Environmental Impact Assessment (EIA)

Guidelines for River Sand and Stone Mining

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Foreword

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

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

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

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

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

Yabi Yangkat

Director

Environment Protection Department

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1 Introduction

1.1 Definitions

The aim of this EIA guideline is to provide a framework for the preparation of an Environmental Impact Assessment (EIA) report for river sand and stone mining activities in the State of Sabah, Malaysia. This EIA guideline should serve as an operating manual for the Project Proponents as well as a guide for environmental consultants.

River sand and stone mining is defined as mining, excavating, extraction or dredging of sand, gravel, rocks, boulders and other riverine deposits from the riverbed, bank or floodplain of a river, or from a river reserve. This includes its ancillary activities such as processing, storage, infrastructure development and transportation out to potential buyers. Throughout this EIA guideline, these activities shall be uniformly known as aggregate extraction activities.

Within Sabah, aggregate extraction activities for commercial or construction purposes are categorised as a "prescribed activity" under the Second Schedule of the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005. This requirement therefore subjects the Project Proponent to appoint an environmental consultant registered with the Environment Protection Department (EPD), to conduct an EIA report for submission to, and approval by EPD Sabah prior to project commencement.

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

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

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

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

This EIA guideline excludes offshore mining, excavating, extraction or dredging activities which are located more than 1.5 km off the coastline or have 10 metres of water depth, measured from the Lowest Astronomical Tide,

whichever is further from the shoreline. The coverage of this guideline is up to the river mouth/ estuaries of a particular river.

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

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

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

1.2 Assessment Procedures – A Quick Reference

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

Table 1-1: Assessment Procedures

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

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

2 Sabah Context

2.1 Geographical Overview

Within Sabah, there are few rivers where aggregate extraction activities are carried out (refer to Figure 2-1). These include:

District	River
Beaufort	Sg. Padas
Papar	Sg. Papar, Sg. Kimanis
Beluran	Sg. Klagan
Tuaran	Sg. Tuaran, Sg. Damit
Lahad Datu	Sg. Segama, Sg. Lamag Kecil
Tambunan	Sg. Pegalan
Kota Marudu	Sg. Bandau, Sg. Talantang
Telupid	Sg. Labuk
Kota Belud	Sg. Kadamaian
Sipitang	Sg. Lakutan
Tawau	Sg. Apas, Sg. Membalua, Sg. Brantian
Pitas	Sg. Bengkoka
Ranau	Sg. Lohan, Sg. Liwagu

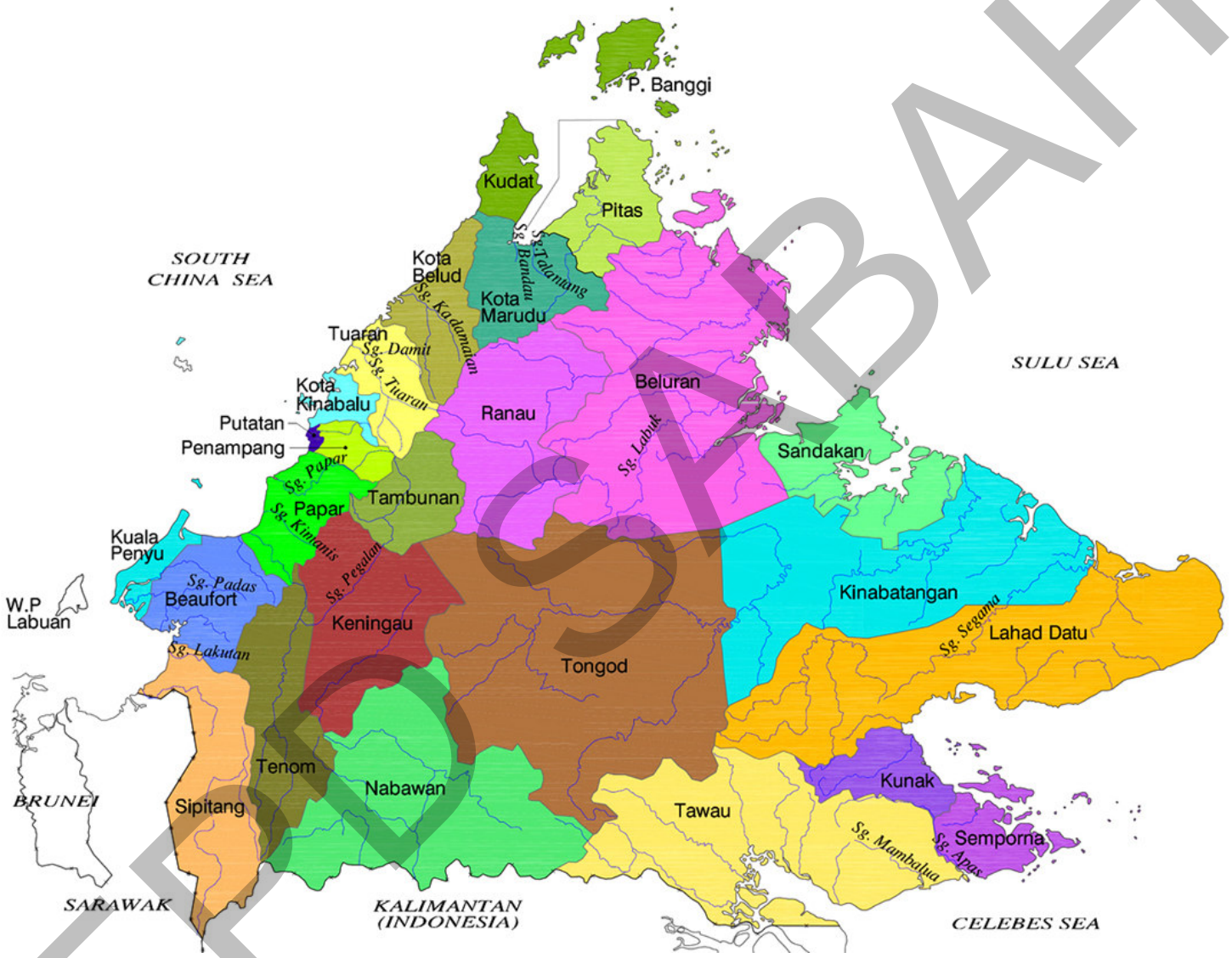


Figure 2-1: Map showing major rivers in Sabah where river sand and stone are extracted

2.2 Current Trends

In Sabah, aggregate extraction is carried out for two (2) main purposes:

- Construction – for road construction, filling materials, concrete aggregate and landscaping works. River sand is commercially important as raw material for the building construction industry in Sabah.
- River engineering – for flood control, navigability and maintaining water intake points.

River sand is widely used in the building construction industry as finishing material due to its small and fine grain size. This will produce a smoother texture on the concrete surface. Marine sand is less desirable due to high extraction costs and the fact that it leads to corrosion of reinforcing steel due to salt content.

River stone is used in certain areas of Sabah; e.g. Ranau, Telupid and Keningau where land based rock aggregates are either not commercially available in the surrounding area or do not meet the quality standards of the construction industry. The transport cost to transport rock aggregates from land based quarries to these areas in Sabah may not be economically attractive, thus further encouraging the use of river stone, when it is suitable.

2.3 Legal Requirements

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

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

Item 9: Quarries

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

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

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

Item 5: Quarries

> *Quarrying of aggregates, limestone, silica, quartzite, sandstone, sand, marble or stones within 200 metres from any streams or rivers*

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

An EIA is an important technique for ensuring that the likely impacts of aggregate extraction on the environment are fully understood and taken into account, before such development is allowed to commence. The main objectives of an EIA for aggregate extraction are:

- To assess and recommend the most appropriate aggregate extraction options based on existing site conditions, so as to minimise impacts on the environment;
- To identify, predict and wherever possible quantify the significance of any adverse impacts on the environments and communities that are likely to be affected by the aggregate extraction;
- To formulate and incorporate appropriate and cost effective mitigation and abatement measures into overall planning for aggregate extraction; and
- To determine a suitable and effective programme for ensuring environmental compliance and monitoring of residual impacts.

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

Legal Requirements	Relevance
Environmental Quality Act, 1974	– Restriction and prohibition of pollution (air emissions, noise pollution, inland waters, soil, waste, hazardous and scheduled substances) – Prohibition of open burning – Management of scheduled waste
Environmental Quality (Sewage) Regulations 2009	– Provision and proper operation of sewage treatment system – Sewage discharge quality
Environmental Quality (Scheduled Wastes) Regulations 2005	– Management and disposal of scheduled waste including storage and labelling
Wildlife Conservation Enactment 1987	– Protection and management of plants and animals
Town and Country Planning Ordinance (Sabah Cap. 141)	– Preparation and approval of schemes for designated landuse of an area (zoning)
Land Ordinance (Sabah Cap. 68)	– Land matters – License for aggregate extraction
Water Resource Enactment, 1998	– Written approval for removal of materials from a river or river reserve – Water conservation areas – Flood plain management areas – River reserves
Cultural Heritage (Conservation) Enactment 1997	– Preservation and conservation of cultural heritage sites
Fisheries Act 1985	– Development and management of inland fisheries including removal of sand or gravel from the natural environment or habitat of fish
Inland Fisheries and Aquaculture Enactment 2003	– Protection of fisheries habitat

Legal Requirements	Relevance
Sabah Biodiversity Enactment, 2000	– License to access biological resources

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

- Guidelines for Processing Applications and Determining Conditions of River Sand Mining (Department of Irrigation and Drainage, 1993);
- Environmental Impact Assessment (EIA) Guidance Document for Sand Mining/ Dredging Activities (Department of Environment, Malaysia); and
- Guidelines on Erosion Control for Development Projects in the Coastal Zones 1/97 (Department of Irrigation and Drainage, Malaysia).

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

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

2.4 Application and Approving Procedures

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

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

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

Approval is also required from the following local authorities prior to commencement of aggregate extraction activities (but not limited to):

- **Lands and Surveys Department**

  A license to remove stone, earth and sand from state and alienated land is required from the Assistant Collector of Land Revenue, as required under Section 23 of the Land Ordinance 1968 and Land Rule 3(2).

  The general application and processing procedures for licenses issued by the Lands and Surveys Department for state and alienated land are illustrated in Appendix 6: License Application Procedure for Sand Extraction Activities.

- **Department of Irrigation and Drainage**

  Written approval for the removal of material (including sand, soil, gravel, stones, vegetation whether alive or dead, roots and other matter) from a river or shore reserve, is required from the Director of the Department of Irrigation and Drainage, under Section 41 of the Water Resources Enactment 1998.

- **Minerals and Geoscience Department Malaysia**

  Acceptance of the geological assessment report on the available sand/ stone reserve at a particular aggregate extraction site is required from the Minerals and Geoscience Department Malaysia.

For the purpose of the EIA study, copies of the license application/ approval and geological assessment report must be made available to the environmental consultant.

2.5 Key Stakeholders

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

Department	Responsibility
Lands and Surveys Department	- Land titles/ ownership, Temporary Occupational License (TOL)

Department	Responsibility
District Offices	- Local settlement issues, i.e. flooding, public complaints and others
Sabah Wildlife Department	- Habitat and wildlife issues
Department of Irrigation and Drainage	- Drainage system, water catchment areas, water supply, riparian reserves
Department of Fisheries	- Estuarine fisheries
Ports and Harbours Department	- Water traffic navigation in all ports, harbours and rivers, boats/ vessel licences (including barge registration)
Water Department	- Water intake points, water catchment areas
Town and Regional Planning Department	- Zoning
Municipal Council	– Municipality issues, i.e. waste management
Minerals and Geoscience Department	- Geological features, sand/ stone deposit estimates and suitability
Department of Environment	– General environmental concerns (air, effluent, water, scheduled waste and other)

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

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

3 Typical Project Activities

3.1 Project Plan

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

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

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

3.2 Project Stages

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

Table 3-1: Typical Activities for Aggregate Extraction Projects

Phase	Activities
Pre-Development	• Land acquisition and access - Acquire land - Relocation of existing occupants (if any) • Investigation - Detailed river cross-section (latitude and longitudinal) survey - Preparation of geological report (general geology, sand/ stone reserve estimation, physical properties of materials) - Environmental Impact Assessment (EIA) study
Site Preparation	• Site preparation works - Construction of temporary access roads - Vegetation and site clearing

Phase	Activities
	- Mobilisation of equipment and machinery - Installation of sedimentation pond and drainage system - Establishment of site office, workers' quarters and workshop.
Extraction and Processing	• Aggregate extraction activities using mechanical methods or hydraulic dredger • Aggregate processing activities - Screening - Washing - Crushing - Segregation - Stockpiling • Transportation of aggregates to buyers • Regular environmental monitoring works (riverbank erosion; water, air and noise quality; aquatic and riparian ecology)
Post Extraction/ Abandonment	• Updated river cross-section survey • Site rehabilitation works - Workers' quarters and site office removal - Waste disposal - Equipment and machinery removal - Liquid waste disposal - Site rehabilitation works, i.e. planting of cover crops, soil stabilisation

3.3 Project Components

Generally, river aggregate extraction activities involve two (2) main components, i.e. extraction from or along the river bed and processing at the processing site (refer to Figure 3-1). The definition of these two components is as follows:

Extraction Site: Area where the actual sand and stone materials are excavated. The location of the extraction point is relatively mobile, moving upstream and downstream along the allowable extraction area depending on the material deposits available.

Processing Site: Area where the excavated sand and stone materials are processed. The location is usually along the riverbank near the extraction site and outside of the river reserve. At the processing site, the following activities may be undertaken: screening, washing, crushing, stockpiling and loading onto trucks or barges for transport to potential buyers and end users.

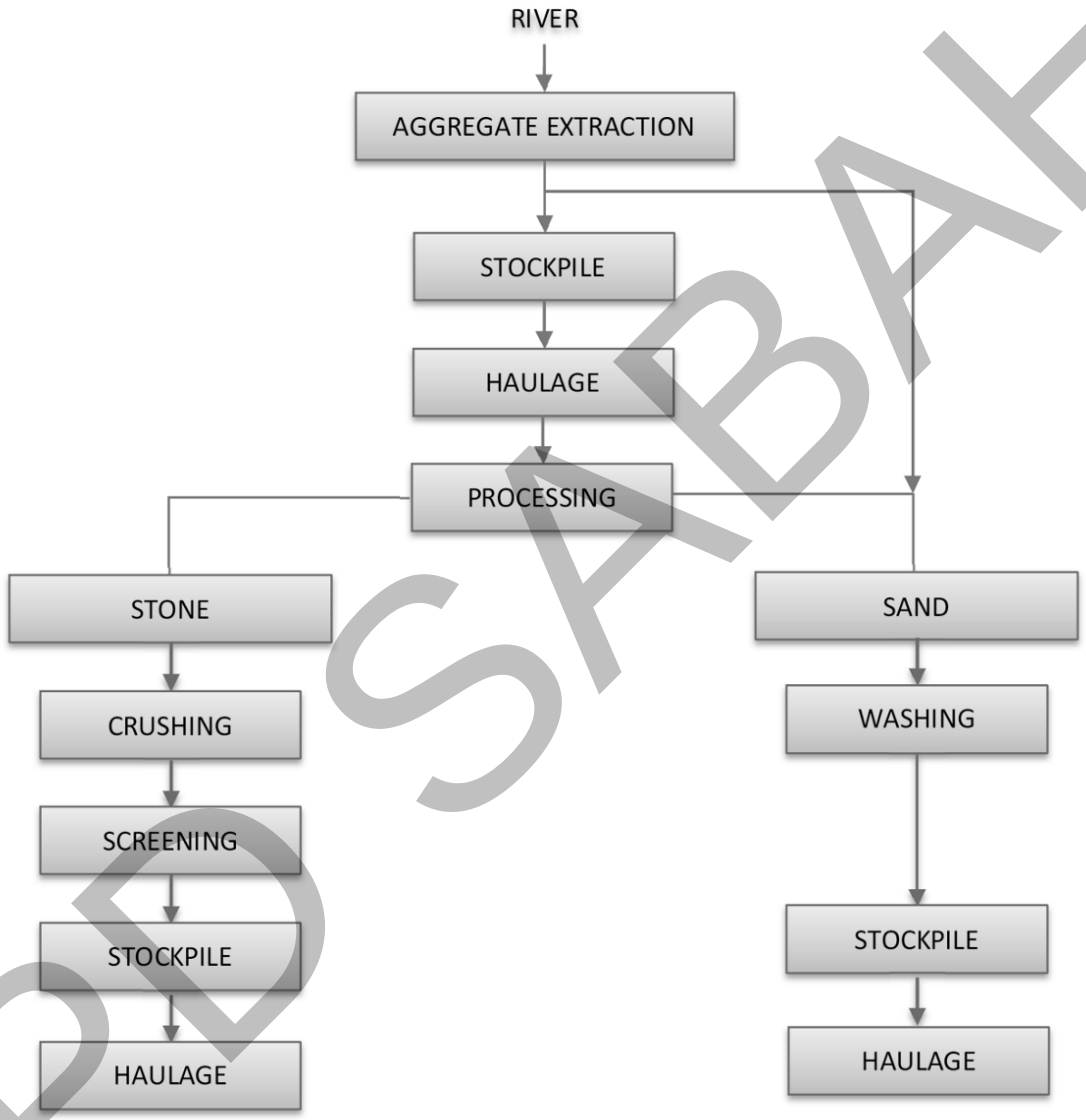


Figure 3-1: Flow diagram of typical aggregate extraction activities

The existing aggregate extraction methods practiced in Sabah include:

- Mechanical: This method involves the use of construction machinery such as excavators, backhoes and bulldozers (refer to Plate 3-1). This method is the most commonly used method throughout Sabah in shallow rivers and for larger size deposits. Another method used involves sitting an excavator on a barge (refer to Plate 3-2). With this method, the aggregate

is also processed on the barge, with the finished product being transported downstream. This method is normally utilized for project sites that do not have dedicated access roads or are only accessible via river.

- Hydraulic Dredging: This method involves the use of specially built equipment to dredge sand, either by excavation, dragging or suction. Generally a suction pump is sited on a pontoon (refer to Plate 3-3). This method is normally used for larger scale operations, on large rivers and at the confluence of rivers.

Plate 3-1: Sand and stone extraction using excavator

Plate 3-2: Sand extraction and processing conducted on a barge

Plate 3-3: Sand extraction by suction pump method

4 Scoping

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

Table 4-1: Assessment Procedures - Scoping

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

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

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

- Identification and preliminary assessment of potential impacts with respect to certain approaches to aggregate extraction activities and with respect to specific project locations; and
- Selection of appropriate assessment methodologies, based on project sensitivities.

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

4.1 Project Information

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

4.1.1 Description

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

4.1.2 Project Location

A preliminary assessment of the baseline conditions shall be made to identify key sensitive receptors. Consideration should be given to the existing river conditions, vegetation cover, aquatic and riparian ecology, water quality and sensitive habitats and land uses.

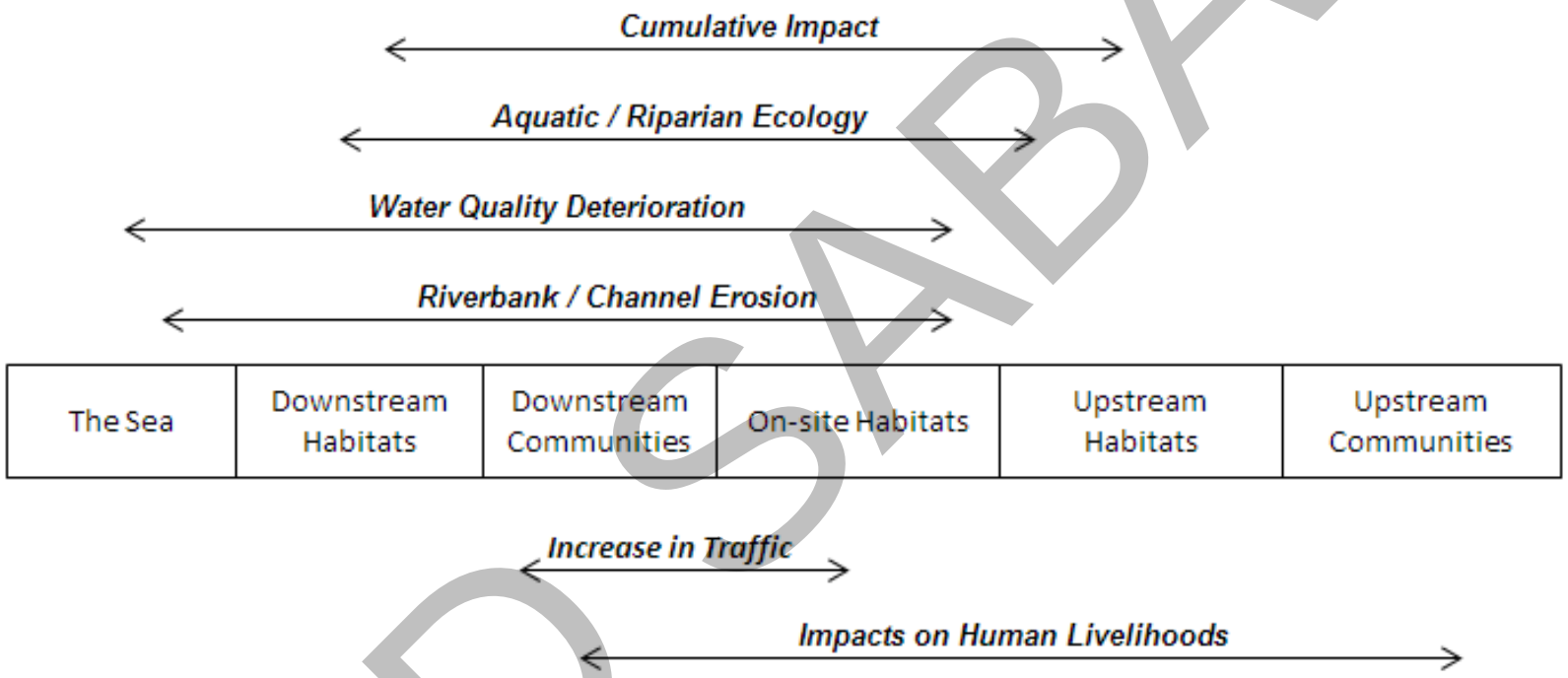
A site visit and preliminary consultations with relevant regulatory authorities must be undertaken during the scoping exercise.

4.1.3 Identification and Prioritisation of Impacts

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

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

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



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

Figure 4-1: Main issues and extent of impacts for aggregate extraction projects

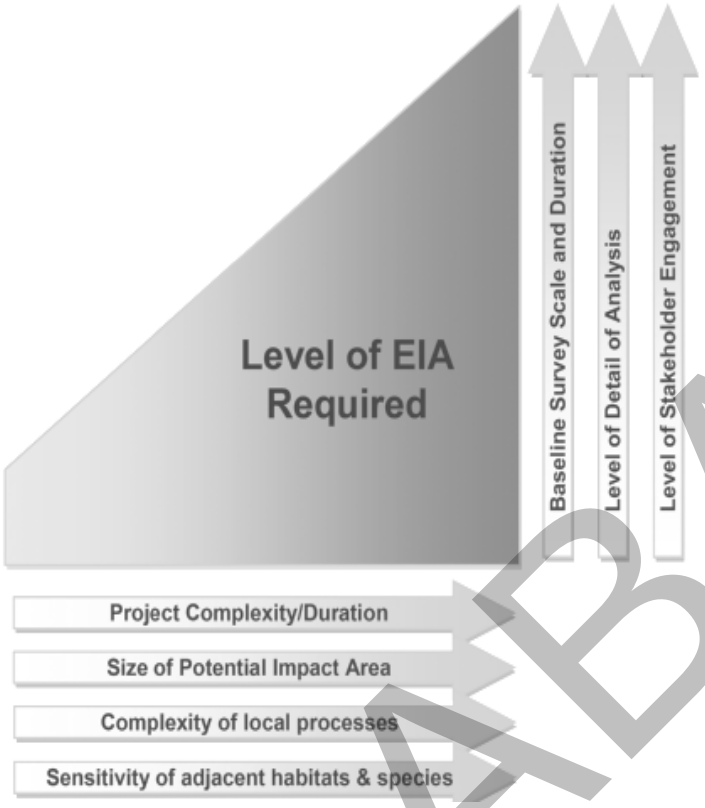
4.2 Types of Impacts

Whereas aggregate extraction can provide significant planning and development opportunities as well as benefits to the public if properly planned and executed, there are also numerous potential adverse impacts that have to be taken into account. The potential impacts are site and project specific, depending, among other factors, on riverbank conditions but mostly on the aggregate extraction methods chosen as well as the nearby environmental receptors.

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

4.3 Terms of Reference

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



Source: PIANC 2010

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

4.3.1 Data Collection Requirements

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

Primary field surveys are almost always required for most aspects of the environment, such as: existing river condition, riparian vegetation and habitats, wildlife, water quality, socioeconomic and other factors. Field surveys are needed either because published information in Sabah often does not exist at a suitable scale, or is not generally applicable to the project being assessed.

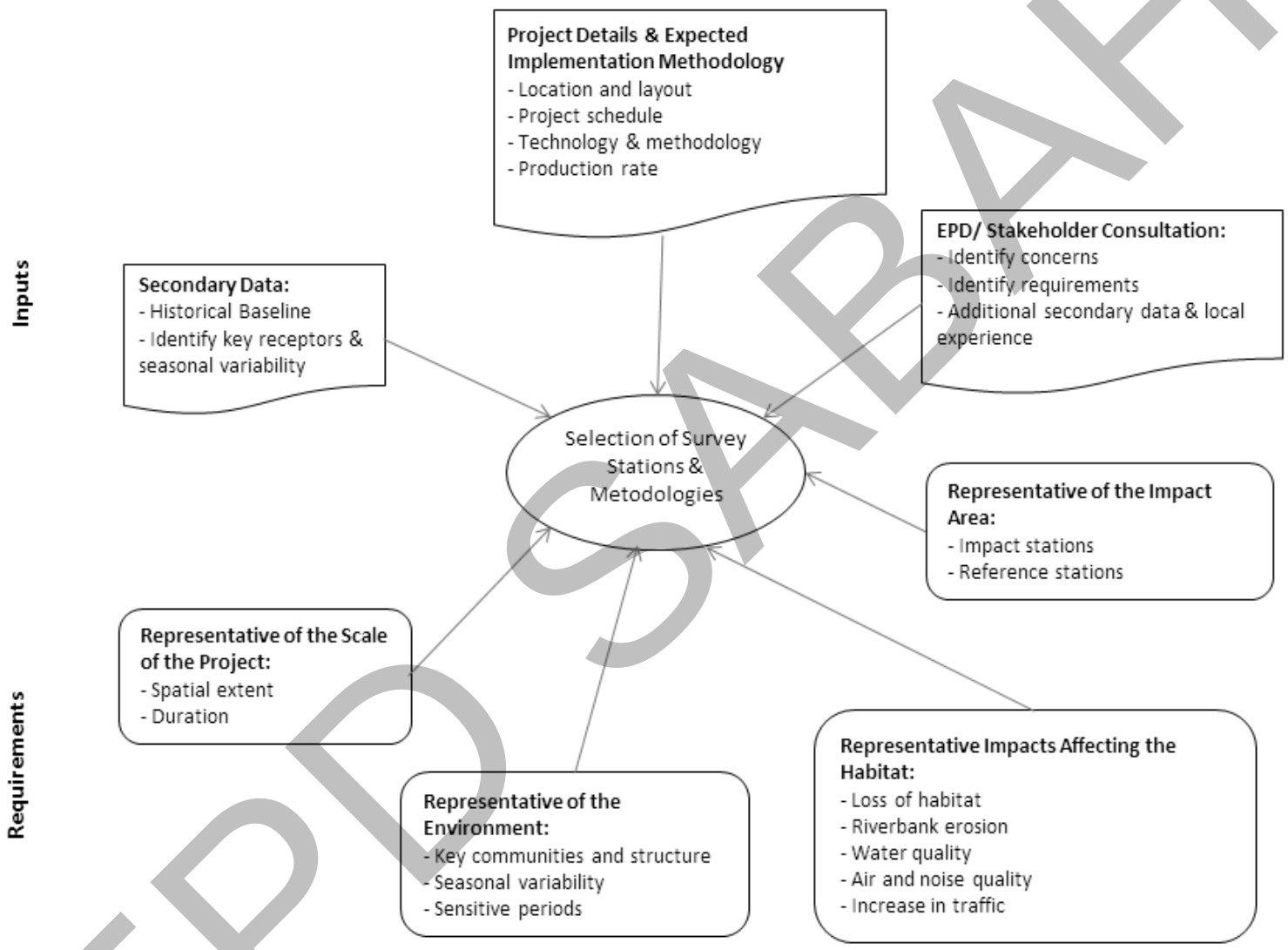
Where primary field surveys are required, careful consideration must be given to the design of the field survey and sampling programme (refer to Figure 4-3). The data collection must focus on the key issues needed to be examined for the EIA (identified during the scoping process), and should be collected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

of rainy and dry seasons, and on the coast, the monsoon and inter-monsoon periods.

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

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

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



Source: Adapted from PIANC, 2010

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

5 Impact Prediction and Evaluation

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

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

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA study	Environmental Consultant: • *Assess the project details* - *Plan assessment* • *Assess the existing environments* - *Physical environment* - *Biological environment* - *Human environment* • *Assess the environmental impacts* - *Riverbank/ channel erosion/ soil erosion due to site clearing and extraction activities* - *Water quality deterioration* - *Loss of in-stream and riparian ecology due to removal of vegetation* - *Downstream sedimentation due to high turbidity from extraction area* - *Impacts on existing river and land based traffic and transportation* - *Air and noise pollution* - *Potential ground vibration due to aggregate processing activities* - *Social economic impact due to creation of job and business opportunities, access and provision of services* - *Waste management* - *Cumulative impact from multiple aggregate extraction operators* - *Potential abandonment* • *Devise and propose mitigation measures* • *Devise and propose monitoring programmes*

This section outlines procedures for identifying the environmental impacts associated with aggregate extraction activities, as well as proposed methodologies for assessing the scale and extent of the environmental impact. The magnitude of the impacts depends on the combination of existing conditions and the selected technologies and methodologies, while the zone of impact depends on existing environmental conditions such as river channel characteristics, vegetation, key conservation value habitats or species, land use, or nearby settlements. Adverse environmental impacts affect habitats and livelihoods outside the project area, and hence, the Project Proponent is responsible to minimise such impacts by adopting mitigation measures. As a general principle, mitigation measures should preferentially focus on addressing the impacts in order to eliminate/ minimise the residual impacts.

The assessment must consider site characteristics, the proposed extraction concept and the cumulative impact of this development with other existing or proposed sand/ stone extraction (if known) within or near the proposed project site. Integrated assessment of the river system's sensitivity to changes will assist in managing the resources in a way that is compatible with environmental protection. The environmental consultant's approach to assessing these interrelated factors should be clearly described based on the TOR as approved by EPD.

5.1 Description of Plans and Site

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

i. Description of planned activities and existing environment conditions;

ii. Assessment of environmental impacts;

iii. Devising mitigation measures; and

iv. Formulation of monitoring programme.

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

The assessment of the existing environment and thus also the activities and associated mitigation will, to a large extent, be based on an analysis of topographic maps combined with knowledge of the field conditions. These maps are based on aerial photo interpretation of dense canopy cover and can only be indicative of terrain contours and smaller features such as creeks and streams. The actual delineation of areas and mitigation measures must be based on the verifiable conditions in the field i.e. be based on a field surveys.

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

The Seven Steps	Summary of Main Required Activities

Step 4:
Undertaking the EIA study
	Environmental Consultant:
	• *Assess the project details*
	  • *Plan assessment*
	• *Assess the existing environments*
	  • *Physical environment*
	  - *Water quality*
	  - *Air and noise*
	  - *River morphology*
	  - *Soils and geology*
	  • *Biological environment*
	  - *Flora and fauna (aquatic and terrestrial)*
	  • *Human environment*
	  - *Public administration*
	  - *Demography*
	  - *Livelihoods and economic activities*
	• *Assess the environmental impacts*
	• *Devise and propose mitigation measures*
	• *Devise and propose monitoring programmes*

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

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

5.1.1 Site Selection/ Consideration

A good aggregate extraction location will satisfy the following criteria:

i. Suitable land area is available nearby for processing activities and waste management; and

ii. Areas where operation and maintenance of the aggregate extraction activities will not damage sensitive habitats or threatened protected

species. These include land and water resources used by the local populations.

Generally, aggregate extraction activities should be at a distance of more than 500 metres from the following:

- High risk channel erosion areas (i.e. at concave bank);
- Important fish (or other aquatic fauna) breeding grounds, including aquaculture operations;
- Gazetted environmentally sensitive areas;
- Water supply intake points for potable or irrigation water; aquaculture operations; and
- Burial reserves.

Aggregate extraction activities should not be undertaken during periods of migration of aquatic fauna. Shallow and fast flowing river sections with steep channel slopes should also be avoided. Any aggregate extraction activities which may interfere with human activities should be reconsidered. These include:

- Where the river is used for navigation, recreation or fishing activities; and
- Existence of settlements along the riverbanks (within 500 metre radius or at identified high risk areas).

In addition, the Department of Irrigation and Drainage (DID) has also established aggregate extraction guidelines, which should be considered by all aggregate extraction applicants. These include:

- River aggregate can only be extracted from the middle third section of a river;
- River aggregate is not allowed to be extracted within 500 metre radius from any hydraulic structure such as pump house and water intakes, as well as within 200 metre radius from any bridges;
- River aggregate extraction is not allowed at areas where erosion is expected to occur such as on a concave bank of a river; and
- Sand extraction is not permitted along coastlines.

5.1.2 Site Operation/ Size/ Extraction Method

Characteristics for aggregate extraction activities can be determined through several factors, as defined in Table 5-3.

Table 5-3: Characteristics of Aggregate Extraction Operation

Size	**Capacity**
Small	< 1,000 MT/month
Medium	1,000 – 5,000 MT/month
Large	> 5,000 MT/month
Complexity	**Extraction Method**
Simple	Mechanical method
Complex	Hydraulic dredging method
Sensitivity	**Type of Activity**
Sensitive	*Tagal* areas, river mouth, gazette conservation area, presence of significant aquatic species or ecological communities, high risk channel erosion, localities within 500 metres of hydraulic structure
Normal	Anything not listed as 'sensitive'

The technology applied for aggregate extraction is determined by several factors including the depth at which the source of sand/ stone is located, type and quality of material, time frame available for extraction, weather and river conditions, river traffic and others.

5.1.3 Project Screening

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

Screening allows for focus on real environmental issues at an early stage of the assessment process and allows for environmentally sensitive planning and the early resolution of some issues. This will minimise the possibility of residual impacts. Project screening is conducted by assessing the project details in relation to the existing environment as described in Section 5.1.4 and Section 5.1.5.

5.1.4 Assess the Project Details

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

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

i. Project Location and Concept

- Exact location of the proposed aggregate extraction areas with clear boundary coordinates (detailed survey map);
- Size of proposed aggregate extraction areas;
- Mapping of sensitive receptor along the river banks within 1 km upstream and 3 km downstream of the extraction site.
- Mapping of existing land use and sensitive areas (including forest reserves, *Tagal* areas, water intake points, important fishing ground to the locals, historical or archaeological sites, jetties and bridges) and constraints within 1.0 km radius from the site. This should also include areas where riverbank erosion is observed and its severity;
- Mapping of river habitat within 1.0 km upstream and 3.0 km downstream of the proposed extraction site. This should include river bank vegetation description (grassland, overhanging trees) and river features such as confluence of tributary rivers and streams, pools, riffles, islands and sand bars; and
- Other nearby aggregate extraction areas within 500 metre radius.

ii. Project Concept/ Development

- Riverbed sediment/ geological study – the results of investigation will provide the basis for addressing the availability and suitability of the dredged materials in the proposed aggregate extraction areas, in terms of:
  - Particle/ grain size;
  - Organic content; and

- Mineral content.

- Site layout plan indicating locations of allowable extractable aggregate materials, sedimentation pond, silt traps, drainage systems, stockpile area, workshop, workers' quarters and crusher plant;

- River cross-sectional and longitudinal surveys covering a minimum of 1.0 km upstream and downstream of the proposed extraction site (as per Department of Irrigation and Drainage guidelines);

- Types of sand dredger and equipment used for aggregate extraction activity, including transportation of sand/ stone;

- Estimated volume of sand/ stone to be dredged/ extracted per month/ year; and

- Proposed project implementation and work schedule.

5.1.4.1 List of Supporting Documents Required

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

Report/ Study	Details Required
Geological Report prepared by a registered geologist	– Site morphology, geological reconnaissance, bed sediment grab samples and characteristics including laboratory test results, sand reserve estimation, method and rate of extraction, river replenishment rate
Erosion and Sediment Control Plan (ESCP) as prepared by a competent party (latest as per submitted to the local authority)	– Layout and design details for erosion control facilities such as sedimentation pond, silt traps and temporary drainage network
River cross-sectional and longitudinal survey plan as prepared by a licensed surveyor	– Existing river profile (bed and bank levels, river reserves) covering a distance of 1.0 km upstream and downstream of the proposed extraction site

5.1.5 Assess the Existing Environment

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

- **Physical Environment**: hydrology (river channel characteristics, i.e. width, depth, flow velocity, river cross section and hydrological regime, i.e. catchment areas, tributaries, river mouth); geomorphology (sediment movement in the system, landslips, erosion features, sediment build up areas), sediment feature (grain size analysis), soil, surface water (source of pollutants), air quality and noise level.

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

- **Human Environment**: population and communities (including numbers, locations, compositions, employment and other), land use (burial ground, fish breeding ground, *Tagal* system, aquaculture operation, and others), infrastructural facilities (including water supply, water intake points, electricity, sewerage, flood control/ damage and others), institutions (such as schools, hospitals and places of worship), transportation (roads, river navigation and other), archaeological, historical and cultural values and aesthetic values.

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

5.1.6 Study Area and Zone of Impact

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

There may be different zones of impact for the physical (such as riverbank erosion, water quality and hydrology), biological (such as wildlife species, habitat and diversity) and human (such as social issues affecting

communities, cultural and aesthetic aspect and land use) environment. The environmental consultant should overlap these impact zones and decide which zone is particularly sensitive and where impacts are likely to be of some significance. Such zones may reach far downstream from the site, particularly if there are water intakes, mangroves or other sensitive areas downstream. The zone of impact can be determined after understanding the concept of the proposed development and conducting ground observations to identify these sensitive areas.

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

5.2 Impact Assessment

The EIA for aggregate extraction will assist in the following:

- Planning of overall activities onsite;
- Identification of environmental impacts and the risk of negative impacts;
- Exclusion or protection of sensitive or vulnerable areas; and
- Protecting environmental components in the immediate site area, in adjacent areas and in the broader environment.

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

- Sensitive or endangered flora and fauna;
- Aquatic plants and animals; and
- Historical buildings/ cultural areas that are considered as sensitive.

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

5.2.1 EIA Matrix

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

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

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

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

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

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

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

The summary of results shall be presented in an EIA Matrix, an example of which is shown in Table 5-4. To guide the reader of the EIA report, this summary table is best placed before the descriptions of environmental impacts.

Table 5-4: EIA Matrix (Example)

Impacts	Magnitude	Permanence	Reversibility	Cumulative
Key Environmental Impacts				
Riverbank/ Channel Erosion/ Soil Erosion	2	3	3	3
Water Quality Deterioration	2	2	2	3
Ecology	2	2	2	3
Traffic and Transportation	2	2	2	3
Other Environmental Impacts				
Air Pollution	2	2	2	2
Noise Pollution	2	2	2	2
Social Economic	2	1	1	1
Waste Management	1	2	1	1
Cumulative Impact	2	2	2	3
Abandonment	1	3	1	1

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

Impacts	Magnitude	Permanence	Reversibility	Cumulative
cumulative effect over time or a synergistic effect with other conditions				

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

Table 5-5: Activity Level EIA Matrix (Example for Riverbank Erosion Impact)

Criteria	Score	Justification
Magnitude of Change/ Effect	2	Impacts extend to 200 m upstream and 500 m downstream of the river.
Permanence of Impact	3	Permanent – with the newly established river alignment.
Reversibility of Condition	3	Irreversible upon commencement of aggregate extraction.
Cumulative Impact	3	Cumulative impact with other aggregate extraction operators and river conditions such as river flow and replenishment rate.

5.2.2 Use of Geographical Information System (GIS)

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

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

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

5.2.3 Optimisation of Project Plan

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

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

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

5.3 Environmental Impacts

The environmental impacts associated with aggregate extraction activities concern:

- Riverbank/ channel erosion/ soil erosion
- Water quality
- Aquatic and riparian ecology
- Downstream sedimentation
- Traffic and transportation

- Air and noise pollution
- Social economic
- Waste generation and management
- Cumulative impact
- Potential abandonment

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

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

5.3.1 Riverbank/ Channel Erosion/ Soil Erosion

Rivers are natural drains channelling water from catchments to the sea. The flow of water in the rivers is often associated with a significant transport of catchment sediments which, through continuous deposition and erosion processes, reshapes the river itself and forms the morphology of the downstream catchment. The cross-sectional shapes as well as the meander and braiding patterns of natural river systems change continuously adapting to the flow and sedimentological conditions and reflecting the history of flow events.

Water enters a river system through rainfall events, inflow from river tributaries and seepage from the banks. Surface runoff from the catchment of the river brings about dissolved and solid materials. The associated influx of sediments to the river constitutes an important part of the overall river sediment budget.

The quantity of sediment varies considerably from time to time due to changes in discharge. As velocity increases, the amount of sediment being transported increases correspondingly. Changes in sediment concentration vary from one storm to another. During periods of low flow, relatively little sediment movement takes place, as a consequence river channels tend to be stable during these phases. Conversely, as the flow increases, more and more sediment is entrained from the river floor and stream banks. Loose material on the bed is picked up largely by the fluid drag exerted by the flowing water. Materials from the stream bank are eroded mainly by the action of bank caving as the waters in a channel may undermine the bank and cause collapse.

Much of the material, which is carried during periods of high discharge, is therefore old material reworked from the bed and banks. Most of it moves intermittently, often with long periods of storage as channel deposits/ bars or on the floodplain, interrupted by short periods of transport.

The annual overall river sediment budget for a given river or river segment is composed of several components, and in general terms the budget can be expressed as:

$$Q_{Catchment} + Q_{Upstream} - Q_{Sea} - Q_{Extraction} = \text{Deficit}$$

Whereby:

$Q_{Catchment}$ = Sand supplied to the river segment from the catchment (in m^3/year)

$Q_{Upstream}$ = Sand entering the river segment from upstream river segment (in m^3/year)

Q_{Sea} = Sand discharged through river mouth to the sea (in m^3/year)

$Q_{Extraction}$ = Total amount of sand extracted through other means e.g. mining, extraction or other types of dredging operations (in m^3/year)

The river sediment budget is thus composed of sediments entering a given river/ river segment (i.e. primarily $Q_{Catchment}$ and $Q_{Upstream}$) and sediment that leaves the river/ river segment (i.e. primarily $Q_{Extraction}$ and Q_{Sea}) (refer to Figure 5-1).

The difference between what enters and leaves a river defines its stability:

If Deficit>0 then the river system will remain stable.

If Deficit<0 then the river system will remain unstable.

Allowable sand extraction volumes can thus be estimated based on estimated values for the sediment fluxes (i.e. transports from the catchment, in river and at sea).

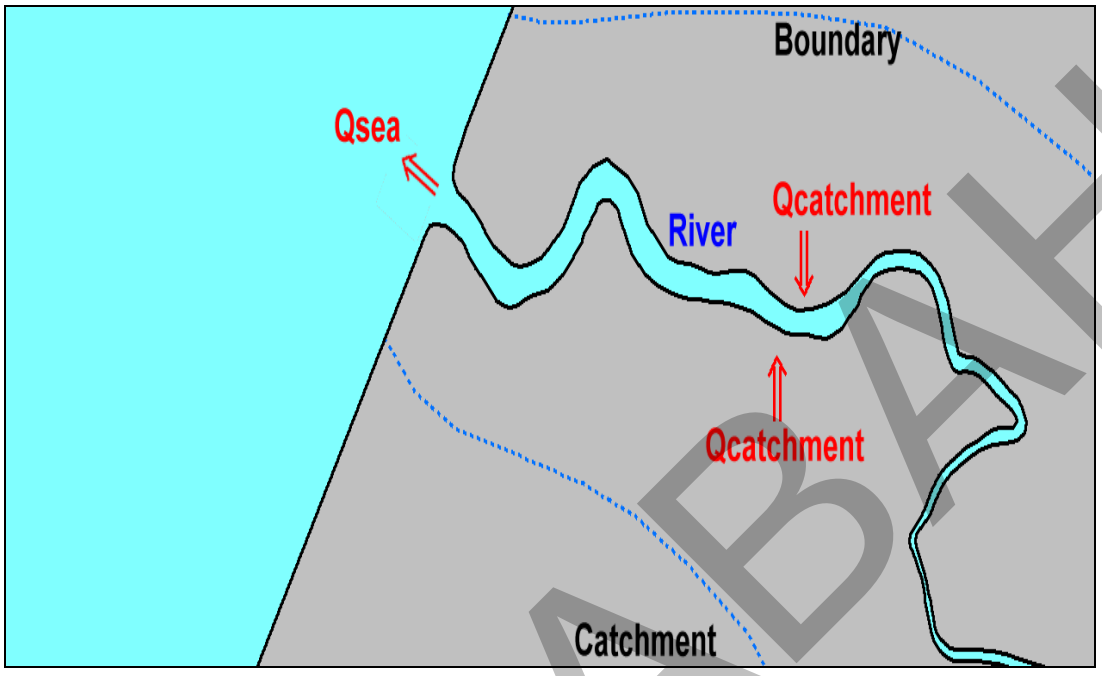


Figure 5-1: Sediment components for a river section

Generally, the flow of water and sediment from the upstream catchment alters the landscape and hydrology of the downstream catchment. Hydraulic factors of a river such as depth, slope and flow velocity and direction induce riverbank erosion and sediment transport. These factors determine the cross sectional shape, frequency and occurrence of in-channel deposits and the meander pattern of the river channel.

Flow within a river channel is typically unsteady and turbulent. Under equilibrium conditions, river channels tend to be morphologically stable, transporting the water and sediment load imposed from the upstream catchment without enlarging or aggrading. However, it is important to understand that even under natural conditions, river channels continually reshape their morphology including their beds and banks. If the amount and type of sediment transported is changed, then further alterations will occur as a direct result.

Aggregate extraction activities in a river lower the river bottom, which causes channel erosion and reduces the supply of sand to the coastal areas. Most channel erosion takes place during high flow events. Constant variations in the river flow make the channel floor and riverbank a dynamic interface whereby some materials are eroded while others are deposited. The net balance of this activity on a short term basis is often referred to as scour or fill. Continuous scour on a long-term basis will result in erosion (degradation) while continued fill results in deposition (aggradation).

For large scale removal of sediment deposits, the river may be left with excess energy and two situations may develop: i) if the river banks are well protected with vegetation or engineering structures, the excess energy may erode and deepen the river bed; and ii) if the channel sides are not protected by vegetation, the banks will erode, leading to river bank collapse and possibly loss of valuable land and property as well as leading to downstream sedimentation issues.

Aggregate extraction below the existing river bed level or creation of hollows in the river bed can also cause erosion in both the immediate upstream and downstream area of the excavation site. The hollows created provide an area for the downstream movement and accumulation of the river bed load which leads to the development of steeper slope at the head of the hole. Steeper slope allows water to flow faster, thus causing continued erosion on the upstream side and along the steeper slope.

However, not all the effects of human interference with river channels and drainage basins are as severe. Often the consequences are subtle. Nevertheless, human activity on the drainage basin almost invariably has an impact on the river system. It is important to manage the whole drainage basin as integral components.

Assessment Methodology:

The options that can be considered for assessment of riverbank/ channel erosion/ soil erosion include (but are not necessarily limited to) the following, or a combination of the following:

Description and Classification of River Bank Erosion Rate: Through ground truthing, description and classification of the existing bank erosion observed at a particular river should be made as follows:

i. Severe – Threat to properties/ structures;

ii. Moderate – Obvious erosion observed but no threat to properties/ structures (refer to Plate 5-1); and

iii. Mild – Slight erosion observed with no properties/ structures affected in the immediate and medium term (refer to Plate 5-2).

The classification should be used in tandem with the site selection criteria in Section 5.1.1 and the development of mitigation measures as described in Section 6. A general indicator of the stability of a river is through amount of vegetation present on the riverbanks.

Plate 5-1: Moderate riverbank erosion

Plate 5-2: Mild riverbank erosion

The type, size and specification of the barge used for aggregate extraction activities must also be made known and be assessed based on the river condition and its suitability to manoeuvre to minimise riverbank erosion.

In addition, proposal for access into the river should be thoughtfully considered in terms of suitability and legal ownership. This should be clearly mapped out.

Description of Sand/ Stone Materials to be Extracted: Generally, the larger the material deposit size, the slower the replacement rates are. In addition, amount, type and characteristics of materials that can be extracted should be clearly stated with the intended area for extraction marked on a map. For hydraulic dredging method which involves the use of suction pump, the number of pumps used for aggregate extraction should also be determine and assessed accordingly to avoid over extraction.

River Longitudinal and Cross-Sectional Profile: The plan which shows the riverbed and riverbank level profile including river reserve should be conducted at the extraction site and within 1,000 metres[1] upstream and downstream at 20 – 30 metres interval (refer to Figure 5-2). This is also in compliance with the Department of Irrigation and Drainage (DID) requirement for river aggregate extraction.

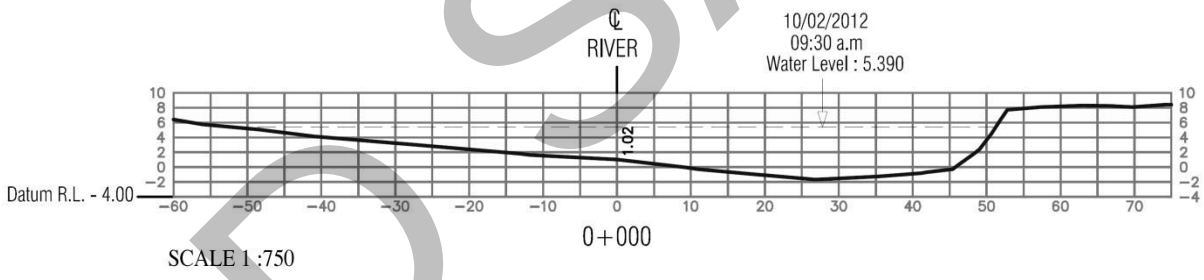


Figure 5-2: Example of river cross-section profile

Identification of River Users and On-going Activities: Field investigation and land use survey to identify other river users, i.e. fisheries and water supply as well as other active aggregate extraction activities along the river system within the zone of impact.

Replenishment Rate: The DID guidelines (September 2009) provide guidance on the estimation of the annual river replenishment rate, but limits operation to a maximum allowable extraction depth of 1.5 metres. The estimation of the annual river replenishment rate is based on the understanding of the overall river sediment budget for a given river or a river segment which requires that

[1] *Based on the River Sand Mining Management Guideline published by the Department of Irrigation and Drainage, Malaysia (September 2009).*

the individual components can be estimated. The overall annual river sediment budget including the proposed amount of annual volumes to be extracted ($Q_{Extraction}$), must not become negative.

Application of the river replenishment concept is important in ensuring long-term river channel stability as well as the health of the aquatic and riparian habitats, by allowing only a sustainable volume of sand based on the natural sediment transport process to be extracted. There are two existing sediment transport equations that have been identified as suitable by the DID for use in prediction of the sediment transport components in the sediment budget in Malaysia, i.e. i) Yang Equation (1973); and ii) Engelund-Hansen Equation (1967).

Locality Map: Ground survey and mapping of identified settlements, houses, structures, river reserve, navigational areas, sensitive fishery areas (*Tagal*), recreational areas, burial reserves and other important land area. The map must show all structures within or nearby the river reserve and at a minimum of 500 metres upstream and downstream of the project site boundary.

Mapping of River Flow Channel: Mapping and classification of the river channel at the project site and to a minimum of 500 metres upstream and downstream. This base river map will subsequently be used for comparison later on during aggregate extraction. Given the dynamic nature of river channels, the base river map should be produced from the most recent aerial photos/ images available provided the sufficient scale is available (1:50,000 or larger) and compared to historical aerial photos/ images for that same area. Alternatively, survey of the existing environment at the extraction site should be conducted. This map should also include location of channel deposits and active erosion areas. Due consideration may also be given to aggregate extraction outside of the middle third section of the river by the environmental consultant based on river condition, i.e. severe riverbank erosion which affects private lands along the river. However, prior consultation with the Department of Irrigation and Drainage (DID) is recommended.

5.3.2 Water Quality

Aggregate extraction activities may cause river water quality to deteriorate due to:

- Short-term increase in the amount of suspended solids in the river from re-suspension of sediment. Suspended solids may adversely impact the aquatic ecosystem, by blocking the sunlight required by aquatic organisms to survive. An increase in water turbidity may also affect downstream

water users who extract the water for domestic use. In addition, higher levels of suspended solids can increase the cost of water treatment downstream (refer to Plate 5-3);

- Sedimentation from material stockpiling and release of excess screened materials and organic particulates back into the river (refer to Plate 5-4); and

- Potential oil spills or leakage from excavation machinery and transportation vehicles, which is then carried by surface runoff into the river. The contaminated water supply will poison the aquatic life and increase the cost for downstream water treatment.

Plate 5-3: Highly turbid water condition at the extraction site

Plate 5-4: Wastewater from processing site

Assessment Methodology:

Water Quality Assessment: Conducting baseline water quality sampling and analysis in a laboratory accredited under Skim Akreditasi Makmal Malaysia (SAMM) by the Department of Standards, Malaysia, to ascertain baseline water quality status. The list of water quality parameters that should be included are (but are not limited to): pH, Temperature, Ammoniacal Nitrogen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen, Total Suspended Solids, Turbidity, Oil & Grease, Faecal Coliform Count and Total Coliform Count. The sampling locations should consider the location of sensitive receptors. Results should be compared to the National Water Quality Standards for Malaysia (NWQSM) based on the river water usage and the Water Quality Index (WQI) classification by the Department of Environment.

Water samples are to be collected and analysed as follows:

- Samples are to be collected from a minimum of three (3) locations, i.e. within the extraction site (approximately at the discharge outlet) as well as at the boundaries of the allowable extraction area (upstream and downstream).

- Samples are to be collected during day time only.
- Sampling locations are to be clearly indicated on a map together with GPS coordinates and photographs of the sampling activity.

If the intended area for aggregate extraction is within or constitutes a pristine environment, this warrants the need for reconsideration of the extraction location. See also Section 5.1.1.

Site Assessment: Identification and mapping on the type and number of water users upstream and downstream of the extraction site, as well as reference to the assessment of channel erosion to assess the risk to water users. The results should be presented on a 1:50,000 or larger topographical map. The map should also show the location of water intake points, water catchment areas, fish breeding grounds and other potential users/ sites that may be affected by the decrease in water quality.

The discharge point for surface runoff from the processing site should be clearly indicated in the map in comparison to the overall surrounding land use, for a better understanding of the impacts.

5.3.3 Aquatic and Riparian Ecology

A river together with the river reserve supports a wide range of sensitive habitat types of ecological importance. River reserve habitats are often important areas for wide range of plant and animal species. The importance is related to the diverse range of habitats, access to river and the rich feeding grounds found alongside the water edge and flood plain.

Aggregate extraction will affect the existing ecological component of a river by destroying the in-stream and river reserve habitats for a wide range of aquatic species, as well as indirectly impairing the function of the aquatic ecosystem in the affected area nearby. It can severely impact the food chain of a river – aquatic plants through the benthic community and higher order fish and mammals in the river.

The increase in river turbidity due to aggregate extraction will also temporarily reduce sunlight penetration into the river. This will directly impact the aquatic plant's photosynthesis rate and therefore, the production rate. Increase in sediment load in the river can cause fish spawning problems as deposited silt provides unfavourable conditions for adhesive eggs, causing a migration of fish, crustaceans and invertebrates from the affected areas. This is even more significant in shallow rivers and fast flowing habitats, or when a barge is used for aggregate processing and transport.

Nevertheless, in general, disrupted sites are resilient and can maintain a high potential to recover if the aggregate extraction area is dredged within the acceptable limits. However, this is also dependent on the sand replenishment rate of the river as well as re-colonisation rate of the benthic organisms.

Assessment Methodology:

Inventory Survey and Mapping: A detailed survey of the aquatic environment is only required if the extraction area is located upstream or nearby any known fish breeding grounds or other ecologically sensitive areas. The essential elements of such a survey include (but are not limited to):

- A series of river bed samples for macro-invertebrates;
- A quantitative measure of fish populations and diversity;
- An assessment on the importance of the site as a breeding ground; and
- An assessment on the trophic links and structure.

As for the river reserve, a site inventory which lists out the type and number of flora and fauna communities noted at or nearby the extraction and processing area should be conducted.

Site Assessment: For river reserve and terrestrial sites, production of a habitat map based on aerial photographs together with ground checking, as well as augmentation based on existing information on the distribution of important species should be conducted. The species identified should be compared with the species listed under the Sabah Wildlife Conservation Enactment 1997 and IUCN Red List of Threatened Species. Description of the plant features and their approximate coverage onsite should also be provided.

Consultation with Specialist Group/ Agencies: If it is known that the locality is either a permanent or temporary home to endangered migratory species, through consultation with the surrounding locals, data should be collected on these species. The presence of endangered species may be difficult to assess from a limited number of site visits and time, particularly if the species is migratory. As such, discussion with specialist groups/ agencies such as Sabah Wildlife Department, Sabah Parks, Sabah Forestry Department, or WWF Malaysia-Sabah, may provide additional information pertaining to the significance of these species and the effects of aggregate extraction on their existence.

The overall assessment of ecological impact should be based on:

i. Habitat type in accordance to State, national and regional significance;

ii. Social economic significance, i.e. impact to local fish breeding grounds, access to fishing sites, eco-tourism;

iii. Scale of aggregate extraction operation and location of processing area and the impacts of these on the current natural habitat; and

iv. Legally protected or endemic flora and fauna species.

5.3.4 Downstream Sedimentation

The morphology of river deltas, estuaries and coastlines near the river mouth is relatively complex, with influences from both tidal and wave driven currents along the coastline, as well as tidal flushing and river discharge through the river mouth. This often leads to a complex circulation pattern of sediments over the river delta with sediments being washed seaward by the ebb tidal flow and shifted back landwards by combined flood tidal flow and waves.

The littoral sediment transport is dominated by the monsoon climate with predominantly southerly transport during the north-east monsoon period and northern transport during the south-west monsoon period.

Assessment Methodology:

Assessment of the impacts of these seasonal sediment transfers on downstream sedimentation caused by aggregate extraction can be done by observing the historical changes in the riverbank alignment. A large change in the riverbank alignment causes the net sediment transport to shift direction and potentially lead to erosion at the affected areas along the river, unless the sediment replenishment rate is sufficient to cover the loss in the surf zone processes.

5.3.5 Traffic and Transportation

Transportation of finished products, i.e. sand and stones to potential buyers, can cause dust and noise nuisance as well as affecting the traffic volume, flow and density in the surrounding area. The increase in traffic volume can potentially cause accidents due to spillage of vehicle loads as well as irresponsible driving. In addition, the use of a barge for transporting finished products or for aggregate processing can potentially create traffic hazards to surrounding locals, particularly in areas where the river is used for local navigation and fishing activities.

Assessment Methodology:

Traffic and transportation impacts from aggregate extraction, on the existing road or river capacity, can be assessed by considering the changes to the existing average traffic density. Estimation of additional traffic volume generated on main and feeder roads, as well as a description of the existing road infrastructure together with illustrations should be provided in the EIA report. The viability of using a barge for transportation of finished product must consider the existing river traffic conditions, whether the river is used by the locals for fishing, recreation purposes and others. Consideration should also be made on the downstream river width and meandering through route mapping to assess whether the barge can navigate comfortably at certain areas of the river.

5.3.6 Air Pollution

Sand and stone processing activities will generate dust which is a concern to surrounding residents. Dust is generated from the re-suspension of fine materials from processing equipment (crushers, screens, hoppers and associated conveyors), wind on sand and aggregate stockpiles and movement of lorries to and from the site. Dust is considered as hazard due to its composition and properties as well as its potential negative health effects on humans. Continuous and intense exposure to dust can cause eye, nose, throat and lung irritation, triggering coughing and sneezing. The key to minimizing health concerns associated with a dusty working environment is by reducing or eliminating inhalable dust from the air.

Assessment Methodology:

Air pollution assessment shall be made based on the type, activities and scale of aggregate extraction in relation to the surrounding land use, i.e. location of nearest houses, high-risk areas such as schools, religious institutions and hospitals. The predominant wind direction in the area of aggregate extraction shall be determined in relation to the nearest human settlement(s). There is no specific method to quantify the effects of fugitive dust on the surrounding areas. Good management of the aggregate extraction operation is crucial to minimize problems related to dust.

5.3.7 Noise Pollution

The main sources of noise in aggregate extraction are from heavy diesel-powered aggregate processing equipment both mobile, semi-mobile and fixed plant. The equipment associated with each of these plants includes:

Type of Plant	Equipment Involved
Mobile Plant:	Lorries and graders
Semi-Mobile Plant:	Excavators, loaders and bulldozers
Fixed Plant:	Rock crushers (refer to Plate 5-5) and screening plants, generators

Noise from these sources is inherent in the machines and as such, cannot be subdued.

Plate 5-5: Typical crusher plant used for stone processing

Assessment Methodology:

Prediction of noise impacts from aggregate extraction is difficult. Reasons for such difficulty include:

i. The activity is often temporary and mobile rather than located at a permanent site. The extraction location is not fixed and will change according to the availability of sand/ stone supply along the river;

ii. Much of the work is conducted outdoors without the benefits of fixed plant houses;

iii. The use of large numbers of mobile and semi-mobile plant; and

iv. Excavation works are often only operated for a short duration.

Noise pollution assessment shall be made based on the type, scale and timing of the activities in relation to the nearby sensitive areas, mainly human settlements. The noise impact can also be assessed through comparison with existing noise levels in the area and/ or a comparison with absolute levels that are judged to be satisfactory, i.e. through opinion surveys.

5.3.8 Ground Vibration

Ground vibration in aggregate extraction projects is mainly caused by the operation of the hydraulic crusher for crushing of stone aggregates as well as the utilisation of heavy vehicles within the site and along the transportation route. This can possibly cause structural damage to the surrounding land use and create annoyance to the public.

Assessment Methodology:

Vibration assessment shall be based on the best management practice of the proposed crushing and transporting activities, i.e. type and siting of the crusher plant in relation to the nearby receptors, timing of activities, access road surface condition and loads of heavy vehicles. Perception of surrounding communities on this issue must also be taken into consideration, particularly if there are other existing aggregate extraction operators nearby.

5.3.9 Socio-Economic

In general, aggregate extraction can have beneficial social impacts such as:

- Produces employment opportunities and stimulates local economy and business spin offs;
- Develops social infrastructure in the area – access roads that increase rural residents' mobility;
- Increases overall land values;
- Contributes towards construction industry in the State of Sabah – road construction, building construction and engineering requirements – flood control, and maintaining water supply intake point; and
- Injects funds into the State of Sabah economy through natural resource revenue.

On the other hand, aggregate extraction may impact the existing land and water values. Impacts will range from a temporary change in the land use associated with the project site, actual and potential use for eco-tourism purpose especially at areas designated for *Tagal* as well as potential to disrupt access or navigation along the river or river mouth.

The *Tagal* initiative system is a smart community partnership between the riparian river communities and the Sabah Fisheries Department to ensure sustainability of the river resource (refer to Plate 5-6). Generally, sustainability

is achieved by dividing the river of each *Tagal* system into three one kilometre long zones. Description of each zone is as follows:

- Green Zone: Individual villagers are allowed to catch fish for own consumption at any time;
- Orange Zone: Harvesting and sharing of fish on a community basis is carried out at specific times decided by the local *Tagal* Committee; and
- Red Zone: Catching of fish is totally prohibited.

The *Tagal* system has the potential to generate new source of income for rural villagers such as eco-tourism for fishing sport and recreational areas. In Sabah, the total number of *Tagal* areas established is 212, involving 107 rivers in eleven districts.

Plate 5-6: Signboard showing a river practising *Tagal* system

Impacts on existing *Tagal* and other fish rearing ventures as well as aquatic based eco-tourism activities should be outlined, including descriptions of both the temporary and possible long term impacts on these activities.

Assessment Methodology:

The assessment of social economic impact can be made based on population surveys, scale of land use change and changes in livelihood of surrounding settlements. The extent of the *Tagal* and other river-based livelihood systems

should be determined through consultations with local communities and the Department of Fisheries.

The social economic assessment shall also include:

- Liaison with the surrounding settlements and local authorities including District Office, Water Department and Department of Fisheries on any aspects of concern;

- Identification of historical sites, archaeological sites, tourist attractions, sensitive places such as religious institutions, schools and burial grounds;

- Social economic surveys including:

  - Demographic profile (settlement, household and population distribution);

  - Type and source of water supply for the surrounding settlements;

  - River uses for recreation and other purposes;

  - Existing surrounding land use and economic activities; and

  - Public perception and awareness towards the aggregate extraction project.

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

    A consultation plan document including the following should be prepared:

    - *Objective of the consultation process*

    - *Identification of zone of impact*

    - *Level of communication, i.e. door to door interviews, community dialogue and others.*

    - *Relevant questions that should be posed to the community can include (but are not limited to):*

- *Have you heard about the upcoming project?*
- *What are your concerns related to the project?*
- *What benefits do you perceive from this project?*
- *What is your recommendation for improvement of the project?*
- *What is your level of acceptance of the upcoming project?*

The Zone of Impact (ZOI) for the aggregate extraction activities shall be identified and clearly indicated. This represents the geographical area where the proposed extraction activities are expected to cause changes in the social economic environment. The number of respondents to be consulted within the ZOI must be determined and justified by the environmental consultant with the **locations of those interviewed marked on a map**. Emphasis should be given on consultation with the village head/ local representative. Brief social survey notes describing the aggregate extraction concept and outlining the social consultation method including list of questionnaire must be prepared and documented in the EIA report.

5.3.10 Waste Generation and Management

Wastes generated from aggregate extraction activities are mainly comprised of debris/ refuse in the extracted sand, stones, oil and grease from the on-site machinery and equipment including barges, as well as sewage and solid waste from the on-site workers (camps, quarters, toilets, washing facilities). Improper management of these wastes can cause health concerns and create an aesthetically unpleasant working environment for the workers onsite and surrounding settlements. It will also cause water pollution and impact the aquatic and riparian ecology.

Assessment Methodology:

Waste management assessment for solid waste and sewage can be made based on the estimated number of workers on-site, as well as the suitability and location of the proposed temporary onsite storage facilities for these wastes, i.e. distance from the nearest waterway. Management of scheduled waste (e.g. waste oil) will be under the purview of the Department of Environment (DOE) as per the Environmental Quality (Scheduled Waste) Regulations 2005. Proper handling and management of these wastes is the key to ensure minimal deterioration of environmental quality at aggregate extraction sites.

5.3.11 Cumulative Impact

Deforestation and land-use changes have led to large changes in flow and sediment loads in a high percentage of rivers in Sabah and shifted the original regime of some rivers. Widespread conversion of rain forests to agriculture, mainly oil palm plantations, is partly responsible for changes in flooding patterns owing to the loss of rain forest capacity to gradually collect, store and release rainfall. Increased surface runoff has changed river characteristic towards lower base-flows and higher peak discharges: a pattern more distinct in areas of Sabah with steeper terrain. The higher peak flood discharges and reductions in flood storage capacities in lower river plains will, during heavy rainfall, aggravate flash-floods and increase volatility to severe flooding. These variations in flow and sediment discharges need to be taken into account in the determination of the overall catchment and coastal cell sediment budget.

Assessment Methodology:

It is envisioned that significant environmental impacts may not occur from a single aggregate extraction operation along a stretch of a particular river. However, the situation changes if several aggregate extraction operations are operating at the same time within the same river. In such situations, the following guidelines should be considered:

- A minimum distance of 1,000 metres should be maintained between each aggregate extraction operation on a particular river. However, this is also dependent on the replenishment rate of a particular river; and
- No multiple aggregate extraction is allowed if the river flow/ velocity is more than 3.0 m/s, or at rivers which have a depth of less than 1.0 metre.

The surrounding environment and carrying capacity of the particular river should be assessed to ensure that multiple aggregate extraction operations will not significantly affect the environment (hydrology, geomorphology, water quality and usage) of the river.

5.3.12 Potential Abandonment

Abandonment refers to an event whereby the aggregate extraction has to be halted either temporarily or permanently due to circumstances such as economic downturn, management issues and/ or technical problems arising during the implementation of the project. For example: poor market demand for the finished products, or changes in government policy on such projects. Abandonment involves the withdrawal of onsite workers and removal of

machinery and equipment used for the aggregate extraction activities. Improper abandonment can cause soil erosion from exposed working areas, aesthetically unpleasant and unhealthy riverine environments that provide breeding grounds for vectors and pests. Site rehabilitation works particularly at the processing site should be specified in the EIA report aimed at reducing, or eliminating negative impacts related to project abandonment.

5.4 Additional Impacts

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

6 Mitigation Measures

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

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

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* - *Provision for erosion control measures* - *Minimising water quality impact* - *Provision for aquatic and riparian ecology protection/ conservation* - *Provision for transportation management* - *Minimising air and noise pollution impact* - *Minimising ground vibration impact* - *Reducing adverse impact on surrounding community* - *Management of waste generated* • *Devise and propose monitoring programmes*

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

- Proposals for improved technologies or methodologies for planned activities in order to minimise their negative environmental impact, e.g. site selection, site layout orientation, selection of aggregate extraction method or exclusion of high risk/ sensitive areas.

- Proposals for management activities, which are not included in the Project Proponent's original plan of activities but which are necessary in order to control environmental degradation, e.g. waste management, drainage, soil erosion control practices and others. This is mainly related to working

practices such as limiting the allowable extraction area and daily working hours.

- Proposals to compensate for unavoidable, residual impacts, e.g. community development programmes or a specific contribution towards local conservations or offsets.

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

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

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

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

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

6.1 Key Mitigation Measures

6.1.1 Riverbank/ Channel Erosion/ Soil Erosion

The mitigation measures that can be considered for riverbank/ channel erosion/ soil erosion impact include (but are not limited to):

- **Limitation of work** - Limiting work during high water levels and/ or dry/ wet seasons, as river bank failure and channel erosion are correlated to the seasonal fluctuation of the river flow.

- **Provision and protection of riparian reserves** - Riparian reserves contribute to the protection of river banks and act as reserves for natural habitats and wildlife corridors. They also act as a limited filter, providing some protection against sediments flowing into the river. The Water Resource Enactment 1988 requires a 20 metre riparian reserve on either bank of any river exceeding 5 m width. The DID has expanded this with additional recommendations relative to different river widths. The environmental consultant should devise riparian reserves that suit local conditions, i.e. topography, soil, vegetation and connectivity to other protected areas, as well as make it clear which activities, if any, are permissible within the reserves while also adhering to the DID requirements.

- **River width** - The DID has established a guideline for the relationship between river width and the allowable depth of aggregate extraction as outlined in Table 6-2. While observing these guidelines, the environmental consultant shall propose similar regulations depending on local conditions.

Table 6-2: Allowable Sand Extraction Depth

Width of River (metre)	Allowable Sand Extraction Depth (metre)
< 10	Not Permitted
10 – 20	0.5
20 – 50	1.0
> 50	1.5

Source: DID Guidelines (2003)

- **Allowable aggregate extraction area** - The DID only permits sand extraction at the middle third section of the river to minimise riverbank erosion (refer to Figure 6-1). The environmental consultant should assess the validity of this requirement based on site conditions and recommend a local management regime along the DID requirements.

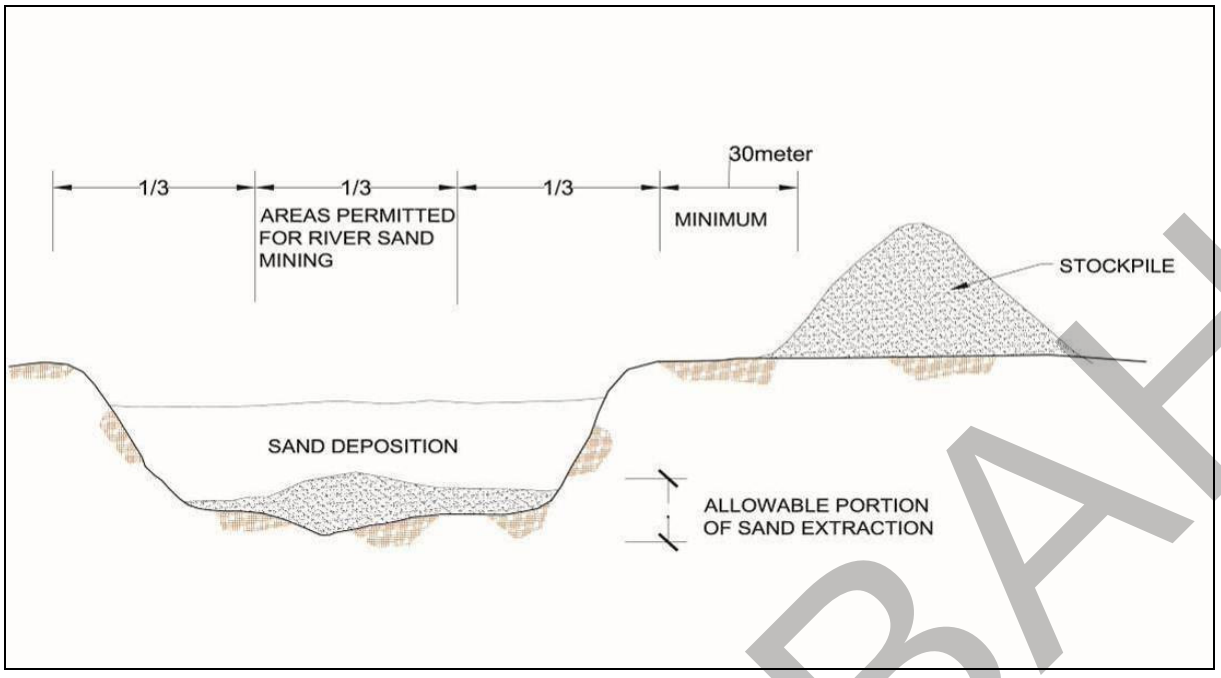


Figure 6-1: Allowable sand extraction area

- **Visible demarcation of the allowable extraction area** - The area where extraction is permitted should be clearly marked.

- **River bank protection** - To further avoid channel erosion, riverbanks with little or no vegetation may be planted with trees and ground cover. Vegetation species that can be considered include fern, *Nephrolepis sp.* for steep river banks and ground cover plants such as *Centrosema pubescens*, Vetiver grass and Cow grass for other areas. Construction of artificial walls such as sheet piling or gabions can be considered for protection of riverbanks with approval from the Department of Irrigation and Drainage.

- **Minimal land clearing** - Land clearing for the processing area should be as minimal as possible.

- **Provision for location and design of access routes into the river** - This may include the laying of aggregates to minimise erosion during periods of rainfall (refer to Plate 6-1). Upon completion of the aggregate extraction, the access point(s) must be rehabilitated in line with a proposal made by the environmental consultant.

Plate 6-1: Access into the river must be of minimal width

6.1.2 Water Quality Deterioration

The mitigation measures that can be considered for managing water quality deterioration include (but are not limited):

- **Distance from the river** - Restrictions on distance between the river and the stockpile of finished products (sand and/ or aggregate) to minimise washdown. DID recommends a distance of at least 30 metres from the riverbank. Storage of stockpiles along the river reserve is not allowed.

- **Pollution prevention** - Measures to prevent oil and other pollutants from entering the water course from machinery should be proposed by the environmental consultant. Such measures may include general cleanliness as well as maintenance schedules.

- **Provision of drainage system** - If the management plan does not include sufficient measures for drainage and similar controls of sediment, such measures must be included in the proposals from the environmental consultant. The environmental consultant must ensure drainage and sedimentation ponds (refer to Figure 6-2) are designed taking into consideration the holding volume (sufficient size to hold wastewater and runoff); retention time (sufficient time to allow for silt deposition within pond prior to discharge); and location (suitable location to capture all discharge

from the processing area) into account. The environmental consultant must also make recommendations for sediment removal from the sedimentation ponds and appropriate disposal.

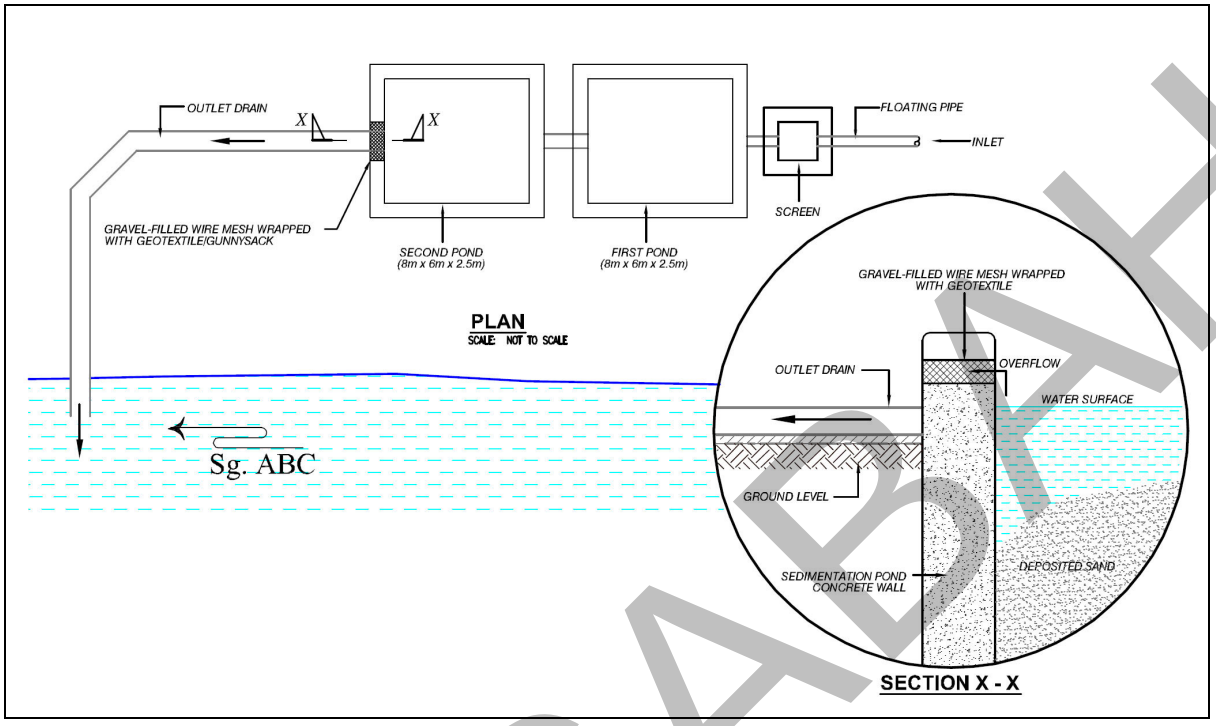


Figure 6-2: Typical cross-section of a sedimentation pond

- **Water quality monitoring** - Regular water quality sampling must be conducted on a regular basis at the final discharge outlet as well as upstream and downstream of the aggregate extraction site to monitor the difference in water quality, due to the aggregate extraction operations. The lists of water quality parameters to be tested are to be recommended by the environmental consultant based on local conditions and receptors. However, the following should be seen as a minimum requirement: Total Suspended Solids, Turbidity, Total Coliform Count, Faecal Coliform Count and Oil & Grease.

6.1.3 Aquatic and Riparian Ecology

The mitigation measures that can be considered for aquatic and riparian ecology impact include (but are not limited to):

- **Avoid aquatic breeding or migrating periods** - Aggregate extraction activities should be avoided during known aquatic breeding or migration periods to protect fish and other forms of aquatic life.

- **Notification to authorities** - Notification should be made to the Sabah Wildlife Department if there is discovery of any protected or endangered

flora and fauna species of significant biological habitats or to Sabah Fisheries Department on the discovery of any protected or unique aquatic species.

6.1.4 Traffic and Transportation

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

- **Parking overnight** - Measures should be implemented to avoid parking of vehicles overnight at public areas/ roads, such as the provision for onsite parking areas.

- **Properly covered loads** - Transporting vehicles carrying aggregate are required to be properly covered and sealed to avoid spillage when utilizing the public road. The environmental consultant should assess the adequacy of this requirement and make appropriate proposals.

- **Schedule of transportation and road maintenance** - Consideration on the need for road maintenance, traffic regulations (road signs and other road furniture), speed regulations, and where appropriate management of transportation schedules.

- **Provision for noise and dust control** - Effective measures such as road humps must be proposed to minimise dust and noise from traffic near human settlements, schools and places of worship. This will also improve the safety of the local population.

- **Proper planning** - Proper planning of transportation activities including working hours and transportation route.

- **Pipeline systems** - Pipeline systems between the aggregate extraction equipment and the processing site should be designed so as to minimise river navigation issue with surrounding locality. The maximum length of the pipeline systems must be determined.

- **Use of barge** – The use of barge for transportation of aggregate products should be in accordance to the relevant local regulations and during periods of high water level to facilitate manoeuvrability. Consultation should be made with the Ports and Harbours Department and Marine Department.

- **Internal roads and junctions** – Design and construct internal road system and parking facilities within the project site. Regular maintenance should be conducted and ensure that it is clean at all times.

- **Traffic signage** - Provide proper and adequate traffic signage at road junctions where transportation vehicles ingress and egress, particularly at entrances to the project site and near human settlements to warn other road users of the transportation activity.

- **Local authority compliance** - Comply fully and at all times with the requirements of local authorities including Public Works Department and Road Transport Department for operational activities on land especially with regards to speed limit and vehicles load.

6.1.5 Air Pollution

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

- **Water spraying/ sprinkling** - Water spraying or other means of dust control should be proposed at the stockpile area and internal access roads. These controls include the height of the aggregate stockpiles relative to the height of zinc hoarding/ vegetation along the site boundary or the distance between these.

- **Wheel washing facility** - Wheel washing facilities should be provided and used by the site vehicles in order to prevent dust from being carried off the site. Proposals for cleaning and management of waste water must be made.

- **Design control** - The design of the conveyor for processed aggregates should consider the risk of wind transportation of dust. This may include issues such as height from the ground, shielding and water spraying.

- **Material cover** - Properly cover transported material with canvas or similar covering materials to avoid spillage and to minimise dust emission. See Plate 6-2.

- **Speed** - Reduce vehicles' speed to assist in reducing the dust generated.

- **Access road** - Ensure access and internal roads are kept smooth, well graded and clean.

Plate 6-2: Canvas sheet securely tightened to cover loads of transporting vehicles

6.1.6 Noise Pollution

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

- **Scheduling of activities** - Aggregate extraction activities should be scheduled to respect nearby sensitive receptors. Surrounding settlements should be duly informed of the working hours for awareness.

- **Physical barrier** - Physical installations or tall vegetation may be considered at areas facing settlements to minimise dust nuisance (refer to Plate 6-3). The type and design of the physical barrier should be recommended based on the nature, duration and size of the earthwork activities involved.

Plate 6-3: Zinc hoarding provided along aggregate processing area

- **Location of site equipment** - The location of the primary crusher plant and stockpile should be as far as possible from the nearest settlement and on the downwind direction to ensure minimum noise nuisance to nearby communities.

6.1.7 Ground Vibration

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

- **Location of crusher plant** – The crusher plant should be sited away from the nearby receptors.

6.1.8 Socio-Economic issues

Consideration should be given to the affected local population by protecting sources of local water supply, fishing and recreation area. In addition, effective public relations exercise is importation in ensuring social acceptability of the project. The mitigation measures that can be considered for socio-economic impacts include (but are not limited to):

- **Local water supply** - Ensure that government potable water supply, and general livelihood of the local population are not negatively affected by the project.
- **Compensation** - Any monetary, equipment or other assistance to the affected local population should be discussed and agreed by the local council and local leaders.
- **Employment and business opportunities** - Preference for employment and business should be given to local population. This will provide some opportunities to the local people to participate in the development of the project, as well as providing them with an opportunity to earn extra income. In addition, their employment and business participation will prevent social resentment and conflicts, increase their positive feelings

towards the project, and create a sense of pride towards the development of their area.

- **Public relations** - Conduct a proper public relations exercise involving the local authorities and surrounding settlements. Two-way communications through dialogue help both parties to understand each other, set a forum for understanding, and establish rapport. Information about the numerous benefits of the project and minimum environmental impacts should be made readily available to the public. A grievance reception system for public complaints should be established.

- **Dialogue** - Hold regular meetings/ dialogues with the surrounding population and their community leaders. The Project Proponent should explain to the villagers the nature of the project, the extent to which it will affect their villages, and the mitigation measures undertaken to eliminate or minimise environmental problems.

6.1.9 Waste Generation and Management

Wastes generated from the project should be handled and disposed of in accordance to Malaysian legislative requirements. The mitigation measures that can be considered for waste management include (but are not limited to):

a) Oily Waste/ Scheduled Wastes

- **Legal requirement** - Handle and dispose of used oil, oily wastes and hazardous waste in accordance to Environmental Quality (Scheduled Wastes) Regulations 2005.

- **Oily waste** - Collect used oil and oily wastes from machinery and transportation vehicles and store and label in proper containers for disposal. A temporary storage facility should be constructed within the processing site, and should be fenced, covered, bunded, sign posted, have impervious flooring, and be provided with proper drainage and oil trap. The facility should be sited more than 50 m away from any river, stream or sensitive area.

- **Oil trap** - Construct oil/ water separator to trap and treat oily wastewater on-site. Drainage from workshop floor and temporary storage area should be directed to the oil trap, prior to final discharge to public drain, river, stream or other water body. The effluent quality from the oil trap should be able to meet the Environmental Quality (Industrial Effluent) Regulations 2009.

- **Bund** - Construct non-permeable bund surrounding the oil storage facility to ensure that no oil or oily waste enter river/ stream or waterways in case of spillage or leakage. Bund holding capacity should be at least 110% of the largest storage volume on-site.

b) Solid Waste

- **Disposal** - Provide adequate waste bins with covers within aggregate processing site especially at the workers' quarters. These should be regularly disposed off at dumping sites approved by the local authorities.

- **Prohibition** - Prohibit burning of solid waste within the project site, or direct disposal into waterways or onto lower ground.

- **Housekeeping** - Good housekeeping practice should be implemented at all times to ensure a clean, healthy environment for workers and nearby communities.

- **Unsuitable materials** - Excess extraction materials or overburden should not be disposed of within the river reserve or into the river. Instead, it should either be disposed of offsite or properly compacted onsite.

c) Sewage

- **Legal requirement** - Handling and disposal of sewage should be done in accordance to Environmental Quality (Sewage) Regulations, 2009.

- **Sewage discharge** - Sewage discharges from workers' quarters and site office should be discharged into an on-site temporary basic treatment facility, such as a septic tank, prior to final discharge.

d) Administration

- **Written approval** - Open burning on-site is not allowed, except as per the requirements of Environmental Quality Act, 1974 and Environmental Quality (Declared Activities) (Open Burning) Order, 2003.

- **Written approval** - Written approval should be obtained from DOE for use or installation of fuel burning equipment (including generator), and for installation of pollution control equipment on-site.

6.1.10 Abandonment

In the event that the works are abandoned during the aggregate extraction or processing stage, every attempt should be made to reinstate the condition of the site to that which existed prior to commencement of aggregate extraction works. Whilst this will not be feasible where large scale excavation works have taken place, as a minimum, the cleared area should be re-vegetated. This will involve breaking up compacted ground, covering with topsoil, and planting/ seeding with selected local tree species and/ or cover crops such as *Pueraria javanica*, Mucuna, *Calopogonium caeruleum*, or *Centrosema pubescens.*

Where a structure is partly erected, this should be demolished and removed from the site.

All drainage provisions, including sedimentation ponds should be retained.

All equipment, machinery and waste materials should be removed from the site.

6.2 Residual Impacts

It is unavoidable that there will be some adverse impacts from some of the aggregate extraction, even if activities are carried out with every intention of avoiding or minimising such impacts.

There will be riverbank erosion and soil erosion with subsequent water pollution issues and loss of ecological features in terms of natural wildlife habitat. For such impacts, the risk and the magnitude must be assessed as part of the assessment procedure.

6.2.1 Off-set of Residual Impacts

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

6.2.2 Mitigation of Residual Impacts

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

7 Monitoring Programmes

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

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

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

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

In general, environmental monitoring programmes will involve collecting data for one or more of the following purposes (Everitt, 1992):

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

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

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

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

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

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

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

7.1 Compliance Monitoring

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

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

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

The frequency of environmental monitoring and reporting may be varied depending on the stages of the project and sensitivity of the area, i.e. erosion prone area, social concerns and will be specified by the EPD through the AEC issued with the EIA approval.

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

7.1.1 Monitoring Techniques

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

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

- Extraction at allowable areas in the river.
- Provision of river reserves.
- Conditions of riverbank upstream and downstream.
- Reducing the land area disturbed.
- Re-vegetation works on exposed areas.
- Reducing dust and noise problems.
- Provision of buffer zones or protected area management.
- Proper waste handling.
- Phased clearance.
- Proper transportation management.

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

Field checks. Periodic field checks at appropriate stages of the aggregate extraction activities should be undertaken in order to ensure compliance with the following mitigation measures:

- Extraction and processing methodology (area extracted; period and timing of operations; volume of materials extracted and equipment and method used).
- Provision of river reserves.
- Improved working practices/ management procedures.

- Landscaping works.
- Reducing dust and noise problems.
- Provision of buffer zones or protected area management.
- Proper waste handling.
- Phased clearance.
- Proper transportation management.

Records. Records of aggregate extraction activities to ensure compliance with the following mitigation measures:

- Allowable aggregate extraction rates through verification of equipment used and capacities.
- Allowable aggregate extraction area and river reach (upstream and downstream of extraction area) should be re-mapped once in every two (2) years for comparison of the river alignment and other parameters.

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

- Provision for erosion control facilities onsite, i.e. sedimentation pond, silt trap and drainage network.
- Provision for dust and noise suppression facilities, i.e. water sprinkling activities, planting of trees, installation of zinc hoarding.
- Proper waste management practice onsite, i.e. provision for waste bins, location of workers quarters, site office, storage area, workshop, sewage facilities and others.

A sample of the overall recommended mitigation measures and monitoring points can be referred in Figure 7-1.

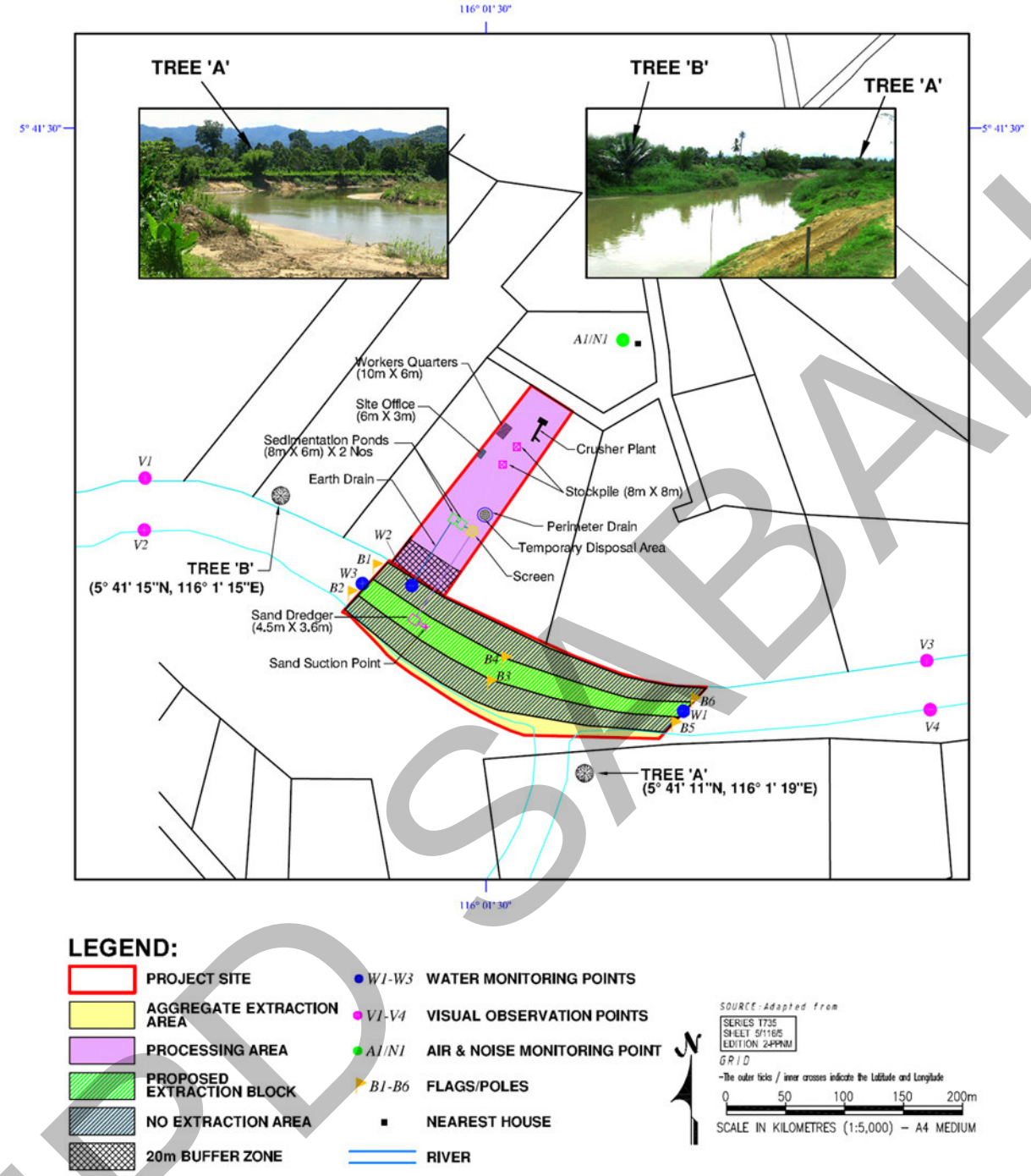


Figure 7-1: Typical extraction and processing site layout plan including mitigation measures and monitoring points

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

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

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

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

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

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

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

7.2 Impact Monitoring

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

7.2.1 Riverbank/ Channel Erosion/ Soil Erosion

If the aggregate extraction area is located in a high risk area as determined by the environmental assessment, impact monitoring for riverbank/ channel erosion/ soil erosion could include (but is not limited to) the following:

- Mapping of the physical and hydrological characteristics of the river and riverbanks at the high risk areas. Physical data including river cross-sectional profile is recommended to be conducted at least annually during and after aggregate extraction activities to determine the volume of materials extracted. As for river bank mapping, it should be conducted annually covering 1.0 km upstream and downstream of the extraction area.

- Field surveys and photographs (with GPS coordinates) of the physical conditions along both riverbanks including areas experiencing riverbank erosion and its severity.

7.2.2 Water Quality

Impact monitoring for water quality could include (but is not limited to) the following:

- Water quality monitoring should be carried out during the operation stage of the aggregate extraction activities at the following areas:
  - Within the extraction site (at the discharge outlet into the river)
  - Within the extraction boundary (upstream river)
  - Within the extraction boundary (downstream river)

  The results should be comparable to the National Water Quality Standards for Malaysia (NWQSM) and the baseline water quality results collected. The list of water quality parameters that should be included are (but are not limited to): Total Suspended Solids, Turbidity, Total Coliform Count, Faecal Coliform Count and Oil & Grease. Additional parameters may be recommended depending on site characteristics.

7.2.3 Air and Noise Pollution

Impact monitoring for air and noise pollution control could include (but is not limited to) the following:

- Visual inspection for excessive dust or noise generated from the site.
- Air and noise quality monitoring should be carried out during the operation stage of aggregate processing at the nearest receptors. This is to assess the severity of the activities towards the nearby settlements.

7.2.4 Ecology

Impact monitoring for ecological impacts could include (but is not limited to) the following:

- Re-mapping/ surveying of the habitat surrounding the extraction site. Known aquatic life in the area, such as key fish species, may be used as biological indicators.

- Repeated surveys of selected indicator species to monitor population trends.

7.2.5 Monitoring Frequencies

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

References

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

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

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

3. DHI Water & Environment (M) Sdn Bhd (2011). Carrying Capacity Study for River Sand Mining in Sg Papar and Sg. Kimanis.

4. Environment Protection Department (2005). Handbook on Environmental Impact Assessment in Sabah.

5. Environment Protection Department, Sabah (2011). Guidelines for Minimising Impacts of Sand Mining on Quality of Specific Rivers in Sabah. First Edition. Ministry of Tourism, Culture and Environment, Sabah.

6. Environment Protection Department, Sabah (2011). Impact Study on Palm Oil Mills, Oil Palm Plantations and Other Pollutants on the Quality of Specific Rivers in Sabah. First Edition. Ministry of Tourism, Culture and Environment, Sabah.

7. Everitt, R.R (1992). Environmental Effects Monitoring Manual. Prepared for the Federal Environmental Assessment Review Office and Environment Canada, Environmental Assessment Division, Inland Waters Directorate. Ottawa, ON.

8. Department of Environment, Malaysia. Environmental Impact Assessment (EIA) Guidance Document for Sand Mining/ Dredging Activities. Ministry of Natural Resources and Environment, Malaysia.

9. Department of Irrigation and Drainage (2009). River Sand Mining Management Guideline. Ministry of Natural Resources and Environment, Kuala Lumpur, Malaysia.

10. Department of Irrigation and Drainage Malaysia. Garispanduan Pembangunan Melibatkan Sungai dan Rizab Sungai.

11. Department of Irrigation and Drainage (1997). Guidelines on Erosion Control for Development Projects in the Coastal Zone. DID Guidelines 1/97. Ministry of Natural Resources and Environment, Kuala Lumpur, Malaysia.

12. Department of Irrigation and Drainage Malaysia (River Engineering Section) (1993). Garis Panduan untuk Memproses Permohonan dan Menetapkan Syarat-Syarat Pemgambilan Pasir Sungai.

13. Everitt, R.R. (1992). Environmental Effects Monitoring Manual. Prepared for the Federal Environmental Assessment Review Office and Environment Canada, Environmental Assessment Division, Inland Waters Directorate, Ottawa. ON.

14. PIANC (2010). PIANC Report No 108: Dredging and Port Construction Around Coral Reefs. PIANC Secretariat General, Belgium.

15. Process Guidance Note 3/16 (04) (2004). Secretary of State's Guidance for Mobile Crushing and Screening.

Appendix 1: Glossary of Terms

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

Aquaculture – propagation of fish seed or the raising of fish through husbandry during the whole or part of its life cycle.

Aquatic environment – the physical and biological features, including land, water, atmosphere, animals and plants, which are within, under, over, in contact with, or sustained by the water in the water bodies.

Aquatic vegetation – vegetation which lives on or in water for all or most of its life cycle, and includes mangroves.

Bed – in relation to water body, this means the land under the water body bounded by the banks closet to the water body and in relation to a water body subject to tidal influence, means the land under the water body extending to the high-water mark of ordinary spring tides.

Conservation – process of looking after a conservation area so as to retain its significance, and includes maintenance, preservation, restoration, reconstruction, adaptation or a combination of two or more of these.

Cultural Heritage – any antiquity, historical object, historical site, site, area (whether on land or in the sea), fabric, building, structure, ethnographic matter, work of art, manuscript, coin, currency note, medal, badge, insignia, crest, flag, armour, vehicle, ship and tree, which has a significant and special architectural, aesthetic, historical, cultural, scientific, economic, environmental or any other interest or value and has been declared to be subject to preservation or conservation under Section 4(1) of the Cultural Heritage (Conservation) Enactment, 1997.

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

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

Estuarine Waters – the waters of a river extending from the mouth of the river up to the point upstream penetrated by sea water at neap tides.

Factor – basic element of analysis used in any method. In most methods, factors relate to some form of environmental impact.

Fish – any aquatic animal or plant life, sedentary or not, and including all species of finfish, crustacean, Mollusca, aquatic mammals, or their eggs or spawn, try, fingerling, spat or young, but does not include any species of otters, turtles or their eggs.

Floodplain – the area of a river valley which is covered with water when the river overflows during floods.

Groundwater – water occurring under the surface of the ground in any geological formation including alluvial layers, or in land which has been reclaimed or artificially filled.

Local Authority – any person or body of persons appointed under any written law to exercise and perform the powers and duties which are conferred or imposed on a local authority under any written law.

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

Monitoring Programme – all actions taken and equipment used for the purpose of detecting or measuring quantitatively or qualitatively the presence, amount or level of any substance, characteristic or effect.

Pollution – any direct or indirect alteration of the physical, thermal, chemical or biological properties of any part of the environment by discharging, emitting, or depositing environmentally hazardous substances, pollutants or wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety, or welfare, or to animals, birds, wildlife, fish or aquatic life, or to plants or to cause a contravention of any condition, limitation or restriction to which a license under the Environmental Quality Act, 1974 is subject.

River – a continually or intermittently flowing body of water, and includes a stream or modified watercourse by does not include any artificial watercourse unless it is a declared channel.

River Reserve – a reserve established for protecting the volume or flow of water in water bodies and preventing the degradation of the quality of water resources and damage to the aquatic environment in water bodies. It is established on land which is within twenty metres of the top of the bank of every river, including its estuary, where the river channel is not less than three metres in width.

Riverine Waters – waters of any rivers, lakes, streams, ponds and such other waters in Malaysia other than maritime waters, whether natural or man-made, privately owned or otherwise.

Subsistence Agriculture – agricultural activity capable of sustaining no more than a family group, including commercial transactions necessary for subsistence, but does not include commercial agricultural enterprise.

Vegetation – all species of plants and trees, whether terrestrial or aquatic, and any other vegetable product of the soil or water.

Water – water flowing over the ground in significant quantities, water in a water body and water returned by artificial means to a water body, including drainage water, stormwater, wastewater, effluent and sewage generated by urban, industrial and agricultural activities.

Water body – a river, estuary, lake, lagoon, swamp, marsh or other wetland; an aquifer; coastal water and a declared channel.

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

Appendix 2: List of Abbreviations

ACLR	Assistant Collector of Land Revenue
AEC	Agreement of Environmental Conditions
DID	Department of Irrigation and Drainage
DOE	Department of Environment
EIA	Environmental Impact Assessment
EPD	Environment Protection Department
GIS	Geographical Information System
IUCN	International Union for Conservation of Nature
LSD	Lands and Surveys Department
MD	Mitigation Declaration
NWQSM	National Water Quality Standards for Malaysia
PMM	Proposal for Mitigation Measures
RM	Ringgit Malaysia (Malaysian Ringgit)
ROI	Region of Influence
Sg.	Sungai (River)
TOL	Temporary Occupational License
TSS	Total Suspended Solids
WHO	World Health Organization
WWF	World Wildlife Fund
ZOI	Zone of Impact

Appendix 3: Contact Details

Contact details for other key government agencies related to aggregate extraction activities are as following:

Department	Address	Contact Details	
Lands and Surveys Department	Wisma Tanah dan Ukur, Jalan Perwira, Beg Berkunci No. 2044, 88576 KOTA KINABALU	Tel No.:	088 - 527600/ 527601
		Fax No.:	088 - 413626
		Email:	-
Sabah Wildlife Department	Tingkat 5, Blok B, Wisma MUIS, 88100 KOTA KINABALU	Tel No.:	088 - 215167/ 214515
		Fax No.:	088 - 222476/ 254767
		Email:	jhl@sabah.gov.my
Department of Irrigation and Drainage	Aras 5, Wisma Pertanian, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, Beg Berkunci 2052, 88767 KOTA KINABALU	Tel No.:	088 - 280500
		Fax No.:	088 - 242770
		Email:	did@sabah.gov.my
Department of Fisheries	Aras 4, Blok B, Wisma Pertanian Sabah, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, 88624 KOTA KINABALU	Tel No.:	088 - 235966/ 245489/ 245490
		Fax No.:	088 - 240511
		Email:	fish.dept@sabah.gov.my
Water Department	Tingkat 6, Blok A, Wisma MUIS, Beg Berkunci No. 210, 88825 KOTA KINABALU	Tel No.:	088 - 232364
		Fax No.:	088 - 232396
		Email:	muis.air@sabah.gov.my
Town and Regional Planning Department	Tingkat 3, 4 dan 5, Blok B, Wisma Tun Fuad Stephens, KM 2.4, Jalan Tuaran 88646 KOTA KINABALU	Tel No.:	088 - 222336/ 222337/ 222031
		Fax No.:	088 - 222557
		Email:	-
Minerals and Geoscience Department Malaysia, Sabah	Jalan Penampang, Beg Berkunci 2042, 88999 KOTA KINABALU	Tel No.:	088 - 260311/ 252494/ 252496
		Fax No.:	088 - 240150
		Email:	jmgsbh@jmg.gov.my
Department of Environment, Sabah	Aras 4, Blok A, Kompleks Pentadbiran Kerajaan Persekutuan Sabah, Jalan UMS-Sulaman, 88450 KOTA KINABALU	Tel No.:	088 - 488166
		Fax No.:	088 - 488177/ 488178
		Email:	sabah@doe.gov.my

Appendix 4: List of Environmental Consultants/ Study Team

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

- Soil Erosion
- Hydrology
- Ecology/ Fisheries
- Geology
- Air Quality and Noise
- Socio-Economic
- Noise and Vibration

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

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

Appendix 5: Standard List of Content

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

CHAPTER 1: EXECUTIVE SUMMARY

Project Description

Findings

CHAPTER 2: GENERAL INFORMATION

Project Title and Project Proponent

Environmental Consultant

Public Hearing (for Special EIAs)

CHAPTER 3: PROJECT DESCRIPTION

Statement of Need

Concept and Phases

Description of Location

Project Status

CHAPTER 4: IMPACT PREDICTION AND EVALUATION

Significant Environmental Impacts

EIA Matrix

Impact Assessment

CHAPTER 5: RECOMMENDED MITIGATION MEASURES

Recommendations

Additional Mitigation Measures

CHAPTER 6: RECOMMENDED MONITORING PROGRAMME

Compliance of Mitigation Measures

Residual Impacts

ANNEXES

Annex 1: Baseline Environmental Data and Information

Annex 2: Methodologies and Analysis of Data

Annex 3: List of References

Annex 4: Terms of Reference

Appendix 6: License Application Procedure for Sand Extraction Activities