal Scouring	✓	✓			
Coastal Armouring	✓	✓			

e. Heavy Metals

If dredged material is to be used for material filling, release of heavy metals into the sea can occur. The environmental impact of this depends very much on the metal contents of the dredged material (sediment) and their solubility. As the sediment is submerged, the concentration in water should already be in equilibrium with the concentration of heavy metal in the sediment and the dredging should not lead to sudden dissolution of metals unless a pH change occurs. The extent to which the dredging activity and the use of dredged material for material filling will release polluting levels of metals, can be determined by carrying out the standard elutriation test on the sediments from the borrow area.

The most likely activities that will contribute to oil and grease pollution are shown in Table 7.3.

7.2 BIOLOGICAL SYSTEM

Any set of data obtained while carrying out the scoping process will be useful for the prediction of impacts. Interaction between project activities and environmental components must be clearly defined before impact prediction can be made. Diversity of the organisms should be determined using some of diversity indices such as Shannon index and Evenness index. Information can be used to evaluate the distribution and abundance of the organisms. Additional information may be required to evaluate the valuable species or its conservation status (whether endangered, protected, etc). Benthic communities that may receive impact from this project are micro-macro benthos, coral, coral fishes, macroalgae and seagrasses.

For the mangrove area, productivity should be determined due to the importance of this area to support the aquatic food chain, an example of which is the determination of the chlorophyll *a* content in the water column. Fisheries and fishing ground should be determined by assessing the value of the mangrove as a spawning and nursery ground. Standing stock may be used to show the production of the fisheries and this should be determined for the impact assessment.

7.2.1 *Habitat Damage*

Significant changes to the habitat and its living component as a result of project development should be studied in association with physico-chemical changes involved. Any alteration of the physical sediment structure from its previous or original state should be discussed in relation to impact on marine life such as corals, seagrass, benthos and fisheries.

7.2.2 *Benthic Biology*

Modifications of the ocean floor such as those incurred by reclamation works will cause destruction to the living habitat of the organisms involved, specifically benthic communities. These impacts, either permanent or temporary need to be identified earlier. The type of benthic organisms that might become extinct or migrate to another area should be included in the report. In order to ensure that relevant information is given, the IUCN Red Data Book should be referred to. Apart from that, identifying the ability of certain species to rehabilitate the area should also be included in the discussion.

7.2.3 *Habitat and Marine Biodiversity*

Seabed is considered to be amongst the most affected component caused by the reclamation activities such as during site preparation, dredging, dumping and operation. Physically, seabed structure will be destroyed during sand dredging, and thus sufficient information on marine biotic components such as benthic organisms need to be obtained to determine impacts of project activities on the latter. Although the seabed area may stabilise and the marine communities may recover later, most of the existing biotic life may be lost permanently.

Additionally, surface water runoff can cause water turbidity to the marine water, which in turn will affect marine primary and secondary productivity.

7.2.4 *Drainage Interceptor*

Runoff water should be evaluated to ensure runoff and discharges are not released directly to the marine water body.

The importance of estuaries and streams for the biological communities should be ascertained. If the natural water drainage is disrupted, there will be no interchange of nutrients and animal species between the freshwater, brackish and saline water. Migration of some species such as eels and prawns between freshwater and saline water for laying eggs and breeding will be adversely affected. Some larvae and juveniles, which require intermingling of freshwater and saltwater (brackish), will also be affected by disruption of these areas such as estuaries.

7.3 *SOCIO-ECONOMIC SYSTEM*

Socio-economic impacts are basically the outcome of the interaction between the characteristics of the project/development action and the characteristics of the host environment. Once the baseline information on both sets of characteristics has been assembled, impact assessment may commence.

Socio-economic impacts normally pertain to the changes that the project action may bring about to the local or host society. The real challenge is to be able to predict what aspects of the socio-economic components that may be impacted and how this may occur. Besides, it is also important to note to what extent the impact will have on each of the components.

The socio-economic components can be classified into several aspects, namely; population and its demographic compositions of age and sex, social system and organisation, economic attributes of employment and income, health and safety, psychological well-being, aesthetic and cultural, utilities and amenities, and labour force.

The criteria of impact assessment do not only apply to the type of impacts but also to its magnitude, extent, significance and special sensitivity. Type of impacts refers to whether an impact will be direct or indirect.

Magnitude refers to the quantum of change that will be experienced. A change of great magnitude would be, for example, the doubling of a place's population. As such, the measured level of the environmental impact will be twice as large.

The extent of an impact refers to the area that will be affected. In spatial terms, it can be translated into whether the impact will be merely local, regional, national or even trans-national.

The significance of an impact goes beyond the magnitude to the actual effects. A small change may not be great in magnitude but may cause a significant change in the affected component or parameter. The analyst must be aware of, and is able to distinguish this particularly in assessing parameters that are critical and sensitive.

The special sensitivity criterion refers to environmental concern that is area-specific. It simply asks whether the impact of a proposed action will affect an area of special sensitivity.

Impact assessment is focused on aspects that are likely to be affected in terms of magnitude, extent or significance, or which involve areas of environmental sensitivity. The following are some of the socio-economic components that may be impacted by a proposed project during its implementation as well as its post-implementation periods.

7.3.1 *Demographic Impacts*

A project is known to attract different types of people from within and outside an area to seek employment opportunities, either directly of indirectly. The impact that this incoming population will bring to the local demographic scene will be in terms of changing the size, age structure, sex ratio and household characteristic (nuclear, extended, multiple) of the population.

An assessor will have to predict the nature of the incoming population (who will be moving in and how many) based on the nature of the activities of the project. The extent and duration of the project's requirement should also be included in determining the type of change that is likely to take place. Knowledge of the existing population and its demographic characteristics is important as the basis for determining how the population change will take shape.

7.3.2 *Social System and Organisation*

The incoming population will not only affect the population size and structure but the racial mix as well. The assessor will have to be sensitive to this aspect of the social impact and should be able to identify at what juncture will it affect the society (if any), what will the nature of the impact be and what attempts should be made in order to avoid any social and cultural conflicts.

7.3.3 *Economic Impacts*

Economic impacts very often outweigh other impacts in project decision-making. Economic impacts are normally translated in terms of the generation of employment, income and revenue, either directly or indirectly. An important question to ask is who will be the recipients of these benefits and what is the spatial extent of these economic advantages and disadvantages.

Another aspect of importance is determining whether or not the labour requirement of the project can be tapped from local resources. Hence knowledge of the quality of local labour is useful in identifying the extent of labour availability to meet the requirement of the project.

7.3.4 *Health and Safety*

The aspect of health and safety is an important socio-economic component in EIA. This is because physical well being of people, be they workers, residents, passers-by etc., is central in any project implementation. Project activities are potential sources of occupational hazards that may incapacitate or mime personnel. The latter may also be exposed to other health hazards that may not necessarily be caused directly by the project.

7.3.5 *Psychological Well-being*

Closely related to health and safety is the psychological well being of people that will be affected by the project. Certain structures, activities and unbalanced knowledge may cause untoward fear and pandemonium to different people. The project proponent should take measures to ensure that such a situation does not arise.

7.3.6 *Aesthetics and Cultural*

Aesthetics is an important element to an area as it is closely related to quality of life. The aesthetic value of an area is difficult to quantify and evaluate objectively. Impacts of direct and indirect interaction of a proposed project with the landscape are most subjective in an EIA.

It is important to note that the significance and value of a cultural landscape depends on recognition and associations of residents and visitors and that landscape is also linked to ecological quality.

The assessor will have to qualitatively assess what aspect of the landscape will be impacted, what will be lost with the implementation of the project and find ways to minimise impacts.

7.3.7 *Utilities and Amenities*

Project implementation and the population influx drawn by the former may not only utilise the existing community support facilities and amenities but may cause stress on the existing ones if the supply is limited. New requirements such as housing may also arise due to the effect of population change.

The adequacy of these community support facilities such as schools, hospitals, clinics, religious buildings (mosques, *surau*, temples, churches, etc.), businesses, government services (postal, policing, fire-fighting, garbage collection, etc), electricity, water and local road network should be assessed based on the predicted increase in demand, etc.

7.3.8 *Labour Force*

The impact discussion of labour force is considered separate from that of the population at large. It is specific to the project needs. Aspects to be assessed include size, skill requirements, local availability and potential source of supply.

7.4 *ARCHAEOLOGY*

Physical development will have direct impacts on both standing and buried cultural heritage and archaeological sites as well as the environment surrounding them. It will also affect monumental remains (if any) due to the air pollution. Besides, the infrastructure of the archaeological and cultural tourism may also be affected.

Another impact will be the destruction of the remains of shipwrecks located in the development area.

Cultural heritage and archaeological sites can either be standing or lying buried under the ground. It is necessary to carry out pre-project reconnaissance survey of the area to determine the existence of the cultural heritage or archaeological sites in order to draw up rescue plan to save the cultural heritage or archaeological sites. This is due to the fact that the coastal reclamation project will destroy the sites directly or indirectly by damaging, destroying or burying them through various activities such as site preparation, dredging, dumping, etc.

Cultural heritage and archaeological sites are normally located within certain environment. This environment surrounding the sites will be affected if precautions are not taken prior to the reclamation activities to ensure that development does not include the area where cultural heritage and archaeological sites are located. An example of such site is the archaeological site located on the mangrove swampy island off the coast of Matang, Perak and Pulau Ketupang.

Monumental remains located near the reclamation activities will be indirectly affected through air pollution due to the suspended dust.

Coastal reclamation activities which have taken place near the cultural heritage and archaeological sites will not only affect the standing monuments but also the various infrastructures built for the promotion of such cultural and archaeological sites as tourist attraction. The infrastructures may include roads, pipelines, electricity lines and hotels.

Coastal reclamation activities which have taken place near or within the area where wrecks of boats or ships are located will definitely damage or destroy them if no efforts are made prior to the reclamation activities to rescue them. The coastal reclamation activities, which will directly affect the wrecks, include dredging, dumping and sand sourcing.

The use of archaeological surveys should depend on the site of reclamation. If through historical search, the site is not known to be important as a navigation channel or historical/cultural sites, then there would be no real need for such surveys to be carried out. Survey work should only be commissioned on historically important area

7.5 COSTS AND BENEFITS

7.5.1 *Cost-Benefit Analysis*

Cost-benefit analysis is a well-known tool in an EIA but by no means the only final decision-making tool in determining the feasibility of the project. This is due to the fact that many environmental and social parameters are not easily quantifiable or defined in monetary terms. For example, loss of scenic value, loss of certain biological components of the ecosystem, psychological stress due to relocation and health and well-being of people are some of the parameters that cannot easily be translated in monetary terms.

Nevertheless, where cost-benefit analysis can be conducted on specific project aspects and impacts, it should be carried out in the EIA. However, these analyses of costs and benefits should only refer to those of the public, as it is the public who will be the final adversaries or beneficiaries of the project's outcomes.

In conducting cost-benefit analysis, all relevant costs and benefits should be included. What it entails is the determination of which project effects are efficiency benefits and which are efficiency costs. The efficiency benefit of a project is the value of the goods and services provided by the projects, whereas the efficiency cost (often referred to as opportunity cost) of a project is the value of the goods and services forgone as a result of the project. The 'value', in both

instances, is measured by individuals' true willingness to pay for the goods and services involved. There are established texts written on cost-benefit analysis (Dasgupta & Pearce, 1972; Laynard, 1974; Anderson & Settle, 1977; etc.). Costs and benefits of the project should be considered at the various levels of the impacted zones, be it at the project site, area of immediate influence and area outside of immediate influence.

Since quantitative cost-benefit analysis has often been difficult to handle, of late, attempts have been made to provide for a qualitative cost-benefit analysis. This is because costs and benefits need not be financial alone, but social or ecological as well, involving aesthetic and ethical considerations. Instead of converting spiritual value into financial ones, a modelling technique based on decision theory, using 'strength of expert opinion' as currency can be adopted. This exercise entails the listing down of the unquantified costs and benefits accrued by a project. These costs and benefits are then assessed qualitatively, in terms of losses to the public as well as the advantages that they will bring to the latter.

It is also possible to provide for a combination of two cost-benefit analyses; one, which is quantitatively analysed (comprising those whose costs and benefits can be measured) and the other which is qualitatively assessed (comprising those which cannot be measured). In so doing, every aspect of the parameters assessed will be covered and a comprehensive outcome will be achieved.

Whilst the above cost-benefit analysis reflects the conventional techniques, other new techniques of assessing the economic value of wetlands have also emerged. This is elaborated in the following section.

7.5.2 *The Economic Value of Wetland*

In reclaiming the wetland, the major question that arises is the economic benefits derived from the newly gained land as opposed to the mangrove land that has been traded off. In economic terms, the value of the newly created land can be justified through property development and regional growth and consequent indirect benefits or the multiplier effects. However, it is not so easy to quantify the economic value of the wetland of which mangrove is a part. To determine the economic values of mangrove landuse a wide range of valuation techniques (some of which are quite complicated) is required. Turner et al. (1994) explained that the economic components of wetland could yield direct and indirect use values as well as non-use values. Some of valuation methods available to evaluate such environmental benefits are shown in Figure 7.1. The figure indicates that a full range of valuation techniques is required to quantify the economic value of wetlands. It is commonly observed that direct use value such as reclaiming land (for residential, industrial purposes) have often taken precedence over long-term sustainable utilisation of wetland ecosystem conservation.

Benefits derived from coastal zone in Malaysia contribute significantly to the Gross National Products (GNP). Maintenance of marine and coastal zones is therefore of economic importance. Policies and practices of the states that maximise short-term financial returns should not take precedence over longer term economically beneficial and sustainable resource uses, unless resource substitutes are available. Along this argument, many functions and services of mangrove land are non-market goods and therefore do not carry appropriate market prices and values. It is estimated that the total economic value of wetland function varies from US$ 1.5 million/km^2 to US$ 13 million/ km^2 and the average is between US$ 2.5 million/ km^2 for OECD countries and US$ 1.25 million/ km^2 for developing countries. The following are examples of other cost benefit estimates provided by the various functions of wetlands:

- The Broadland coastal wetland in England is estimated to provide recreation and amenity benefits of around US$ 5 million per year (Bateman et al 1995).
- The Terrebonne coastal wetland in Louisiana is a buffer zone. It protects the shoreline from retreating and property damage due to the storm. The protection value is estimated to be US$2.3 million per year.
- Apart from the above, the wetland is valuable to human in that it is an irretrievable loss if such an ecosystem is damaged or destroyed, and such loss is difficult to quantify.

It is interesting to compare cost impacts estimates to develop wetland for reclamation purposes with other development types. Table 7.4 summarises some of the economic development pressures to the coastal environment and their related impact categories. The coastal ecosystems and wetland impacts are all considered non-market impacts. Thus these impacts must be calculated via various relevant methodologies such as travel-cost method, indirect opportunity cost approach based on option foregone and indirect substitute approach. All these approaches are recently developed methodologies for evaluating and quantifying the wetland and are not used in Malaysia in cases of their trade-off to reclamation project. It is therefore pertinent that the authorities take these evaluation procedures seriously and incorporate them into their project planning. The scope of work for all coastal zone developers should include the above-mentioned evaluation. It is only then that the public would know and appreciate the true value of the environmental trade-off, which is at present being dismissed as irrelevant or not important.

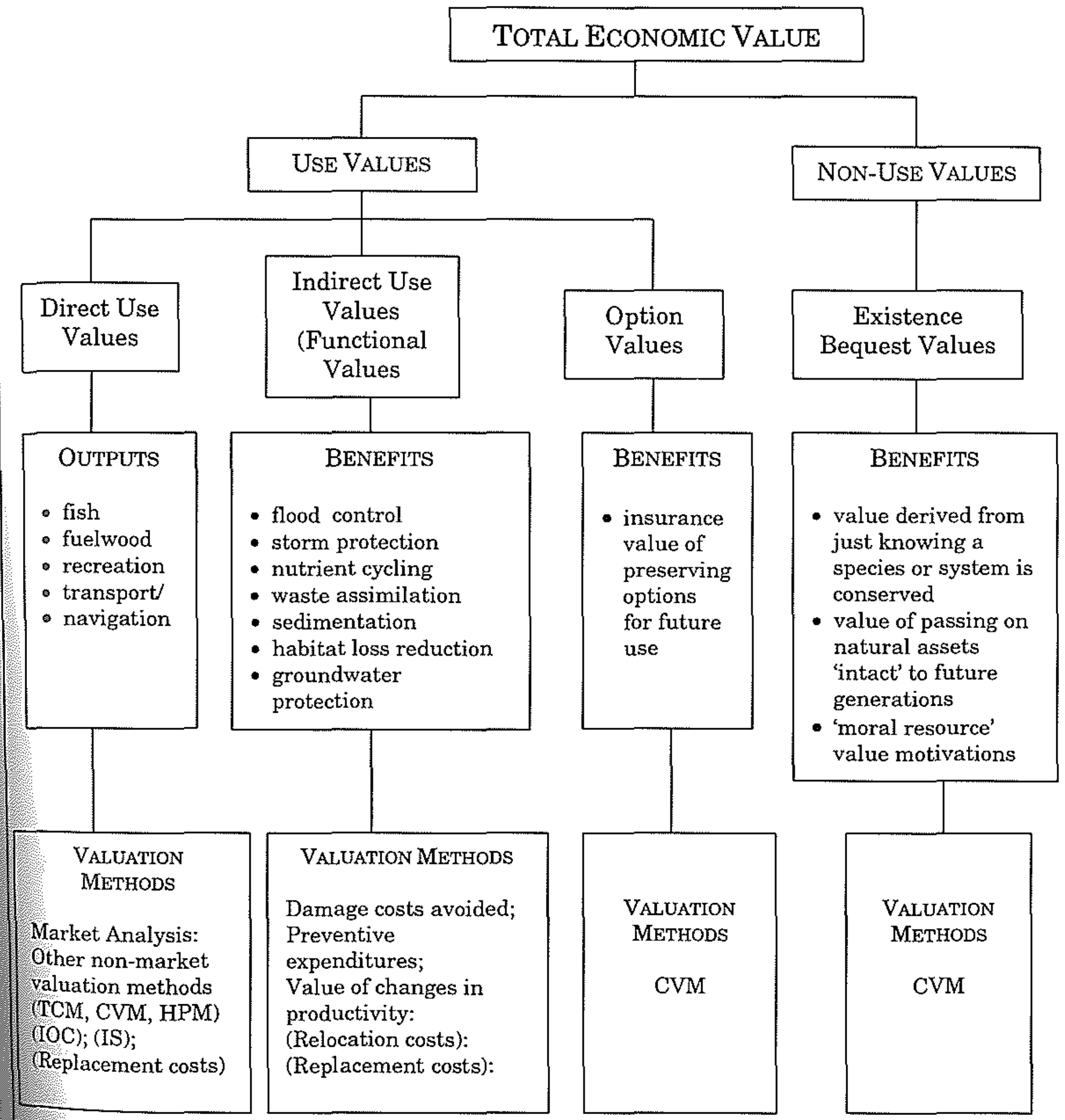
Table 7.4. Environmental Pressures and Impact Categories

Impact Categories	Climate-related Events and Human Activities					
	Erosion	Flooding/ inundation	Saltwater Intrusion	Siltation	Pollution: Water Quality Sanitation and Eutrophication	Storminess
Tourism	$				$	$
Fresh water supplies			$	$	$	
Fishing/Aquaculture	'$'	'$'		$	$	
Coastal residences	$	$				$
Commercial/Industrial buildings, ports etc.	$	$		$		$
Coastal ecosystems and wetlands	$, nm	$, nm	$, nm	$, nm	$, nm	$,nm
Agriculture		$	$	$	$	$
Human Health		$, nm			$, nm	$, nm

Source: Turner et al. (1995)

Note: nm = non-market impacts,
$ = Market priced major impacts,
'$' = Minor impacts

Figure 7.1 The Economic Value of Wetlands



Notes:
Market Analysis: based on market prices.
HPM = hedonic pricing, based on land/property value data
CVM = contingent valuation method based on social surveys designed to elicit willingness to pay values
TCM = travel cost method, based on recreationalist expenditure data
IOC = indirect opportunity cost approach, based on options foregone
IS = indirect substitute approach

The benefits categories illustrated do not include the "indirect" or "secondary benefits" provided by the coastal zone to the regional economy, i.e. the regional income multiplier effects.

CHAPTER 8

MITIGATION AND ABATEMENT MEASURES

8.0 *INTRODUCTION*

For each of the evaluated significant impacts, there shall be preventive and abatement measures to prevent and reduce the adverse impacts. Mitigating measures may require changing of project site, layout, methods of transportation and construction, timing, engineering design, etc. Other forms of mitigation may include pollution control, waste treatment, phased implementation and construction, engineering measures, landscaping, social and economic measures, education, restoration, relocation, compensation, concessions for damage and environmental monitoring.

8.1 *PHYSICAL ENVIRONMENT*

8.1.1 *Geology and Minerals, Soil Erosion and Sedimentation*

The suitability of fill material to be used needs to be sufficiently addressed. Overall stability of the area must be adequately proposed in terms of standard engineering practices undertaken during and after construction stage. Abatement measures to ensure stability of landfill and other superstructures should be mentioned in relation to the main impacts.

8.1.2 *Climate, Air Quality and Noise*

During construction stage, the potential problem of localised wind-blown dust shall require the inclusion of designs to reduce the problem such as the selection of haulage route into the site and the location of stockpiles. Other specific measures such as frequent

spraying of water on stockpiles and access roads, covering of lorry loads, etc. should be incorporated in the report.

When emission of noise is likely to exceed the recommended level in the standard, mitigating measures are required. Even when standards are met, mitigation may still be required to prevent annoyance and complaints. The most effective would be to control the noise at the source such as by using anti-vibration mountings, fitting silencers on internal combustion engine, etc.

8.1.3 *Coastal Hydraulics*

Mitigating measures may include construction of proper containment structure prior to the disposal of fill material, controlled operations with more environmental-friendly and latest technology of dredgers, silt curtain to enclose the dredging and disposal area where necessary. Monitoring of environmental impact during operation works may also assist in identifying any adverse conditions resulted especially from unpredictable conditions.

8.1.4 *Water Quality*

The followings are parts of the mitigating measures on water quality during reclamation and post-reclamation.

a. Turbidity/Suspended Solids

In the course of project operation, if turbidity is found to exceed 200 NTU limit or suspended solids higher than 50 mg/L limit of the Interim National Marine Water Quality Standards for Malaysia, the latest state of the art technology available in the market should be considered in meeting compliance with regard to water quality.

Surface run-off should be directed to a number of silt traps as an immediate turbidity control measure and to make sure that the turbidity and total suspended solids of the water released to the receiving water bodies are lower than 100 NTU and 100 mg/L respectively. Any degraded area identified must be covered with mulch, fibromat, etc.

b. Oil and Grease

In the event of oil spill, badly contaminated soil should be collected and properly disposed according to the Environmental Quality (Scheduled Wastes) Regulations, 1989.

Discharge of oily wastewater from sea vehicles' engine room should be channeled into the oil separator. The waste oil should then be stored in slop tanks and managed as scheduled waste according to Environmental Quality (Scheduled Wastes) Regulations, 1989.

c. Wastes (solid waste, effluents and wastewater)

Providing sufficient number of mobile toilets and treating the effluent from the toilets and the sullage in self-contained septic tank system will minimise potential pollution of surrounding and downstream water bodies by sanitary wastewater. The system should be the one approved by the Ministry of Health and/or the Ministry of Housing and Local Government. Left over wastes should be collected by contractor and properly disposed off in a landfill site approved by the local authority. Project management must handle garbage collection if outside the municipal area. The wastewater discharges should comply with the Standard B of Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979.

d. Nutrients

In the course of project operation, if nutrients in the water are found to exceed the limit stated in the Interim National Marine Water Quality Standards for Malaysia and Class IIA/IIB of the Interim

National Water Quality Standards for Malaysia, then the latest state of the art technology available should be adopted as part of mitigating measures.

e. Heavy Metals

The use of certain dredged sediments for material filling should depend on the positive result of the standard elutriation test carried out (refer to Figure 4.1).

In the course of project operation, if heavy metals are found to exceed the limit in the Interim National Marine Water Quality Standards for Malaysia and Class IIA/IIB of the Interim National Water Quality Standards for Malaysia, then the latest state of the art technology available should be adopted as part of mitigating measures.

8.2 *BIOLOGICAL SYSTEM*

8.2.1 *Habitat Damage*

Concern should be given to the types of equipment used for dredging and dumping. The use of suitable dredgers should be recommended to ensure minimum seabed disruption and dispersion of sand.

A specific depth of sand dredged should be fixed to ensure that the profile of the dredged seabed is not drastically altered. Some organisms may not survive in the new habitat structure and permanent loss may occur. Areas that have been identified, as containing endemic, totally protected or rare species should not be unduly disturbed. Mangroves ecosystem should be evaluated for the fishing ground and fisheries resources and needless disturbance of those ecosystems with high production rate should not be allowed.

The short term and long term function of the mangrove area should be determined to ensure that aquatic food web is not disrupted.

8.2.2 *Benthic Biology, Habitat and Marine Biodiversity*

The following are some mitigating measures pertaining to issues in biological system:

- To safeguard marine life and in particular the benthic organisms, minimal disturbance to the bottom sediment should be ensured through the employment of suitable dredging technique.
- Pollution of marine ecosystem can be avoided if sludge, toxic, scheduled and hazardous wastes are not discharged directly into the sea.
- The general waste should be appropriately disposed off and hazardous waste should be handled, treated and disposed following proper procedures.
- Spillage and fugitive release should be minimised through good design, regular inspection and maintenance of sea vehicles and equipment.
- Dredged materials should be disposed off at the designated dumping area only. The application of a reliable global position system (GPS) device will ensure exact positioning of vessels while releasing the dredged materials.
- Proper drainage should be ensured to prevent blockage of the reclaimed land and flooding which can disrupt the coastal habitat and its associated life.
- Human activities such as waste disposal etc. from the development over the reclaimed land should be strictly controlled

to avoid pollution of the water quality in the vicinity of the reclaimed land. The various stages of project development should be well managed and regulated to avoid significant long-term impact to marine waters. Such impact would result in subsequent deterioration of the associated mangrove, corals, seagrass and other sensitive coastal marine habitats.

- Inducing habitat preservation and rehabilitation, such as the installation of artificial reefs, etc can mitigate loss or decline in biological productivity and biodiversity.
- Exposure of coastal ecosystem (human population, fauna and flora) to increasing potential hazards and risks from anthropogenic sources (such as industrial pollutants of downstream development on the reclaimed land) should be minimised through planning, legislative, institutional and other support measures.

8.2.3 *Drainage Interceptor*

The natural flow of rivers and streams to the sea must not be blocked with any structures or filled areas. If necessary, the natural outlets should be maintained and controlled by gated entrance to prevent seawater intrusion into productive lands.

8.3 SOCIO-ECONOMIC SYSTEM

8.3.1 *Economy*

Most predicted economic impacts are normally encouraged by the local decision-makers. However, there may generally be concern about some negative economic issues, which require mitigation. The assessor should be able to address these in order to reduce impacts. The former may take the form of introducing formal and/or informal controls, such as drawing up of agreements (in cases of labour poaching). Others may be in the form of a provision for a compensatory 'assisted area' package for other employment with the demise of employment associated with the project concerned, such as loss of livelihood due to restricted fishing, or loss of fishing ground.

However, in general the focus of economic impacts is more on measures to enhance benefits. When positive impacts are identified there should be a concern to ensure that they do take place. Suggestion should be made for measures to improve potential employment benefits, commerce and income for local people. Besides, targets for the proportion of local recruitment may also be set. Various measures, such as a register of local suppliers, may be suggested to help encourage local links and to reduce the leakage of the wider economic impacts outside the locality.

There should also be suggestions for other measures that can ensure mitigation and enhancement of benefits particularly in relation to contributions by proponents. Examples are good management practices, liaison committee that brings together the proponent and community representatives and a responsive complaint procedure. A commitment to monitoring and the publication of its data may also contribute to effective mitigation.

8.3.2 *Social*

Major social impacts are often reflected in the forms of demographic and accommodation impacts as well as impacts on local services, facilities and amenities. Several approaches to the mitigation of social impacts are available but the assessor should be able to address these accordingly as the magnitude and extent of impacts depend greatly on the conditions in the impact zone and also the nature of the project.

One basic mitigating measure to cushion off demographic impacts is to ensure that the needs of the people who will be displaced by the project will be attended to. Measures should also be found to reduce in-migration so that local facilities are able to cope with the demand, and if additional population to the area is unavoidable, measures must be taken to accommodate this.

Accommodation issues, particularly during construction should also be addressed, either by providing additional accommodation for the workforce or by encouraging the use of unoccupied and under-occupied accommodation in the impact zone.

Impacts on local services have to be addressed too. The contribution made by the proponents, such as provision of certain facilities is also pertinent. Developer funding of additional local authority provision necessitated by the project is also likely to be requested. Funding of local community projects may also be offered as partial compensation for the adverse impacts of the project.

Mitigation for other social impacts such as health and safety, social problems (if any), have to be suggested.

8.4 ARCHAEOLOGY

In the case of the cultural and archaeological sites located directly in the development area, the monumental remains must be first excavated and studied and relocated in another area.

For archaeological sites discovered during construction, work on the sites must be stopped temporarily and the Department of Museum and Antiquities be informed to give time to the archaeologists to salvage and record the finds. Efforts must be made to preserve the cultural remains and archaeological sites located outside the development area. This may include landscaping of the immediate surroundings, etc.

Sometimes it is necessary to set up markings where cultural remains and archaeological sites are located before they are salvaged or moved. Important cultural and archaeological remains to the nation must be preserved *in situ* at all costs. In the coastal area where there is a presence of shipwrecks, a study must be conducted before the area is allowed to be developed.

CHAPTER 9

ENVIRONMENTAL MANAGEMENT PLAN

9.0 ENVIRONMENTAL MANAGEMENT PLAN

A key outcome of the EIA process will be an Environmental Management Plan (EMP) which:

a) identifies key potential project impact areas;
b) sets up a programme for monitoring the potential impacts; and
c) establishes reporting and mitigation (including emergency) response procedures.

The EMP should contain a concise statement of purpose, summarising the key potential impacts that could arise from project implementation, and setting out the way in which the EMP will ensure that these impacts are properly monitored and controlled.

9.1 RESPONSIBILITY DURING PROJECT IMPLEMENTATION

Upon approval of the EIA report and permission given for commencement of the project, the project proponent, the regulatory agency, and other relevant authorities need to ensure that mitigation and control measures recommended to be taken are incorporated into the final project plan and implemented on the ground.

The project proponent, his project manager or implementing body is required to undertake the following actions and responsibilities.

a) Allocate institutional/administrative responsibilities for planning and management of environmental requirements. The results of the EIA are to be applied to shape the project and influence engineering designs;

b) Responsibility to execute mitigative action to be allocated to the project manager and/or the contractors responsible for project construction (e.g. soil erosion control planning and execution by the earthworks contractor);
c) Implement a monitoring and auditing programme to check the effectiveness of mitigating measures, and to modify, or implement further measures, to redress or overcome the impacts;
d) Appoint relevant expertise or consultants to assist if in-house capability is not available;
e) Ensure that recommended mitigating measures are incorporated in detail design and contract documents;
f) Allocate adequate budget for implementing the EMP; and
g) Actively promote and practise habitat and species conservation.

Issues that are relevant to public authorities should be reported. Such issues, as the need to restrict landuse of adjacent surrounding areas, control of types development allowed in the project area, and requirements for collection, treatment and disposal of liquid and solid wastes are particularly relevant to local authorities who ultimately are responsible for the management of these areas.

9.2 *ENVIRONMENTAL MANAGEMENT PLAN COMPONENTS*

The EMP should recognise and include the following:-

a) Management of soil erosion, river and coastal siltation during site clearing and earthworks – a soil erosion control plan is generally necessary;
b) Management of runoff to minimise floods;
c) Regulation of the types of development allowed in the project area;
d) Management of any liquid, solid and hazardous wastes generated;

e) Environmental monitoring requirements; and
f) Responsibilities and role of the project initiator for protection of the environment;

Emergency Response Plan – This plan is also essential for reclamation projects – the ERP may not be specifically detailed out in the EIA but it is essential that a schedule be drawn up, responsibilities for its production identified and a budget allocated, all in the EIA. The ERP should include the following:-

- good system, administration and management to achieve excellent safety performance;
- efficient planning of facilities, good design and operating standards to reduce the potential for accidents at sea and the workplace;
- loading and unloading procedures and emergency procedures for vessels and barges;
- emergency preparedness and response plan to prevent ship collision/spillage, and to ensure safety of navigation for vessels plying within the vicinity and crossing or sharing navigation route of dredgers and barges;
- safety drill to familiarise the workforce with sequence of actions, handling of safety equipment and evacuation procedures in the event of accident/spillage or collision;
- provision of navigational aids, safety guidelines, fire-fighting and rescue/team services; and
- liaison and networking with other rescue teams such as Petrol Industries Malaysia Mutual Aid Group (PIMMAG).

An important aspect of the EIA document is the identification of monitoring requirements which the project initiator, and possibly the regulatory agency, should undertake during project development and operation (for example, water pollution expected in the project area). The programme for monitoring should generally identify:-

a) The type of monitoring required (for example, water quality measurement);
b) The locations of monitoring stations (this should be identified on a map or plan);
c) The parameters to be maintained (for example, dissolved oxygen, if fisheries is important); and
d) The frequency of monitoring. A checklist for use in planning a monitoring programme is set out in Chapter 10.

9.3 *POLLUTION LEVELS AND THE PHYSICAL ENVIRONMENT*

In general, the monitoring requirements for pollution and physical effects are the same as for baseline studies (refer Chapter 6). Regular monitoring should give an adequate indication on whether or not pollution levels are "acceptable", although pollutants should also be monitored directly from the source of the pollution.

9.4 *NATURE CONSERVATION*

9.4.1 *General*

There are two readily distinguishable ecological components of post EIA Environmental Management Plan:-

- surveillance; and
- monitoring.

Surveillance is more commonly undertaken during the construction period and consists of one-off or periodic checking of design or construction parameters such as the avoidance of sensitive sites, integrity of buffer zones, the efficacy of ecologically determined design and construction features, i.e. maintaining appropriate hydrological regime in a wetland area.

Ecological monitoring programmes, in contrast, are comprised of regular biological recordings with the specific aim of detecting changes in distribution or abundance of species and their habitats.

Monitoring of the physical environment in EMPs is generally designed for auditing or compliance purposes against set standards or levels, while monitoring of key biological or ecological components are generally designed to detect 'change' or to provide 'early warning' with reference to specific criteria.

9.4.2 *Ecological Monitoring*

Ecological monitoring programme is still a novel and relatively expensive procedure in Malaysia due to the absence of established 'standards' for population parameters, inherent variability of population data, lack of trained personnel and difficulties of data interpretation. Key concerns regarding ecological components of post EIA EMPs are:

- most are static surveys or, at best, surveillance and not monitoring programmes;
- a lack of specific or specified objectives; and
- inadequate design.

9.4.3 *Justification for Ecological (or Biological) Monitoring*

The major advantage of biological monitoring over monitoring physico-chemical parameters of the environment is that it measures the actual effect of a pollutant on living organisms in their natural habitat. Biological monitoring is, in general; far more time-consuming and expensive than monitoring of the physical environment and any biological monitoring needs to be fully justified.

9.4.4 *Format for Ecological Monitoring*

Ecological monitoring methods and subjects vary greatly and are likely to be site specific, however the procedure for good and rigorous monitoring is well established. Table 9.1 is a questionnaire-checklist, which should be used as guidance before monitoring is attempted. There is a need to specify the purpose for the monitoring data, the specific tests and analysis (methodology) related to questions that need answering This includes determining the type of data required, sample sizes and appropriate statistical analyses.

9.5 SOCIAL ACCEPTABILITY

Follow-up surveys of community groups which the EIA predicted could possibly be affected should be undertaken initially every year and after 5 years at 5 yearly intervals. Information on the health and safety of the communities is available through annual health statistics and information on population and community location is available through census data (every 10 years).

A complaints register should be maintained at the local project proponent office, and proponent staff of the environmental unit should follow up all complaints.

Table 9.1: Questionnaire – Checklist to Determine Monitoring Strategy

1.	Is there a good reason for monitoring? Are your objectives clear? Are you aiming to record local change or the effects of project management or something else?
2.	Have your objectives been ranked?
3.	Which features are to be recorded?
4.	Would the use of aerial photography or remote sensing save time and money?
5.	Are sampling problems complicated by season (e.g. monsoon), succession or other temporal events?
6.	Have the sampling points been located? Are you sure that yourself/other people can relocate them? Have they been marked in at least two ways?
7.	Is your methodology statistically correct? Have you consulted a statistician?
8.	How will the data be analysed, interpreted and presented?
9.	Who will administer/co-ordinate/file the results of the monitoring programme?
10.	Are there any thresholds to be identified for compliance or to trigger a management response?
11.	Who will act on the results? Is the capacity to respond assured, i.e. designated responsibility, secure economic and technical resources etc?
12.	Are the fulfillment criteria of the monitoring programme established i.e. when will it end?

9.6 SUMMARY OF MONITORING OF PROJECTS

Continuous monitoring may be carried out after EIA studies. Such monitoring differs from survey conducted during the EIA. It is important to monitor impacts as it provides some basis for comparing data acquired from pre-EIA, during EIA and post EIA. Variations in this data should provide information on compliance with the relevant authorities.

Monitoring of key construction and operational activities is advisable for the reclamation projects. The activities to be monitored are disposal of material, dredging processes and trenching. These activities are known to have impacts on the surrounding areas and all mitigating measures recommended must be adopted. If these measures should prove to be inadequate, then additional measures must be proposed and adopted to ensure compliance. Components to be monitored would include:

a) rainfall;
b) water quality at various discharge points of the affected river-mouth and coastline, including :
    - salinity;
    - pH;
    - temperature;
    - electrical conductivity;
    - turbidity;
    - dissolved oxygen;
    - suspended solids;
    - phosphates; and
    - nitrates;
c) analysis of fill materials for heavy metals;
d) limnological sampling of plankton and benthic organisms;
e) fisheries assessment surveys (species, population size);
f) wildlife (species, distribution, numbers);
g) vegetation changes (cover, species composition, biomass);
h) impacts on species or plant communities of special ecological significance;
i) public health and disease vectors;

j) in- and out-migration of people to area; and
k) changes in economic and social status of resettlement populations and people remaining in the coastal area.

9.7 *POST-MONITORING AND AUDIT PROGRAMMES*

Post-monitoring and audit programmes for project proponents (and DOE) should include the following:-

- monitoring plan;
- scoping;
- data collection and analysis;
- interpretation of results; and
- feedback of results.

Impact monitoring may be carried out during project operation, thus it is referred to as post-monitoring. Such monitoring is important to detect changes in environmental quality, for project management, to test predictive accuracy of EIA, to improve public confidence and enhance corporate image.

External auditing may be required should the area covered by reclamation raise a lot of controversy. This is to formulate independent opinions on the environmental implication based on EIA report, especially on the adequacy of the report. In implementing audits for enforcement agency, the following aspects should be included:

- policy, objectives, legal requirements and approaches to be specified;
- division of responsibilities i.e. DOE and other agencies;
- detailed guideline on what and how to monitor;
- actions that can be taken for non-compliance;
- criteria to decide which option to adopt;

- record keeping – for example, communication and reporting procedures between agencies and project proponents; and
- indication of grey areas of responsibilities and jurisdictions and how to resolve uncertainties.

Monitoring and auditing objectives should be clear and specific and adequate budget allocation and qualified personnel should be provided. Management process should include an orderly analysis, appropriate organisational arrangements, and aspects on managing relationship between personnel, within and between agencies.

CHAPTER 10

THE RECOMMENDED CHECKLIST FOR RECLAMATION PROJECT

10.1 The recommended checklist for Reclamation Projects is summarised in Table 10.1.

10.2. The Checklist is part of a scoping document which lists all relevant issues pertaining to the reclamation project.

10.3. For Section A (Scoping), this checklist permits ready elimination of non-pertinent items by checking the column "NO" under "ISSUE OF CONCERN". All items checked "YES", or "MAYBE should be addressed in the EIA.

10.4. For Section B (Detailed Format for EIA), each item should be checked for relevance or pertinence to the project. For example, in "5.2 Biological System", if there are no rare or endangered species in the vicinity of the project area, this is clearly NOT an issue – Check "NO".

10.5. The "REMARKS" column is for methodology, standards, regulations, references, action, etc.

10.6. The checklist is also a useful tool in the review of the EIA report by the DOE reviewing officer.

Table 10.1 : Recommended Checklist

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
A. SCOPING				
1. Is the Project a NEW development?				
2. Is the Project an AMENDMENT to an existing development? If so,				
a) Was an EIA previously prepared for the existing development?				
b) Does the addition involve new area development, if so how much and where?				
3. Is the Project located:				
a) on the MAINLAND?				
b) on the ISLAND?				
4. Who are involved in the scoping task				
- Project Proponent?				
- Architect?				
- Engineers and designers?				
- Environmental consultants?				
- Affected public?				

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
5. Which stage of the project is scoping carried out? - Pre-feasibility/site selection? - Feasibility/conceptual layout? - Design and engineering?				
6. Does the Project involve :- - Clearing of an acre or larger? - New borrow? - Sandmining? - Dredging? - Cut-and-fill? - Buildings which require foundations? - New roads or trails? - Upgrading of existing roads and trails? - Construction of maintenance repair in the intertidal or main zones? - New or upgrading of water supply, storage or distribution? - New or upgrading of power supply and distribution? - New or upgrading of waste handling, treatment or storage?				
7. Geographic Scope a) What are the geographic limits of the study area - for development? (project area) - for impact from development? b) Are any of the following landforms intersected by the project? - Marine features? - Intertidal features? - Foreshore features? - Estuarine features? c) What are the environmental issues with each landform?				
8. Time Horizon a) What is the Project Implementation Schedule? *(By phase in chronological order of occurrence)* b) What are the environmental issues: - with each phase of development? - with post-reclamation? c) Is the development concept in harmony with the environmental setting? d) Design and Engineering Phase - Is there a project concept? - Are there criteria for access? (gradient/class of road, road width, surface,control points)				

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
- Are there criteria for structures and facilities (gradient bearing strength of materials, stream crossing structures)? - Is there provision for managed green space and wildland?				
e) Construction Phase - Survey and soil testing - Clearing and disposal - Earthworks - Drainage - Dredging (and disposal) - Reclamation (and borrow site) - Construction of structures - Facilities (basecamp) - Amenities/utilities (water, power, wastes)				
f) Operation and Maintenance Phase - Potable water supply and treatment - Wastewater treatment and disposal - Solid waste disposal - Surface drainage - Transportation and traffic				
g) Decommissioning and Abandonment - Economic life of project - End land use upon decommissioning and abandonment - Identify services and facilities to be decommissioned, suspended or abandoned, and how this will be accomplished				
h) Siting and Routing i) Criteria for siting and routing to accommodate landscape diversity : - Aesthetics (view) - Engineering (terrain, drainage, coastal geomorphology) - Biodiversity: Epi-fauna and in-fauna habitat - Socioeconomics ii) Is siting and routing complete? If not: - what has occurred to date? - What are options for siting facilities and structures? - What are options for routing access & utilities? - Can routing use common corridors? iii) Will the affected public be informed/ consulted? iv) Alternative layouts: - Layout of landscape preservation - Layout of landscape conservation - Layout of least cost development				

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
B . DETAILED FORMAT FOR EIA				
1. Executive Summary				
a) In English				
b) In Bahasa Malaysia				
2. Introduction				
2.1 Title of Project				
2.2 Project Location				
a) Longtitude and latitude				
b) Location map				
c) Cadastral map with lot numbers				
2.3 Scope of project				
2.4 Project concept approval by approving authority				
2.5 EIA Report				
a) Legal requirements				
b) Date of submission				
c) Stage of project at which EIA is conducted				
2.6 Project Initiator/Proponent				
a) Name of firm, address and telephone/fax number				
b) Name and designation of contact person responsible for project				
c) Other project subject to EIA which				
i) have been carried out				
ii) are being carried out				
iii) will be carried out				
2.7 EIA Consultant				
a) Name of firm, address and telephone/fax number				
b) List of team members involved in the preparation of the EIA report and their field of expertise.				
c) List of EIA reports which				
i) have been carried out				
ii) are being carried out				
iii) will be carried out				
2.8 Statement of Need				
a) Principal reasons for proposed project (include relevant supporting documents)				
b) Aim of project				
c) History of project				
3. Site Selection Process				
3.1 Screening of Preliminary Sites				
a) Screening of preliminary site for environmental sensitivity and importance before purchase				
b) Public involvement				

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
3.2 Criteria of Siting and Routing				
3.3 Alternative layouts				
4. Description of Proposed Project				
4.1 Project Concept				
a) Layout Plan (scale and colour)				
b) Zones of development and compatibility				
4.2 Infrastructure and Support				
a) Roads				
b) Drainage				
c) Water Supply				
d) Electricity				
e) Telecommunications				
f) Sewerage				
g) Solid Waste Management				
4.3 Construction Activities				
a) Site clearing and earthworks				
b) Dredging				
c) Reclamation				
d) Access and transportation				
e) Waste disposal (spoil, construction, materials)				
f) Worker's Camp				
g) General Construction/Structures				
h) Utilities Procurement				
4.4 Project Implementation Schedule				
5. Description of Existing Environment				
5.1 Physical System (map, scale 1:5,000-15,000)				
a) Topography				
b) Coastal Geomorphology				
c) Geology and Soils				
d) Hydrology/Drainage				
e) Hydrography (tides, currents, waves)				
f) Meteorology (rainfall, winds, seasonal variation)				
g) Baseline quality of stream water				
h) Baseline quality of marine water				
i) Baseline quality of sediment				
j) Ambient air quality				
k) Ambient noise levels				
5.2 Biological System (species : rate, endemic, endangered, economic)				
5.3 Socio-Economic System				
5.4 Archaeology				
5.5 Land use (map)				

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
5.6 Existing Infrastructure a) Points of access and transportation (roads) b) Availability of potable water supply c) Availability of power d) Availability of telecommunications				
6. Potential Significant Impacts, Mitigation Measures and Identification of Residual Impacts				
6.1 Design and Engineering a) Siting and Routing b) Compatibility with structure plan c) Site survey d) Soil Investigation e) Baseline sampling				
6.2 Physical Impact				
6.3 Biological Impact (Biodiversity)				
6.4 Socio-Economic Impact				
6.5 Archaeology				
6.6 Impact of spinoff activities on environment				
7. Programme for Monitoring and Audit				
7.1 Construction a) Monitoring b) Audit				
7.2 Operation and Maintenance a) Monitoring b) Audit				
7.3 Decommissioning and Abandonment a) Audit				
NOTE : The Programme should include: *i. Location of monitoring points* *ii. Frequency of monitoring* *iii. Parameters to be measured* *iv. Schedule of budget / finance allocation required* *v. Personnel / staff allocation to ensure compliance* *vi. Procedures for reporting and enforcement*				
8. Summary Tables a) Summary Table of Activities, Potential Impacts, Mitigating Measures and Residual Impacts b) Are there significant residual impacts? c) Estimated cost of carrying out mitigation and control measures, and its maintenance.				

ITEM	ISSUE OF CONCERN			REMARKS
	Yes	No	Maybe	
9. Data Sources				
10. List of References				
11. Other Information a) Estimated cost of proposed project b) Cost of EIA Study c) Number of man-months required for EIA study				

APPENDIX 1

SOME RELEVANT LEGISLATIONS WITH REGARDS TO RECLAMATION IN THE COASTAL ZONE

An outline of the environment-related laws and legislations with regard to reclamation in the coastal zone are presented here to provide an insight into the laws that may have direct or indirect relevance to reclamation. These laws, legislations and their related standards represent requirements that have to be generally met or fulfilled before any reclamation project is allowed to go ahead.

(1) Federal Constitution - Ninth Schedule

(i) Federal List

List I (6)	The machinery of government (subject to State List) includes : - purchase, acquisition and holding of property for federal purposes.
List I (9)	Shipping, navigation and fisheries
List I (10)	Communications and transport
List I (11)	Federal works and power
List I (25A)	Tourism

(ii) State List

List II (2)	List II of State List states with respect to land (except those in Federal Territories of Kuala Lumpur and Labuan
List II (3)	Agriculture and Forestry (except those with Federal Territories of Kuala Lumpur and Labuan)
List II (6)	State works and waters
List II (12)	Turtles and riverine fishing
List II (12A)	"... archaeological sites and remains"

Supplement to State List for States of Sabah and Sarawak

List II (A) 15 : Ports and harbours

(iii) Concurrent List

List III (3)	Protection of wild animals and wild birds; Natural Parks
List III (5)	Town and country planning except in the Federal Capital
List III (7)	Public health, sanitation
List III (8)	Drainage and irrigation
List III (9)	Rehabilitation of mining land and land which has suffered soil erosion.

Supplement to Concurrent List for Sabah and Sarawak

List III A (12)	Shipping; marine and estuarine fishing and fisheries
List III A (13)	The production, distribution and supply of water power and of electricity generated by water power
List III (14)	Agricultural and Forestry Research

Other relevant Articles:-

75	Inconsistencies between Federal and State Laws, Federal law will prevail to the extent of the inconsistencies.
81	Obligation of States towards Federation as to ensure compliance with any federal law applying to that state
83	Acquisition of land for federal proposes
85	Grant to Federation of land reserved for federal purposes
86	Disposition of land vested in the Federation
89	Malay reservations
90	Special provision relating to customary land in Negeri Sembilan and Malacca and Malay holdings in Terengganu
92	National development plan i.e. Act 92 (3)
94	Federal powers in respect of State subjects
95D	Exclusion for States of Sabah and Sarawak of Parliament's power to pass uniform laws about land or local government
95E	Exclusion of States of Sabah and Sarawak from national plans for land utilisation, local government, development, etc

ENVIRONMENTAL QUALITY ACT 1974

An Act Relating to the prevention, abatement, control of pollution and enhancement of the environment and for purposes connected therewith.

Application : Malaysia

Part III	Licences
S.11	With regard to licensing made to the Director General (Refer to S.3 (1) (d): issue of licences.)
S.12 - 17	Conditions attached to licences.
Part IV	Prohibition and Control of Pollution
S.18	Prescribed premises to be licensed
S.20	Requirement and approval of plans to carry out "any work..."
S.21	Power to specify conditions of emissions, discharge etc.
S.22	Restrictions on pollution of the atmosphere
S.24	Restrictions on pollution of the soil
S.25	Restriction on pollution of inland waters
S.27	Prohibition of discharge of oil into Malaysian waters.
S.29	Prohibition of discharge of wastes into Malaysian waters.
S.30	Power to prohibit use of any material or equipment.
S.31	Power to require owner or occupier to install, operate, repair, etc.
S.31A	Prohibition order
S.32	Owner or occupier to maintain and operate equipment

S.33	Power to prohibit or control licensed persons from discharging etc. of wastes in certain circumstances.
S.33 A	Environmental audit
S.34 A	Report or impact on environment resulting from prescribed activities
Part IVA	Control of Scheduled Wastes
S.34 B	Prohibition against placing, deposit of scheduled wastes
Part VI	Miscellaneous
S.37	Owner or Occupier to furnish information
S.38	Power to stop, board, search etc
S.41	Penalty for offences not otherwise provided for
S.44	Who may prosecute
S.46 A	Power to seize vehicles or ship
S.46 B	Power of forfeiture and disposal
46 C	Seizure and forfeiture of vehicle or ship
S.48	Power to detain and sell vehicle or ship
S.48 (A)	Power to test and prohibit use of vehicle

Environmental Quality (Prescribed Activities) EIA Order 1987 (Subject To Natural Resources And Environment (Prescribed Activities) Order 1994 (NRED) (Sarawak))

S.4 (4):	Land reclamation in the coastal area

Local Government Act 1976

Application: West Malaysia

Part II	Administration Of Local Authorities
S.3	Declaration and determination of status of local authority areas
S.4	Change of name and status and alteration of boundaries
S.5 and S.6	Merger of 2 or more local authorities and its rights, liabilities and obligations
S.8	Administration of local authority areas
Part VII	Public Places
S.63	Controls of public place etc
S.64	Power to make new public places etc and enlarge them
Part VIII	Pollution Of Streams
S.69	Committing nuisance in steams, channel, public drain or other watercourse
S.70	Pollution of streams with trade refuse etc.
S.71	Local authority may recover for work done
Part IX	Food, Markets, Sanitation And Nuisances
S.72 and 73	Powers of local authorities and its by-laws
S.80 and 81	Nuisances
Part XIV	Miscellaneous
S.107-110	Notices, licences and power to enter premises

Land Acquisition Act 1960

An Act relating to the acquisition of land, the assessment of compensation to be made on account of such acquisition and other matters incidental thereto.

Part II	Acquisition
S.3	Acquisition of land for specific purposes
S.8	Declaration that land is required for a public purpose
Part IV	Taking Possession of Land
S.18	General power to take possession
S. 29	Payment of compensation or deposit in court
Part VII	Temporary Occupation or Use of Land

National Land Code 1965

Application: States of Malaya

Part 3, CHAPTER 1; Property in Land and Powers of Disposal

S.40	Property in State Land
S.41	Powers of disposal of State Authority
S.42	Powers of disposal
S.43	Persons and bodies to whom land may be disposed of
S.44	Extent of disposal; general
S.45	Extent of disposal; minerals, rock materials and forest produce
S.49	Effect of advances or retreat of sea, river etc
S.51	Classification of land

Part 3, CHAPTER 3; Rights of Access To and Use of Alienated Land

S.70-75	Power to permit extraction and removal of rock materials
S.433 B	Non citizens and foreign companies may acquire etc. land only with approval of State Authority.

Town and Country Planning Act 1976

An Act for the proper control and regulation of town and country planning in local authority areas in the States of Malaya and for purposes connected therewith or ancillary thereto.

Application: States of Malaya.

S.3	General planning policy shall be the responsibility of the State Authority
S.5 and 6	Local planning authorities and its functions
Part III	Matters Connected To Development Plans

Part IV	Planning Control In The Use of Land and Buildings
Part V	Development Charge and Liability Thereto
Part VII	Purchase Notice and Acquisition of Land
Part VIII	Declaration and Effect of Development Areas
S.45	Power of entry

Planning Control (General) Rules 1986

S.2	Application for planning permission in respect of a development in FORM A. [Refer to Third Schedule.]

LAND CONSERVATION ACT 1960

An Act to the law relating to the conservation of hill land and the protection of soil from erosion and the inroad of silt.

Part III	CONTROL OF SILT AND EROSION
S.11	Notice to owner or occupier of land to show cause.
Note:	'Watercourse' has not been defined, however, interpretation in the EQA Environmental Quality (Prescribed Premises) Crude Palm Oil Reg. 1977 may be used.

STREET, DRAINAGE AND BUILDING ACT 1974

An Act to amend and consolidate the laws relating to street, drainage and building in local authority areas in West Malaysia and for purposes connected therewith.

Application : West Malaysia.

Part II	Streets
S.4	Maintenance and repairs of public streets by local authority
S.5	Power to make and improve street with consent of State Authority
S.7	Acquisition of any immovable property not being State Land for purposes under S.5 and 6
S.9	Private persons making new streets
S.46	Obstruction by any person
S.47	Depositing dirt on street etc
Part III	Drains
S.49	Local authority to make public sewers
S.50	Constructing and maintaining drains and water courses
S.51	Local authority may recover cost of improving and making sewers, drains etc
S.55	Penalty for making unauthorised drains into public sewers
S.55 (2)	Water closets and trade effluents not to communicate with river, sea etc. without approval
Part V	Buildings
S.70 A	Earthworks

MUNICIPAL AND TOWN BOARDS (AMENDMENT) ACT 1975

An Act to amend the Municipal Act 1975, the Town Boards Enactment of the Federated Malay States, Johore and Terengganu and the Municipal Enactment of Kelantan.

	"Earthworks"
S.2	"earthworks"
S.5	Penalty for failure of earthworks

CONTINENTAL SHELF ACT 1966

An Act relating to continental shelf of Malaysia, exploration and exploitation of its natural resources for matters connected therewith.

Application: Malaysia

S.2	Continental Shelf is an area: (a) beyond limits of territorial water of the states the surface of which has at a depth no greater than 2 hundred metres below the surface of the sea or (b) where the depth of superadjacent water admits of the exploitation of the natural resources of the said areas
S.3	Rights with respect to continental shelf vested in Malaysia exercisable by Federal Government
S.4 (2)	'Minerals" other than petroleum
S.4 (3) – 4 (7)	Licence needed to explore, prospect or bore for or carry on any operations for the getting of minerals in seabed or subsoil
S.5	Application of this Act in specific circumstances.

EXCLUSIVE ECONOMIC ZONE (EEZ) 1984

An Act pertaining to the EEZ and certain aspects of the continental shelf of Malaysia and to provide for the regulation of activities in the zone and on the continental shelf and for matters connected therewith.

Application: Exclusive Economic Zone (EEZ) and Continental Shelf of Malaysia

S.3	Meaning of EEZ
S.4	Sovereign rights in and jurisdiction over the EEZ by Malaysia
S.5	Prohibition of activities subject to provision in this Act or any applicable written law in EEZ or continental shelf in regard to carrying out any search, drilling or excavations operations
S.10	Offence in respect of the discharge or escape of certain substances into the EEZ
S.12	Report of occurrence of the discharge escape
S.14	Direction to resume etc as a result of the discharge or escape
S.15	Power to detain and sell
S.25	Powers of authorized officer

For S. 10-15: Refer to S.3 for 'pollutant' and 'vessel'

Part VIII	Enforcement
Part IX	Offences, Penalties, Legal Proceedings And Compensations

NATIONAL FORESTRY ACT 1984

An Act to provide for the administration, management and conservation of forests and forestry development within the States of Malaysia and for connected purposes.

Application: Malaysia

S.9	Acquisition of land to be instituted a permanent reserved land
S.11 and S.13	State Authority may excise land from permanent reserved forest subject to S.10 and is required for economic use
S.14	All forest produce property of the State Authority
S.15	Prohibition on taking of forest produce from permanent reserved forest or State Land unless licensed etc.
S.16	Power to issue licences, use permits etc. by way of tenders, agreements etc.
S.19	Power to license the taking of forest produce from permanent reserved forest or State Land
S.20	Requirements to be satisfied by applicants
S.24	Forest management plan, forest harvesting plan etc. to be carried into effect
S.28	Power to permit the taking of forest produce by way of minor licence
S.32	Occupation of or carrying out activities upon permanent reserved forest prohibited
S.33	Power to permit the occupation of or the carrying out of activities in permanent reserved forests
S.34	Issuance of use by Director
S.41	Power to permit removal of forest produce
S.42	Issuance of removal licences by Director
S.40	Removal licence is required for the removal of forest produce from certain land
S.45	Power to declare permanent reserved forest, open forest or closed forest
S.46	State Authority to consider the protection of the forest and needs of the public etc.
S.47	No entry into closed forests with certain exceptions
S.65	Licencee to mark forest produce
S.76	Unclaimed timber deemed to be property of State Authority
S.81	Acts prohibited in permanent reserved forests
S.98	Director may close watercourse or forest road.

FISHERIES ACT 1985

An Act relating to fisheries, including the conservation management and development of maritime and estuarine fishing and fisheries, in Malaysian fisheries waters, to turtles and riverine fishing in Malaysia and to matters connected therewith or incidental thereto.

Application: Malaysian fisheries waters and riverine waters within the jurisdiction of each of the States in Malaysia and of the Federation in respect of the Federal Territories of Kuala Lumpur and Labuan.

Part VII	Turtles and Inland Fisheries
S.38	Power of State Authority and Minister to make rules concerning turtles and inland fisheries especially item (k), (y) and (m).
Part IX	Marine Parks and Marine Reserves
S.41	Establishment of Marine Park or Marine Reserve
S.43	Offence to do certain acts without written permission of Director General
S.44	Absolute prohibition of certain 'weapons'
S.45	Powers of the Minister to make regulations

ANTIQUITIES ACT 1976

An Act to provide for the control and preservation of, and research into ancient and historical monuments, archaeological sites and remains, antiquities and historical objects and to regulate dealings in and export of antiquities and historical objects and for maters connected therewith.

Application : West Malaysia

Part II	Discovery of and Property in Antiquities
S.3	Property in antiquities lies with the Government
S.4	Nature of discovery
S.7	Sale or disposal of antiquities and historical objects
Part IV	Ancient Monuments and Historical Sites
S.15	Declaration and schedule of ancient monuments and historical sites
S.16	Acts prohibited in regard to ancient monuments and historical sites
Part V	Archaeological Reserves
S.19	Declaration of archaeological reserves
S.20	Encroachments

PROTECTED AREAS AND PROTECTED PLACES ACT 1959

An Act to provide for protected areas and places.

Application : Malaysia

S.4	Declaration of protected areas
S.5	Declaration of protected places

PROTECTION OF WILD LIFE ACT 1972

An Act to consolidate the laws relating to and to further provide the protection of wild life and for proposes connected therewith.

Application : West Malaysia only

Part IV	Wildlife Reserves and Sanctuaries
S.47	Declaration of wildlife reserves and sanctuaries
S.49	Prohibition of certain acts in wildlife sanctuary
Part VI	Offences and Penalties
Chapter 1	
S.67	Damaging etc nest or egg of totally protected wild life
S.72	Additional penalty
Chapter 2	Methods of Shooting, killing, taking etc.
Chapter 4	Miscellaneous
S.91	Disturbing salt lick or the vicinity thereof
S.92	Cruelty to wildlife

PORT AUTHORITIES ACT 1963
(Revised 1992)

An Act to provide for the establishment of port authorities, for the functions of such authorities and for matters connected therewith.

Part 1	Port Authorities
S.3 (1)	Functions of the authority especially item (p), (q)
S.4	Acquisition of land by the authority in accordance with Land Acquisition Act 1960.

APPENDIX 2

OTHER DEFINITIONS OF THE COASTAL ZONE

- EEZ Act 1980 gave Malaysia the rights over living and non-living resources of the seabed, underlying rocks and overlying waters within 200 nautical miles (312 km) of the shore.

- For some Government Agencies, the coastal zone is referred to dry land within 5 km of the coast. (GarisPanduan Kawalan Hakisan Berikutan dari Pembangunan di Kawasan Pantai, JPS 1/97)

- Teh and Voon (1992) define the entire coastal or alluvial plain as a coastal zone, as it also unites the effect of possible sea level rise. The ASEAN/USAID (1991) has taken into account the coastal plain in the river basin as all these interrelations within the coastal zone areas.

- Coastal zone is commonly referred to as the interface or transition space between two environmental domains, the land and the sea. It has been defined as that part of the land affected by its proximity to the sea and that part of the ocean affected by its proximity to the land (United States Commission on Marine Science, Engineering and Resources, 1969).

- The coastal environment is part of the continent under direct maritime influence, including estuaries and coastal water and lands located at the lower end of drainage basin, where stream and river systems meet the sea and are mixed by twice-daily tides, encompassing saline and freshwater, as well as coastline and the adjacent lands.

- The shore protection manual (1984) defines coastal areas as the land and sea area bordering the shoreline (Coastal Engineering Research Center).

APPENDIX 3

ENGINEERING ASPECTS

A. *PRE-CONSTRUCTION PHASE*

The primary activities to be carried out on site during the pre-construction phase are land and hydrographic surveying and soil investigation at the project site and borrow areas. These are relatively low-key activities that do not induce adverse repercussions, especially in an isolated area that is not inhabited. The time frame involved is short.

For soil investigation works for both of the project site and borrow areas, specialised rigs and pontoons will be transported to the site. It is most likely that this equipment will be transported to the nearest accessible landing point and then towed to the site by using tugboat. Therefore the scale of disturbance for the access site will be minimum.

B. *CONSTRUCTION PHASE*

This shall constitute the initial procedural development of the project where the principal activities will be land reclamation works, which involves the filling of approved fill material. The main activities on the land reclamation works, which shall be carried out in phases, are:

- Access roads;
- Site Clearing and setting up base camps;
- Construction of containment structures and coastal protection works;
- Land Reclamation Works;
- Soil improvement works;
- Dredging of channel water ways; and
- Construction of tidal gates and drainage outlets.

a) Access Road

During construction, heavy machineries in the form of excavators, bulldozers, etc. will have to be transported to the site. However, this shall be done a one-time affair since the equipment can be stationed within the site until all the works are completed. There could, however, be a significant amount of traffic generated in the form of dump trucks and other transport lorries carrying construction materials. Alternatively, materials such as rocks for the containment structures can be transported using barges.

For an island reclamation type, structures such as jetty or causeway can be used for the transportation of construction materials and machinery. Such structure must be of an open type i.e. will not obstruct or block the flow of water in the channel.

b) Site Clearing and Setting Up Base Camps

Site clearing and setting up of the base camp involves clearing of all existing vegetation. In the clearing process all remnant trees will be manually felled. The removal of scrub vegetation, trees stumps, mangrove roots and topsoil shall be performed predominantly by mechanical means such as excavators and bulldozers. No open burning of the vegetative residue material shall be allowed. All waste construction materials shall be disposed to approved localities external to the site or buried on-site in designated fill areas.

For setting up the base camps, the activities involved will be transportation and construction of site offices, laboratory equipment, installation of water supply, electricity, etc. The sanitation for the site offices will be well constructed to prevent any leakage to water body.

c) Construction of containment structures

Constructions of containment structures are required before the commencement of land reclamation works in order to minimise the losses of fill material. In this project, the most likely material for the constructions will be rock. The detailed assessment of the rock's physical properties and the geological considerations at the quarry will have to be made to determine its suitability. This investigation is essential as the state of rock weathering can give rise to considerable variations in properties.

Barges or lorries will make the transportation of rocks from the quarry to the project site. The latter, however, will be more costly and time consuming. Furthermore, it may cause a further damage to the existing roads.

Before the placement of the rocks for the construction of bunds, geotextiles have to be laid. The required width and length of the geotextile mattresses will be obtained by sewing a few rolls of geotextile together.

The rock materials that have been transported from the quarry will be unloaded from the barges using wheel loaders and excavators. Placing of stones will be made in accordance to the designated design layers consisting of core material, sublayers and armour layers. The block armour layers will be placed as soon as possible following the placement of filter sublayers to avoid damages to these layers, which may be difficult to repair.

d) Land Reclamation Works

Fill Material

The type of fill material may vary from the fine to coarse sands. This will depend of the source of borrow areas within the economic haulage distance. Detailed investigations are required to establish its quality, quantity, physical properties, etc. Acceptability of the fill materials will be considered in terms of quantity and quality.

Method of Filling

Method of filling can be either land-based technique or hydraulic fill. Land based method will take a long time to complete the project due to the huge amount of fills material required. The best approach is to use the hydraulic fill method by

using either cutter suction dredgers or trailing suction hopper dredgers depending on the distance of source material.

Hydraulic fills of a predominantly sand nature must be placed in such a way that the small proportions of fine material are not allowed to collect in mud pockets in the reclamation area. Formation of ponds in the reclamation area should be avoided and, where possible, the infilling should be carried out from the middle of the enclosed area towards the boundary of the containment, to facilitate the drainage of the area.

When fills are derived from silty and clayey sand it may be impossible to remove the fines in the overflow water. In this circumstances it is better to accept the presence of the fines and to try to ensure that they are distributed as evenly as possible over the site in order to minimise the degree of differential settlement.

Classification of Dredgers

The dredging of fill materials for reclamation purposes is accomplished by one of two primary techniques, hydraulic or mechanical. Within each class, a number of functionally different systems are available. The ultimate selection of the dredgers is based primarily on the sediment type, water depth, sea conditions, location and proximity of the area to be reclaimed as well as the availability of equipment. In addition, the contamination levels of the sediment and the need to minimise the near-field resuspension and dispersion should also be considered.

(i) Cutter Suction Dredger

The principles governing the operation of a cutter suction dredger lie primarily in two basic components, the cutterhead and dredging pump. The function of the cutterhead is to stir up soft materials or cut harder materials so as to allow it to be conveyed in a hydraulic transport system.

The dredging pump forms part of the hydraulic transport system which is responsible for transporting the spoil through a pipeline. Since the pressure of the water column affects the pumping operation, the dredging pump is usually submerged when the dredging depth exceeds 9 m.

The sand is then pumped directly through the pipeline into a hopper barge for transport to the reclamation area. No winnowing, sorting, or other mechanical separation is required during the mining operation or transfer to the transport barges. The diameter of the pipeline mostly lies between 300 and 1000 mm.

(ii) Sand Pump or Suction Dredger with Hopper Barge

Suction dredger pumps loose, unconsolidated sand and gravel materials from the seabed through a suction pump and pipe system. Sand is then pumped directly into a hopper barge for transport to the reclamation area.

No mechanical separation, winnowing or other sorting is required. There will, however, be overflow of water from the hopper barge.

(iii) Trailing Suction Hopper Dredger

Trailing suction hopper dredger or trailer dredger is a seagoing type which has the molded hull and lines of an ocean vessel and functions in a manner similar to that of the suction dredger although the pump and pipe system are trailed, or pulled behind the vessel. A dredge pump through the drag-arm, which is connected to the ship, raises the spoil. The lower end of the drag-arm is equipped with a drag-head, which draws the seabed materials. The drag-arm is lowered and raised by hoisting tackle and winch. The mined materials are however, stored on-board the hopper dredger for transport to the reclamation area instead of being transferred into a barge.

The shape of drag-heads varies according to the material to be dredged. For soft materials the weight of the drag-head is sufficient to penetrate into the seabed before the soil is lifted through the suction pipe. For harder materials, drag-head with high-pressure water jet is applied to disintegrate the soil.

The dredging pump lifts the mixture through the drag-head to the surface and subsequently discharges into the hopper. During the pumping operation the dredger sails at a slow speed of about 2 to 3 knots. As pumping continues, the solid particles settle in the hopper while the excess water passes overboard through overflow trough. After the hopper has been filled, the drag-arms are raised and the dredger cruises to the dumping sites at high speed of between 9 and 14 knots and unloads the spoil by opening the bottom door. The door then closes and the dredger returns to the dredging site.

Method of Filling Operation

Taking into consideration the substantial pumping distance, provisions have to be made to execute the works utilising the trailing suction hopper dredger with the capability to pump the material onshore. Once the loading process is completed, she will sail to the reclamation site as near as her draught permits.

Once arrived at the connecting point, the dredger will be coupled to either a floating/submerged/shore pipeline or a floating/submerged/spray pontoon combination and will commence the pumping ashore of her load directly from the hopper by means of her own boosting ashore installation on board of the dredger.

In order to avoid the mud waves, a first layer will be placed by means of a floating/submerged/spray pontoon whilst the remaining reclamation will be executed via a floating/submerged/shore pipeline control.

Once the dredger has pumped her load ashore, she will disconnect, and sail back to the sand borrow areas in order to start a new cycle.

Alternative method is to use two cutter suction dredgers with a combination of split hopper barges. A cutter suction dredger will pump the sand from the borrow areas to the split hopper barges and she will be towed by tug boat and then offload near the reclamation area to be pumped again using the similar cutter suction dredger. In this fill material transports, barge position confirmation by radio apparatus, operation controls, etc., by computers and other up-to-date technologies will be utilised to best advantage to ensure efficient reclamation operations.

The above two alternatives will have to be considered based on the period of reclamation required, cost, water depths at the borrow areas and reclamation site and availability of equipment at the time of the commencement of works.

e) Coastal Protection Works

There are various alternatives to protect the beachfront of the reclamation areas. Basically they are divided in two categories i.e. soft approach protection such as natural beach or hard structures such as revetment, groins, breakwaters, etc. For latter approach the structure need to be designed against wave damage and overtopping.

Natural Sandy Beach

In calm sites, and with the availability of cheap and unlimited amount of sand supply, the sandy beach concept is more acceptable and economical. In this alternative the reclaimed coastline is unprotected resulting in formation of sandy beach whenever sand is used as fill. The policy behind this solution is to use nature as partner/minimize engineering interventions and maximize the use of natural forces like tides, currents, wind, waves and gravity.

This approach is particularly relevant in an area where favourable angles of wave approach to the coastline result in negligible littoral drift and thus envisaging the formation of stable beach. Generally, this option is applicable to areas where the beach is in the state of equilibrium where the present erosion rates are tolerable and the expected future rates would also remain about the same order.

For this alternative, periodic nourishment works would be required once in 2-5 years to compensate loss due to onshore-offshore sediment movement during storm attack. However, if the source of the reclaimed material is intermixed with fine silty/sandy material, a continuous nourishment to the area cannot be ensured therefore resulting in this procedure not being feasible.

Revetment/seawalls

In more dynamic areas subjected to severe weather (waves, current, etc.) the reclaimed lands need to be walled using seawall, revetment, etc. Similarly, reclaimed area gazetted for infrastructure development, such as the present proposed project, its stability is assured by erecting seawall. These structures are usually designed to withstand the full impact load of waves.

There are two types of revetments: the rigid, cast in place concrete type and the flexible or articulated armour unit.

A rigid concrete revetment provides good bank protection, but the site must be dewatered during construction so that the concrete can be placed. The proper quality concrete is required for satisfactory performance and durability in the marine environment. The concrete should have low permeability, provided by the water cement ratio recommended for the exposure conditions; adequate strength; air entrainment, adequate coverage over reinforcing steel; durable aggregates; and proper type of Portland cement for the exposure conditions (U.S. Army, Corps of Engineers, 1984)

A flexible structure such as quarrystone or riprap structure provides better bank protection, which can tolerate minor consolidation or settlement without structural failure. The structure allows for the relief of hydrostatic uplift pressure generated by wave action. Stone used for armour layers should be sound, durable, and hard. It should be free from laminations, weak cleavages, and undesirable weathering. It should be sound enough not to fracture or disintegrate from air action, seawater, or handling and placing.

In general, it is desirable to use stone with high specific gravity to decrease the volume of material required in the structure. The type of stone to be used in the construction should be of irregular shape so as to dissipate as much energy as possible.

The construction of the structure should be such that there are adequate filter layers to prevent fines from the fill seeping into the armour, and also, such that fines already in the armour are not carried through the outer protective layers, causing structure failure.

The filtering can be achieved by correct grading of the bund materials or by any means of the many proprietary brands of porous membranes.

f) Soil Improvement Works

Soil Compaction/Consolidation

The consolidation or compaction of a hydraulic fill is an essential step in the transformation of the soil from a slurry, or water/soil heterogeneous mixture, to a competent load-bearing structure suitable for its intended use. Compaction is the process whereby the soil particles are constrained, by rolling or other means, to pack more closely together, thus increasing the dry density of the soil. Consolidation is the process whereby the soil particles are packed more closely together by the application of continued pressure over a period of time. Both processes help to reduce settlement of the soil under load, if they have occurred before the application of load to the soil. The time period over which the processes occur depend on the state and type of soil. For instance, sand hydraulic fill with a small silt fraction will compact naturally in a few hours as drainage occurs, whilst consolidation of soft clays might take 5 years or longer.

There are number of methods for improving the compaction, and the relative density of sandy fills, e.g. vibroflotation and vibratory rolling. Vibroflotation consists of inserting a vibrating probe into the soil to the desired depth and feeding the annular space around the probe with backfilling material as the probe is withdrawn. The probe must be inserted into the ground on a close grid

for full coverage to be obtained. Compaction by vibratory roller is also effective in sands. The maximum density achieved by compaction will depend on the moisture content of the soil and the soil characteristics. The passage of heavy earth-moving equipment over the hydraulic fill should not be assumed to result in adequate compaction since, not only is this equipment designed to exert low bearing pressures on the ground but resonant vibration frequency necessary for good compaction is unlikely to be present.

Soils with high silt contents, or cohesive soils, on the other hand, are less susceptible to compaction by vibration than clean sands. Consolidation by preloading has been used successfully for many years on sites where stiff clays, or silty, clayey sands, have been deposited. Preloading can be applied by the placing of additional fill on the reclamation area; by bunding the area and creating a temporary reservoir over the fill (which was the method proposed for the Elizabeth marine terminals, New Jersey). Preloading must be carried out very carefully under controlled conditions with measurements of pore water pressure, settlement, ground movements, etc. being monitored.

Preloading increases the bearing capacity and reduces the compressibility of the weak ground by forcing loose cohesionless soils to densify or clayey silty soils to consolidate. It is achieved by placing a surcharge on the ground prior to the construction of the planned structure. Although it can be applied to all type of soils preloading is most advantages for modifying soft cohesive soils. The process can be speeded up by the use of vertical drains and, in the case of relatively impermeable fill, with a horizontal drainage layer at the original ground interface.

Dewatering

Due to the surcharge of fill materials, considerable amount of settlement of the underlying strata is expected for a relatively long period. During this process, differential settlement may occur. As such, vertical drains are normally employed to accelerate the settlement process and thus would improve the stability of the soil.

Sand drains are installed by drilling holes through the underlying clay layers in the reclaimed land at regular intervals. The holes are then backfilled with highly permeable sand.

The application of vertical drains can be in the form of cylindrical sand drains or geosynthetic drains:

(i) Sand drains

These consisted simply of boreholes filled with sand. The holes may be formed by driving, jetting or auguring and would typically have had diameters of 200 to 450 mm and would be spaced at 1.5 to 6.0 m apart. To facilitate construction, minimise sand wastage, and ensure continuity of the drain, the sand may be prepacked in a fabric sock.

A large diameter sand in a fine-grained soil will not only enable rapid consolidation of the surrounding material but may also provide vertical compressive reinforcement, and can transfer surface loads to a bearing stratum at depth.

Preloading with or without vertical drains is only effective in causing substantial settlement if the total applied load significantly exceeds the preconsolidation pressure of the foundation material.

(ii) Geosynthetic drain

In order to enable the machinery for the drain to enter the site without sinking into the soft clay, it is necessary to lay a drainage blanket as a working platform, the thickness of which can be chosen in relation to the bearing capacity of the soil.

The drainage layer should be at least 0.3 to 0.5 m in thickness with material of excellent drainage properties; or else it is necessary to improve horizontal drainage by connecting the vertical drains with a horizontal drainage system in order to avoid the built up of back pressure in the drain that will delay the

consolidation process. The next step of construction entails drain installation in accordance with the design requirements.

Generally the drains are installed in an equilateral triangle pattern or in rows with drain spacing equal the spacing to the spacing of the drain rows. Finally, the drained area is loaded in accordance with the loading schedule.

In order to reduce the time of preloading, a temporary excess load higher than the design load is often applied. The temporary surcharge can be removed.

g) Landscaping

Before the proposed development takes place i.e. construction of buildings and infrastructures, the newly formed land need to be protected against surface erosion due to runoff. Landscaping will be needed to accelerate the growth of vegetation required to give better grip of the fill material. The shielding of the soils would also reduce the amount of suspended particulate in the air.

APPENDIX 4

STANDARD WATER SEDIMENTS

Netherlands Standard for Target Value, limits value, reference value, intervention value and signal value for water sediments

(The numerical values in mg/kg apply to standard sediments consisting of 25% lutum and 10% of organic material).

Parameter	Unit	Target value	Limit value	Reference value	Interventi on value	Signal value
Arsenic	mg/kg ds	29	55	55	55	150
Cadmium	"	0.8	2	7.5	12	30
Chromium	"	100	380	380	380	1000
Copper	"	35	35	90	190	400
Mercury	"	0.3	0.5	1.6	10	15
Lead	"	85	530	530	530	1000
Nickel	"	35	35	45	210	200
Zinc	"	140	480	720	720	2500
PAH Total 10PAK*	"	1	1	10	40	-
PCB-28	µg/kg ds	1.0	4	30	-	-
PCB-52	"	1.0	4	30	-	-
PCB-101	"	4.0	4	30	-	-
PCB-118	"	4.0	4	30	-	-
PCB-138	"	4.0	4	30	-	-
PCB-153	"	4.0	4	30	-	-
PCB-180	"	4.0	4	30	-	-
Total 6 PCB	"	20/0	-	-	-	-
Total 7 PCB	"	-	-	200	1000	-
Chlordane	"	10	20	-	-	-
α-HCH	"	2.5	-	20	-	-
β-HCH	"	1.0	-	20	-	-
γ-HCH (Lindane)	"	0.05	1	20	-	-
HCH-compounds	"	-	-	-	2000	-
Heptachlor	"	2.5	-	-	-	-
Heptachlor epoxide	"	2.5	-	-	-	-
Heptachlor + epoxide	"	-	20	20	-	-
Aldrin	"	2.5	-	-	-	-
Dieldrin	"	0.5	20	-	-	-
Total Aldrin + Dieldrin	"	-	40	40	-	-
Endrin	"	1	40	40	-	-
Drins	"	-	-	-	4000	-

Parameter	Unit	Target value	Limit value	Reference value	Interventi on value	Signal value
DDT (incl. DDD and DDE)	"	2.5	10	20	4000	-
α-endosulfan	"	2.5	-	-	-	-
α-endosulfan + sulphate	"	-	10	20	-	-
Hexachloro-butadiene	"	2.5	20	20	-	-
Total pesticides	"	2.5	-	100	-	-
Pentachoro-benzene	"	2.5	300	300	-	-
Hexachloro-benzene	"	2.5	4	20	-	-
Pentachloro-phenol	"	2	20	5000	5000	-
Mineral oil	mg/kg ds	50	100	3000	5000	-
EOX	"	-	0	7	-	-

*Naphthalene, benzo(a)anthracene, benzo(ghi)perylene, benzo(a)pyrene, fenanthrene, indeno(123-ad)pyrene, anthracene, benzo(k)fluoroanthene, chrysene, fluoranthene

Source: CEDA

Notes:

Target value: Indicates the level below which risks to the environment are considered to be negligible, at the present state of knowledge.

Limit value: Concentration at which the water sediment considered is relatively clean. The limit value is the objective for the year 2000.

Reference value: Is the reference level indicating whether dredging spoil is still fit for discharge in surface water, under certain conditions, or should be treated otherwise. It indicates the maximum allowable level above which the risks for the environment are unacceptable.

Intervention value: An indicative value, indicating that remediation may be urgent, owing to increased risks to public health and the environment.

Signal value: Only for heavy metals. Concentration level of heavy metals, above which the need for cleaning up should be investigated.

APPENDIX 5

METHODOLOGY

A. *Hydraulic Modelling*

Potential impact of a reclamation project is governed by a number of factors such as its location, wave and tidal regimes, size and the geometrical planform of the reclamation area as well as the fill material sourcing area and dredging operations. In this respect, hydraulic study/modelling is a useful tool for optimising the layout of large-scale reclamation works and in identifying potential adverse impacts due to both reclamation and dredging activities.

The approach to the study would therefore require the utilisation of numerical models to give sufficient detailed description of the hydrodynamic in the area. In view of the modelling requirements, necessary field investigations and data collection programme need to be carried out.

Data Input / Data Collection Programme

The type of data input depends on the module being considered and the processes to be assessed. For the hydrodynamic module, the input data generally consist of tide levels, waves and bathymetry. For the mud or sand transport module, the input will be the sediment characteristics and the result of the hydrodynamic module. For the shoreline evolution module, the input will be the sediment characteristics, waves and bathymetry.

However, since the hydrodynamic module is the basic module which has to be carried out first, it is important that the input data for this module be verified :-

a) Tidal data are obtained either from tide tables published by the Royal Malaysian Navy (or other reputable sources) or by carrying out actual measurements at predetermined locations.

If the tide data is obtained by measurements, then these measurements should be carried out for at least two weeks to include the spring and neap tides. The following data should be clearly shown :

i) Location /Co-ordinates of Tidal Stations;
ii) Type of tide gauge used; and
iii) Time series observation of tide levels.

b) The wave data can be obtained from either the Surface Shipboard Meteorological Observation (SSMO) database, hindcasting techniques or other sources. If the data is in the form of raw data then the consultant should carry out :-

i) a statistical analysis of all the incident waves in the area to determine the deepwater wave characteristics; and
ii) wave transformations to determine the near-shore wave characteristics.

Whereas if a hindcasting technique is used, then the consultant should:

i) obtain wind rose diagram;
ii) determine the critical fetch lengths;
iii) employ suitable hindcasting techniques to determine the deepwater significant wave; and
iii) carry out wave transformations to determine the nearshore wave characteristics.

c) The bathymetry for the modelling works is normally obtained from the Admiralty Charts for the deep-sea areas while a hydrographic survey is carried out for the nearshore areas (fine grid model).

d) Other data required include water levels, currents, collection of samples of suspended sediments and bed samples.

Example of instruments required for various sampling parameters are shown in Table App.5-1.

Mathematical Modelling

The main thrust of the approach to a hydraulic study in assessing the proposed layout of the reclamation project is by numerical modelling of the current flows and wave propagation. The hydraulic computer model to be used must be carefully selected. It should be of a type which has been well proven and tested. If a relatively new or not generally recognised software is proposed, then sufficient information pertaining to the organisation which developed the software as well as records of actual applications should be furnished for evaluation. At present, there are several numerical models available for the study developed by reputable hydraulic institutes, laboratories and universities.

The hydraulic modelling modules which are most relevant in assessing the impacts of a particular development are :

a) Nearshore Wave Module – carries out wave transformations in the nearshore area such as refraction, shoaling and wave breaking;
b) Hydrodynamic Module – predicts the water level variation, flow response (eg. nearshore current velocity pattern) to a variety of forcing functions (e.g. tides and waves);
c) Advection/Dispersion Module – predicts the spreading of suspended material;
d) Mud/Sand Transport Module – predicts the erosion or sedimentation pattern ; and
e) Shoreline Evolution Module – predicts the shoreline changes.

Generally for hydrodynamic modelling, the selected model should be able to predict the current flow pattern due to tidal and wave forces. However if it can be verified that the location of the study is a very sheltered area where the wave climate is very mild all year round and do not contribute significantly to the current and sediment movement, then models which consider only the effects of tides can be used.

The current velocity, rate of bed sediment movement and rate of coastline erosion or siltation vary throughout the year depending on the wave climate, tides and other factors. During periods of high wave activity the current velocity at wave breaking

is very high and causes most of the sediment transport in the littoral zone, because the bottom velocities and turbulence at breaking suspend more bottom sediment. This suspended sediment can then be transported by currents in the surf zone whose velocities are normally too low to move the sediment at rest on the bottom. Therefore, in order to arrive at a realistic assessment of the sediment transport, the model should consider wave breaking in addition to the other driving forces.

The advection/dispersion module is normally used to determine the dispersion of suspended sediments due to development works such as sand mining or land reclamation. The consultant should clearly state the assumptions used in this module, such as the initial suspended sediment intensity at the source of pollution and whether the pollutant is being discharged continuously or otherwise. The consultant will also have to carry out water sampling at strategic locations to determine the baseline conditions.

The mud/sand transport module would require the input of sediment characteristics. The consultant will have to carry out sediment investigation to determine the representative sediment characteristics to be used as input to this module.

In general the consultant should work on the worst case/dominant case scenarios depending on the purpose of the study. In order to arrive at more realistic values (when assessing yearly erosion or siltation rates) the consultant should consider a combination of the dominant cases (mild, moderate and extreme events) according to their percentage of occurrence.

Table App.5-1 : Parameters and Instrumentation

Items	Parameters	Instrumentation
1.	Tides Water Level	Automatic Tide Gauge
2.	Currents	Currents meter
3.	Suspended and Bed Samples	Water Bottles Bottom Grab Sampler

Methodology of Modelling Works

Modelling works for the study of reclamation project require many steps and processes as follows:

a) General Model Concepts and Procedure;
b) Defining the Hydrodynamic Model;
c) Data Collection and Field Investigation;
d) Setting Up Model;
e) Calibrating and Verifying the Hydrodynamic (HD) Model;
f) Running the Simulation for the Proposed reclamation layout and for the dredged sand borrow area;
g) Setting-up the Dispersion Model for the study of movement of suspended sediment due to dumping and dredging;
h) Simulation of the wave model for the proposed reclamation layout and for the dredging of the sand borrow area; and
i) Analysis of Simulation Results.

General Model Concept

The foremost important element in modelling work is to define the model area that needs to be set-up so that simulations runs can be undertaken in conformity to the numerical model requirements and also taking into consideration the availability of the computer hardware, project requirement and the time-schedule. This includes the specifying the grid spacing and time steps required for the simulation works. The numerical model has to be set-up within the area of interest to represent the real hydrodynamic conditions to simulate tidal currents and changes in water levels. All the data input data required for the modelling work have to be collected so that the model can be calibrated and verified.

Once the hydrodynamic model is calibrated, subsequent runs with the reclamation layout are modelled. A case with the dredging of the proposed sand borrow area is also analysed. Further simulations are then carried out to study the dispersion of suspended sediment due to dumping and dredging during the construction of

reclamation works. Subsequently, the wave models are simulated for the case with the reclamation layout and also with the sand borrow area.

Defining the Hydrodynamic Model Area

The first task of the modelling work is to define the boundary area. In modelling the current patterns and tide levels for the study area, the following consideration were made: -

a) The boundary for the modelling works should be near the established tidal stations or where the tidal data can be observed easily.
b) The boundary should not be situated too close to the river mouths as the discharge can influence the boundary conditions and also to ensure that a uniform flow exists at the boundary. Furthermore, the boundary cannot be situated in the mouth itself, as flooding and drying are not allowed on an open boundary.
c) Two open water level boundaries should be chosen for easier calibration and verification and where the data can be collected easily.
d) The boundaries should not be too close to the study area to avoid non-uniformity to the boundary data and to reduce any error generated from the input data, if any.
e) The main current flow direction at the coarse grid boundary must be perpendicular to it.
f) A reasonable resolution of the model grid is required so that sufficient details of the reclamation layout can be schematised.

Setting Up the Model

Setting up the model refers to "transforming real world events and data in format which can be understood by the numerical model". Thus, all the data collection has to be resolved on the spatial grid selected including the time step required.

Most modelling works are carried out using two levels of models i.e., coarse grid model and fine grid model. The coarse grid model uses a large grid spacing (in the order of 1 km depending on the size of the model). The grid spacing in the fine grid