

Marine Reclamation Works on the West Coast of Sabah

Terms of Reference for

Detailed Environmental Impact Assessment of

“[Insert project name]”

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PREFACE

The present Terms of Reference (TOR) provides a generic description of the scope of work required by the Sabah State Government for developers to fulfil the requirements of a detailed Environmental Impact Assessment (EIA) for marine reclamation works.

1. INTRODUCTION

It is a strong concern of the authorities of Sabah that the development of any marine reclamation project is undertaken with the aim of minimising the negative impact of the development on the physical-chemical and biological-ecological environment, with an overall positive effect upon the socio-economic properties, and within a sustainable operational frame.

Realising this need, the Ministry of Culture, Environment and Tourism, Sabah (MCET) together with the Department of Irrigation and Drainage (DID) and the Town and Regional Planning Department, Sabah (TRPD) have established an overall Shoreline Management Plan (SMP) which delineates areas suitable for land reclamation along the West Coast of Sabah from Pulau Mukan in the north to Menggalung River in the south. This present Terms of Reference (TOR) is developed by the Sabah State Government as a guide to developers in order to ensure a standard of EIA conformance and in compliance to Federal EIA requirements for approval of marine reclamation projects.

The comprehensive Shoreline Management Plan (SMP) for reclamation projects on the West Coast of Sabah has been accomplished for the Ministry of Culture, Environment and Tourism, Sabah by a team comprising Danish Hydraulic Institute, VKI, PEM Consults and Hasløv & Kjærsgaard supported by Universiti Malaysia Sabah, Sustainable Environmental Management Consultants and Sepakat Setia Perunding Sdn. Bhd. Results from this study will be available to the Detailed Environmental Impact Assessment of “[Insert project name]”. The consultant chosen to undertake the Detailed Environmental Impact Assessment of the “[Insert project name]” (hereinafter called the Consultant) is expected to ensure that his work is performed taking full advantage of the findings of the SMP in terms of baseline data, model setup and calibration. These data and reports are available from MCET.

This present TOR represents the requirements for a Detailed EIA for marine reclamation works. Supporting TOR for Environmental Monitoring and Management of marine reclamation projects are also available from MCET.

In addition to fulfilling the TOR specified in the following sections, the impact assessment shall also comply in all respects with the legal requirements as stated in “Environmental Impact Assessment Guidelines for Coastal Resort Development Projects, Department of Environment, Ministry of Science, Technology the Environment, Malaysia, June 1994” and “Environmental Impact Assessment Guidelines for Coastal Reclamation Projects, Department of Environment, Ministry of Science, Technology and the Environment, Malaysia, (in print at the time of writing)”. Copy of these guidelines are available from MCET and the Consultant must provide written proof that these guidelines are in his possession and a statement indicating that the tender complies with these guidelines.

2. OVERALL PROJECT OPTIMIZATION PROCEDURE

The progress of marine development projects shall follow a fixed progression through the various project phases in order to ensure that the findings of the various Environmental Impact Assessments are fully integrated with and influence the final design and work plans during the implementation of the project. These phases are:

i) Project conception

Here a concept design for the project implementation is presented to the State Government. The developer is required to provide the following basic information:

- Project description
- Bathymetry survey
- Outline reclamation design and costing
- Outline perimeter design and costing

For the West Coast of Sabah the project concept must comply with the overall shoreline management plan, which is incorporated into the regional and local plans maintained by TRPD.

ii) Preliminary Environmental Impact Assessment

Based upon the approval of the concept design, a preliminary analysis of the possible impacts of the project upon the physical-chemical, biological-ecological and socio-economic environment, and the operational and maintenance properties shall be performed by a qualified EIA Consultant. The EIA is required to address the following topics:

- Preliminary hydraulic impact assessment including numerical impacts modelling of at least current, waves and sediment transport.
- Marine habitat survey and impact assessment
- Socio-economic impact assessment

For large projects where detailed EIA is mandatory, the preliminary EIA shall be commissioned as an integral part of the detailed EIA.

iii) Preliminary Design

Subject to approval, the results of the preliminary EIA must be integrated into the preliminary design of the project. Detailed plans for project design and project implementation are elaborated.

iv) Detailed Environmental Impact Assessment

Depending upon the scale of the project and findings of the preliminary EIA, there may be a requirement for a detailed EIA to be performed. For large-scale marine reclamation works (over 100ha), the detailed EIA is a prerequisite. The impacts of the preliminary design are analysed in a Detailed Environmental Impact Assessment, the TOR for, which are specified in the following sections. At this level all potential impacts are quantified and/or described and the suitability and effectiveness of those mitigating measures identified in the preliminary EIA investigated.

v) Detailed Design

The mitigating actions emerging from the Detailed Environmental Impact Assessment are built into the project to give a final design minimising the possible environmental impacts.

vi) Construction and Monitoring

Implementation of the project while accomplishing an environmental monitoring and management programme that includes a feedback mechanism and a possibility for mitigating unforeseen adverse impacts.

3. DETAILED ENVIRONMENTAL IMPACT ASSESSMENT

3.1 Objectives

The main objective of the Detailed Environmental Impact Assessment of the “[Insert project name]” (hereinafter called the project) is to analyse the project in order to evaluate the extent to which it complies with the goals of minimising negative impact to the environment and society, whilst attaining the goals of the developer with respect to the provision of the desired resort facilities.

To this end, the detailed EIA shall embrace the following:

- Describe the project,
- Describe the existing physical-chemical conditions and identify the potential impact of the project on the physical-chemical environment,
- Describe the existing biological-ecological conditions and identify the potential impact of the project on the biological-ecological environment,
- Describe the existing socio-economic conditions and identify the potential impact of the project on the socio-economic conditions,
- Describe and analyses the sustainability of the operation and maintenance of the project,
- Recapitulate the mitigation actions that have been taken, and those suggested to minimise negative impact,
- Recommend the appropriate environmental monitoring and management programme that enables control of compliance with the assumptions of the EIA, and compliance with possible environmental quality objectives for the project,
- Recommend the appropriate audit programme.

3.2 Components

The results of the concept design preliminary EIA and preliminary design studies shall be made available to the Detailed Environmental Impact Assessment Consultant.

The Detailed Environmental Impact Assessment of the “[Insert project name]” shall be accomplished using a generally accepted analytical process. The analysis shall include but need not be limited to the following elements:

Bounding: The process of bounding is setting the limits of the study area. This area shall cover any Sabah territory - at land or at sea - that is influenced to any degree by the project.

Scoping: In the scoping procedure, the relevant problems for the study shall be selected. A checklist of possible/potential impacts may be used as a basis. However, the items listed below in sections 4.2 and 4.3 shall be included in the problems to be studied. The scoping shall include the definition of environmental quality objectives for the project. These include but need not necessarily be limited to:

- Definition of primary and secondary impact zones
- Definition of limits of acceptable change within these zones

These quality objectives may be updated throughout the course of the investigations.

Investigation: In the investigation phase the necessary data and information for the assessment shall be collected and assimilated into a baseline for the area.

Quantification: A quantification of the specific environmental impact of the individual components is accomplished through the use of numerical models and other appropriate analytical techniques.

Participation: Information is passed on to relevant authorities and the public for their comments.

Analysis: Information is transferred into one or more reports that includes the findings and presents them in a form where the information is prepared for use in decision-making.

Mitigation: An analysis of the possible actions in the form of, for example, changed design, changed behaviour, protective works, cleaning techniques etc., that can be introduced to mitigate the negative impact of the project.

Monitoring: A plan for an environmental monitoring and management programme that can control the compliance with quality objectives and check the predictions of the Environmental Impact Assessment. Provision of baseline data for the recommended variables are to be included in the programme.

3.3 Study Requirements

The Detailed Environmental Impact Assessment of the “[Insert project name]” shall contain but need not be limited to descriptions and assessments of the following items within the geographical area that may possibly be affected by the reclamation and at the sites where raw materials are exploited, e.g. borrow areas and quarries. In the event that the Consultant chooses to exclude a specific item from their tender, written justification for such exclusion must be provided in the tender submission.

Basic data shall be provided for all items mentioned in the following sub-sections. The data may be supplied from existing sources, but should be supplemented with data from field surveys and recordings as required. The basic requirements of the field survey are listed in Section 5.

3.3.1 Physical-chemical conditions:

Hydraulic circulation

Data pertaining to hydraulic circulation includes the description, assessment and simulation of the present and future prevailing current speeds and directions. The analysis shall include but need not be limited to:

- Simulation of the temporal variation in the current field in the EIA project area over the selected model design period (see section 7) for the pre-construction situation.
- Simulation of the temporal variation in the current field in the EIA project area over the selected model design period for pertinent phases of construction
- Simulation of the temporal variation in the current field in the EIA project area over the selected model design period for the post construction situation.
- The simulations should investigate a minimum of 3 schemes, the preliminary design as supplied by the developer plus two modifications to this design aimed at minimising the potential impact of the project and/or reducing post construction maintenance requirements to increase operational efficiency.
- Analysis must consider relevant seasonal variations.
- Analysis must clearly document the impact of the project on the regional and local current flux.
- Analysis must clearly document the impact of the project on the regional and local current speed.

For the analysis it is necessary to use computerised hydrodynamic modelling as per the specification in section 6.

Boundary data for the local hydraulic model of the project area is available in digital form from the SMP project through DID Kota Kinabalu.

Wave conditions

The analysis of wave conditions entails the description, assessment and simulation of the present and future prevailing wave heights and directions. The analysis shall include but need not be limited to:

- Simulation of the prevailing wave conditions in the project area prior to construction, pertinent stages during construction and the post construction scenario.
- The simulations should investigate a minimum of 3 schemes, that is, the preliminary design as supplied by the developer plus two modifications to this design aimed at minimising the potential impact of the project and/or reducing post construction maintenance requirements to increase operational efficiency.
- Analysis must investigate the change in wave height caused by the project. In those cases where the project causes large longshore gradients in wave height/set-up, radiation stress driven circulations must be included in at least one hydraulic circulation simulation.

- Areas of wave concentration resulting from the project must be identified and the possible impact of these concentrations on coastal erosion assessed.

Boundary data for the local wave model of the project area is available in digital form from the SMP project through DID Kota Kinabalu.

Coastal morphology

Analysis of this item will include the description, assessment and simulation of the present and future coastal morphology and the dominant coastal processes including but not limited to:

- Identification of littoral cells, sub-cells and management units within the EIA boundaries including quantification of the littoral sediment budget and its seasonal variation.
- Impact of the project upon regional and local morphological processes including erosion and sedimentation of cohesive and non-cohesive material as relevant.
- Coastal defence requirements, strategies, options and effectiveness.
- Impact of the project upon local sedimentation arising from rivers, storm drains and/or the sea with particular reference to maintenance requirements for drainage reserves and/or channels and basins with the development.

For the analysis it is necessary to use a combination of 1D and 2D computerised sediment transport modelling as per the specification in section 6.

Water quality

This item includes the description and assessment of the present water quality, and the water quality during the construction phase and after the completion of the project. For the analysis it is necessary to use computerised water quality modelling, as the assessment shall include but need not be limited to:

- Simulation of the temporal and spatial water quality of the existing sea and estuary areas covered by the EIA project over the selected model design period (see section 7) for the pre-construction situation. A conservative tracer should be utilized in the immediate area of interest of the project area. A second set of simulations should be performed to investigate the flushing of the conservative tracer from the major pollution sources.
- Simulation of the temporal and spatial performance of the proposed project area over the selected model design period. A conservative tracer should be utilized in the immediate area of interest of the project area. A second set of simulations should be performed to investigate the flushing of the conservative tracer from the major pollution sources. A relative comparison of flushing performance for three layouts should be investigated, enabling the identification of a preferred design from the point of view of flushing characteristics.
- Simulation of the impact of the preferred project design on hygienic conditions, in particular bathing water quality, levels of *E. coli* and total coliform bacteria, dissolved oxygen and biological oxygen demand, should be performed. In those cases where water quality is decreased, mitigation measures should be formulated.

- Simulation of the impact of the preferred project design on water turbidity (Secchi depth and suspended sediment) should be performed for pertinent phases of construction and in the post construction situation for the preferred project design.
- The impacts resulting from the release of nutrients, noxious substances and oxygen-consuming substances during dredging and landfill operations shall be specifically addressed and evaluated.

Persistent substances

Study of this item aims to describe the use and discharge of heavy metals and persistent organic compounds, and assess their impact during the construction phase and after the completion of the project. The assessment shall include but need not be limited to:

- Simulation of the impact of the project on the transport and dispersion of noxious substances: metals, organic pollutants, oil and grease in the surrounding seawater as relevant.
- Release, distribution and effects of such substances due to dredging and reclamation shall be quantified and assessed
- Release, distribution and effects of such substances which might be released during the operation of the project shall be quantified and assessed
- Release, distribution and effects of such substances due to changed currents and waves caused by the reclamation shall be quantified and assessed

For the analysis it is necessary to use computerised water quality modelling.

Extreme events

Description, assessment and simulation of the present and future actions of extreme waves and flooding. The assessment shall include but need not be limited to:

- Transformation of extreme wave climate to site of interest by numerical modelling
- Establish extreme water levels from reliable statistical sources or hindcast at the point of interest
- Establish the impact of project on extreme waves and water levels by numerical modelling

For the analysis it is necessary to use computerised wave and hydrodynamic modelling. Offshore wind and wave data which may be required for this is available in digital format through the SMP from DID Kota Kinabalu.

Drainage

Description, assessment and simulation of the impact of the project on the hinterland drainage capacity. The assessment shall include but need not be limited to:

- Establishment of design flows in the relevant drainage channels discharging into the project area.

- Simulation of the backwater effect in the drains as a result of the proposed development.
- Optimisation of the drainage reserve and or identification of other measures necessary to mitigate potential impacts on the hinterland drainage capacity.

For the analysis it is necessary to use computerised 1D and/or 2D hydrodynamic modelling.

Borrow materials

Description of the place, type and amount (including estimates of net loss) of material and methods used for the extraction of borrow materials from the seabed. Assessment of the impact on the adjacent physical-chemical environment due to dredging and sand extraction at the dredging location and at adjacent areas. The analysis shall include but need not be limited to:

- Simulation of the transport and dispersion of suspended sediments released from the borrow area due to the dredging process. Source strengths should be representative of the dredging practices likely to be adopted and the composition of the borrow material at the site.
- The design period of the suspended sediment simulations should be sufficiently long to establish a dynamic equilibrium in the plume excursion. Reliable estimates of the fall velocity composition of the material likely to be released into suspension are required. The simulations must include the effects of local wind and waves, including the possible effects on the current profile.
- Maps of the excess suspended sediment concentration, light attenuation at the bed and sedimentation fields should be produced for input to the habitat impact studies.
- Simulations should investigate the effect of alternative dredging practices and provide a basic optimisation of mitigation measures required to obtain acceptable environmental quality objectives

For the analysis it is necessary to use computerised sediment plume modelling.

Reclamation works

Analysis concerning the reclamation works shall include the description of the methods used for the reclamation fill and an assessment of the impact on the adjacent physical-chemical environment due to the spill of sediments from the reclamation works. The analysis shall include but need not be limited to:

- Simulation of the transport and dispersion of suspended sediments released from the reclamation area. Source strengths should be representative of the operating practices likely to be adopted and the composition of the borrow material after hydraulic sorting. Suspended sediment input due to resuspension of fine material from the outer facet of unprotected bunding is to be included.
- The design period of the suspended sediment simulations should be sufficiently long to establish a dynamic equilibrium in the plume excursion. Reliable estimates of the fall velocity composition of the material likely to be released into

suspension are required. The simulations must include the effects of local wind and waves, including the possible effects on the current profile.

- Maps of the excess suspended sediment concentration, light attenuation at the bed and sedimentation fields should be produced for input to the habitat impact studies.
- Simulations should investigate the effect of alternative operating practices and provide a basic optimisation of mitigation measures required obtaining acceptable environmental quality objectives.

For the analysis it is necessary to use computerised sediment plume modelling.

3.3.2 Biological-ecological conditions:

Coral reefs

Description and assessment of the present distribution, biodiversity and health of coral reefs, and impacts both during the construction phase and after the completion of the project. The assessment shall include but need not be limited to:

- Effects of sediment plumes and sedimentation during the construction phase
- Effects of changed sedimentation and water turbidity due to changed currents and waves caused by the reclamation
- Effects of changed water turbidity due to discharges caused by the project
- The area and condition of coral reef directly covered by reclamation

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

Mangroves

Description and assessment of the present distribution and condition of mangrove forests, and impact both during the construction phase and after the completion of the project. The study must include but need not be limited to:

- Effects of changed sedimentation and erosion due to changed currents and waves caused by the reclamation
- Effects of sedimentation and erosion caused by the construction work
- The area and state of mangrove vegetation directly covered by reclamation
- Areas where mangrove vegetation is assessed to develop or disappear due to the project

For the analysis it is necessary to use the results of the above mentioned computerised sedimentation and wave modelling.

Sea grass beds

Description and assessment of the present distribution and living state, and impact during the construction phase, and after the completion of the project. The analysis shall include but need not be limited to:

- Effects of sediment plumes and sedimentation during the construction phase
- Effects of changed sedimentation and water turbidity due to changed currents and waves caused by the reclamation
- Effects of changed water turbidity due to discharges caused by the projects
- Areas where sea grass beds are assessed to develop or disappear due to the project

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

Soft bottom macrozoobenthos

Description and assessment of the present distribution, species composition and richness, and impact during the construction phase including borrow areas, and after the completion of the project. The analysis shall embrace but need not be limited to areas and benthic community types where soft bottom macrozoobenthos is assessed to disappear due to the sand extraction, land reclamation or other impacts of the project.

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

Endangered species

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

- Marine parks
- Wildlife and bird sanctuaries
- Other areas regulated for nature protection purposes
- Sea turtles and sea turtle nesting sites
- Certain ornamental organisms such as single soft coral colonies, and beautiful snail and mussel shells
- The impact of an increased number of tourists, their (planned) activities and their souvenir requirements

Eutrophication

Description of the present conditions concerning nutrient dynamics, algae blooms, and water turbidity (Secchi depth). The assessment shall include but need not be limited to:

- The impact of increased load of domestic pollution

- The impact of increased load of nutrients due to the increase in use of fertilisers
- The impact caused by the change in the hydraulic conditions due to reclamation
- The potential for algae blooms (red tide)
- The changes in water turbidity
- The changes in algal production (chlorophyll-a and primary production)
- Impact during dredging and landfill operations shall be especially addressed

For the analysis it is necessary to use computerised eutrophication modelling.

Terrestrial ecosystems

Description and assessment of the effect on adjacent terrestrial ecosystems of utilising land materials for revetments, bridge and road construction, and for primary armour protection. The investigation shall cover but need not be limited to:

- The size, the flora and fauna, and ecological conditions of the area where raw materials are taken and its foreseen development

3.3.3 Socio-cultural conditions:

Aesthetic and Recreational value

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

- Computerised visual impact assessment from important locations or facilities of public value for example existing hotels, beaches, residential areas, public parks etc.
- Polling of affected population using RRA or similar techniques to assess the perceived impacts of the project by the populace.

Income

Description and assessment of the effects of the project on the income generation for the coastal community. The investigation shall cover but need not be limited to:

- Polling of affected population using RRA or similar techniques to assess the perceived impacts of the project by the populace.
- Analysis of the potential capital returns of the development in terms of salary payments, earnings to third parties and capital return to the developers. This shall be compared to the overall construction investment.

Employment

Description and assessment of the effects of the project on the employment opportunities. The investigation shall cover but need not be limited to:

- Identification of the number and category of jobs likely to be created by the development during construction and in the operation phase.
- Identification of the age group, sexes, and profile of the required categories of the work force.
- Influence upon local salary level
- Identification of the existing employment structure in the area where the workforce is likely to be drawn and the possible benefits/dis-benefits to the local community resulting from this shift in employment structure.

Fishery and aquaculture

Fisheries and aquaculture are important resources along the west coast of Sabah and careful consideration of the impacts in this field are required, for both during the construction phase and after the completion of the project. The locations of present and planned aquaculture sites should be detailed, and the assessment of these must comprise but need not be limited to:

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

Quarries and earth borrow sites

Description and assessment of the supply of durable armour stones for revetments, headlands and breakwaters from quarries, its impact on the physical-chemical environment in the vicinity of the quarries and on the roads along possible transport routes. The study must include but need not be limited to:

- Definition of the type and amount of quarry material required for the development
- Existing and required quarry capacity to obtain the required armour volumes
- Definition of transportation routes and transportation volumes
- Definition of the type and amount of topsoil earth fill required for the development
- Identification of existing and required borrow site capacity to obtain the required topsoil volumes

- In the event that the project requires new or expanded quarries, a separate EIA for the quarry must be initiated in accordance with the appropriate DOE guidelines.
- Documentation of the existing road quality, traffic volumes and potential hazard areas resulting from increased heavy traffic
- Documentation of increased noise and dust levels likely to result from increased heavy traffic volume.

Housing and urban development

Description and assessment of the present situation, the situation during the construction phase, and after the completion of the project with respect to demand for housing and risk for spontaneous settlements both in the vicinity of the project and in the hinterland.

Cost of living

Description and assessment of the effect of the project on the cost of living for the local population, e.g. property values and food prices.

Cultural heritage

Description and assessment of the effect of the project on the traditional, cultural and historical sites, items etc. In this context, archaeological sites both on land, in the reclamation area and borrow area should be described.

Public health

Description and assessment of the effect of the project on community health and well being as a result of activities during construction and competitive demand for social amenities. The analysis shall include but need not be limited to:

- Noise levels
- Dust levels
- Bathing water quality

A computerised model for dust plume excursion should be utilised for the reclamation site.

Utilities

Description and assessment of the effect of the project on accessibility to utilities such as water, electricity, telephones etc., including increased competition with the demands from the tourist sector.

3.3.4 Economic and operational conditions:

Infrastructure

Description and assessment of the impact of the project on the existing infrastructure during the construction phase, and after the completion of the project. The analysis shall embrace but need not be limited to:

- Pressure upon existing roads
- Development of roads as consequence of the project

Utilities

Description and assessment of the impact of the project on the existing utilities during the construction phase, and after the completion of the project. The analysis shall embrace but need not be limited to:

- Pressure upon existing power supply
- Development of power supply as consequence of the project
- Pressure upon existing communication systems
- Development of communication systems as consequence of the project

Maintenance

Description of the need for special maintenance and assessment of costs, sustainability, and impact of those activities of the project after the completion. The assessment shall include but need not be limited to:

- Dredging for navigation or to avoid siltation
- Restoration of revetments
- Nourishment and cleaning of beaches, etc.

Navigation

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

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

Solid waste

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

- Planned collection system

- Amount and type of solid waste
- Waste disposal operation at landfills or other disposal measures such as incineration

Water Supply

Description and assessment of the water supply systems during the construction phase, and after the completion of the project and the impact on freshwater resources and water supply in other areas. The study shall embrace but need not be limited to:

- Pressure upon existing water supply
- Existing and future freshwater and drinking water resources
- Development of water supply as consequence of the project

Waste water treatment

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

- Planned collection and waste water treatment system,
- Problems that may occur in the operation of wastewater treatment systems or wastewater discharge (water quality, smell, noise etc.) The discharge of wastewater must be included in the water quality model.
- Operational demands for waste water treatment

Customer base

Description and assessment of the effect of the project on the future tourism in Sabah. The analysis must comprise but need not be limited to:

- Existing and future customer base
- Competition for customers
- Types and potential for expansion of customer base
- Possibility for the tourist industry development on the shore and hinterland, and for other tourism areas in Sabah

Regional economy

Description and assessment of the effect of the project on the economy of the region. The assessment must include but need not be limited to:

- Attraction of investments
- Influence upon payment balance
- Influence upon taxation base

4. FIELD SURVEY REQUIREMENTS

The Consultant is required to perform the following minimum field surveys, unless recent equivalent information is available from the site.

Bathymetry

A detailed bathymetry survey of the site shall be performed. The coverage of this survey should include the reclamation area and all water areas within a minimum of 2 km of the reclamation boundary. The survey resolution shall be at least 50m between lines and 10m down line. Coincident high resolution water level recordings are required from a minimum of 1 station for a minimum of 29 days irrespective of the type of bathymetric survey equipment.

Current Measurements

To provide detailed local calibration and verification of the hydraulic model, a self-recording directional current meter should be deployed for a minimum of 15 - 30 days (depending upon the complexity of the area). Simultaneous recording of rain, wind and water level by separate instruments should also be executed. Due to the weak current velocities encountered off the West Coast of Sabah, acoustic doppler instrumentation is preferable. At sites where through flow between the mainland and nearshore islands is important or where the site includes tidal lagoons with mangrove fringe, ADCP flux profiling is essential for quantification of through flow and/or tidal prism.

Suspended Solids

Suspended solid measurements should be taken from all significant discharge channels in the area. One sample per day for a period of 15 – 30 days coincident with the offshore current measurements is required. The water flux in the channels should be recorded at the same time as the suspended solid measurements.

Analysis of the suspended solid samples should include suspended solid content (mg/l) by micropore filter technique (all samples), suspended solid grading or fall velocity by hydrometer or oven tube technique (2 samples per drainage channel).

Suspended solid measurements should also be taken from a minimum of 3 offshore stations in the project area. One sample per day for a period of 15 – 30 days coincident with the current measurements is required. Analysis should be as per drainage channel.

Bottom Sediments

A comprehensive bottom sediment survey of the area surrounding the proposed reclamation and within the proposed borrow area should be performed. Visual classification of samples is sufficient to detect spatial variance. A minimum of 10 samples around the reclamation and 20 samples from the identified borrow area must be analysed for grading by an appropriate technique. Layer thickness of borrow material and soft bed overburden areas in the borrow area and at the reclamation site shall be determined by appropriate tools.

Water Quality

The following minimum variables shall be analysed in the samples from any rivers; streams or major surface drain outlets discharging into the project area. The sampling shall be repeated a sufficient number of times to allow the determination of the pollution loading from the various river and drain sources. Measurements must include channel cross section and spot flow measurements in order to establish total flux.

- Ammonium Nitrogen (NH_4^+)
- Oxidised Nitrogen (NO_2^- , NO_3^-)
- Total Nitrogen
- Phosphate Phosphorous (PO_4^{---})
- Total Phosphorous
- Coliform bacteria
- Biological Oxygen Demand (BOD)
- Copper, Lead, Chromium and Cadmium (total concentrations)

The following minimum variables shall be analysed in the samples from representative coastal stations:

- Ammonium Nitrogen (NH_4^+)
- Oxidised Nitrogen (NO_2^- , NO_3^-)
- Total Nitrogen
- Phosphate Phosphorous (PO_4^{---})
- Total Phosphorous
- Coliform Bacteria
- Chlorophyll concentration
- Biological Oxygen Demand (BOD)
- Oxygen concentration
- Oxygen saturation
- Secchi depth
- Temperature
- Salinity
- Copper, Lead, Chromium and Cadmium (total concentrations)

An independent quality control procedure must be set-up by the Consultant to ensure reliable analyses results are obtained from the laboratory.

Marine Habitats

- **Survey of Intertidal Benthic Community**

A survey should be conducted to obtain baseline ecological information and to identify and quantitatively assess the floral and faunal components of the intertidal community, and to document any seasonal fluctuations. The extent and status of mangrove areas should be included in this survey item. Control areas within the mangrove fringe shall be identified and instrumented in order to form baseline data for the environmental monitoring and management plan. The required measurements are described in the supporting TOR for Environmental Monitoring and Management Plan. Particular attention must be paid to identifying primary and secondary drainage channels within the mangrove fringe such that the impacts of construction work on the tidal exchange within the mangrove system can be established.

- **Survey of Sub-tidal Benthic Community**

This survey should be separated into two main tasks. The first is to sample the benthic community, specifically the presence of soft corals and corals, and the second is to sample the ichthyoplankton to assess the value of the site as a nursery and spawning ground for commercial fisheries. An underwater survey is therefore required to locate and document the extent and status of the following types of habitats in the project area:

- Soft bottom communities
- Corals (if present)
- Seagrasses (if present)
- Macroalgae
- Fish

Control areas within the coral and seagrass communities shall be identified and instrumented in order to form baseline data for the environmental monitoring and management plan. The required measurements are described in the supporting TOR for Environmental Monitoring and Management Plan.

Vegetation Survey

A vegetation survey shall be undertaken to establish the baseline information on the floral characteristics of the area directly and/or indirectly affected by the project, and to identify the presence of any protected or rare and endangered species.

Ornithological Survey

An ornithological survey shall be performed to establish baseline information on species diversity and their relative abundance, with focus on identifying key habitats or key breeding areas, as well as the associated breeding species and their abundance.

Visual Survey

A comprehensive photographic mapping of viewing corridors in the study area shall be undertaken for input to the aesthetic impact assessment.

Social-Cultural Survey

Identification of key communities, occupations and recreational activities likely to be impacted by the proposed development. The survey should specifically target:

- Nearshore fishermen
- Foreshore property owners

Of particular interest is the catch and income derived from fishing activities in and around the reclamation and borrow areas.

The survey shall be performed using RRA or similar questionnaire techniques.

A detailed survey and documentation of all cultural and historical sites within the impact area of the development. This may require an underwater survey for identification of wrecks and/or other submerged archaeological sites.

Infrastructure Survey

Documentation of the loading and operational status of all roads likely to be impacted by the development.

5. MONITORING AND CONTROL PROGRAMME

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

- It shall include variables that monitor the ecological and environmental status of features that have been identified to be potentially impacted by the project
- It shall include variables that enable an immediate identification of situations where major environmental quality objectives are exceeded.
- It shall include stations in the monitoring programme in areas that are outside the impact area of the project to provide a non-effect reference
- It shall include a selected number of variables that can act as feed-back variables during the construction phase which possess a sufficient degree of sensitivity to unforeseen negative effects of the project, i.e.:
 - variables that are representative to the most important ecosystems;
 - variables where a limit for transgression can be fixed prior to the possible impact;
 - variables that show a fast response time with respect to the impacts of the project;
 - variables where results of the analyses can be available within 2-3 weeks.
- It shall make use of tools that can forecast the potential impacts on selected variables (e.g. suspended sediment concentration and sedimentation) and provide a continuous update of the temporal and spatial distribution of impacts during the construction period through hindcast modelling coupled with dose-response relationships derived from the biological monitoring of the marine habitats
- It shall provide baseline data for the monitoring and control programme collected before the initiation of the project in order to enable comparison during the construction and after completion of the project

The EMP specifications should follow the TOR guidelines for EMP available from MCET tailored to the specific site conditions.

6. MATHEMATICAL MODELLING

The mathematical models that are to be used in connection with the assessment shall comply with the following requirements:

- The flow model shall be at least a fully dynamic 2-dimensional depth integrated model. It must be properly calibrated and validated with field data to accurately simulate the tidal flow and residue flows due to wind and/or ocean currents. The model must include the effects of flooding and drying and such factors as coriolis bottom friction, etc. The hydraulic flow model must be able to include the effects of wave drive circulation.
- The models shall be set up to investigate the pre-construction situation, pertinent phases during construction and the post construction situation.
- The wave model/models must be able to include the effects of refraction, (diffraction), shoaling, breaking, wind generation and bottom friction. It must be properly calibrated and validated with field data. The model (or models) should either be spectrally or mild slope based.
- The water quality variables covered by the models shall include, but not be limited to, dissolved oxygen, BOD, suspended solids, *E. coli*, inorganic and organic nitrogen, phytoplankton, and inorganic and organic phosphorous. It must take into account the interaction between the variables, and it must be properly calibrated and validated with field data. The models shall be able to calculate the Secchi disk depth from the simulated variables. The water quality model shall be dynamically coupled with the hydrodynamic and dispersion model.
- The sediment transport model must include the effects of combined wave current action on the transport capacity and variable bottom sediment conditions including immobile areas.
- The sediment plume model should be able to include the effects of periodic discharge, multiple sediment fractions, concentration-dependent settling sedimentation and re-suspension. Further, the model should be able to include the effects of waves on the settling and re-suspension processes. The sediment plume model should be dynamically coupled to the hydraulic model.
- The models shall be sufficiently detailed in time and spatial scale as to resolve channels between the reclamation and any drainage reserve to the hinterland. Not less than 3 grid points/cells shall be used for resolving the channels spatially. The consultant shall state the recommended grid area, grid size and time steps to be used for the modelling.
- The simulation period should cover at least 14 days for hydraulic flushing sediment plume and water quality. The simulation period for eutrophication modelling should be at least one month but preferably longer to enable a dynamic equilibrium in the model to be reached.

7. OUTPUT

The deliverables of the Detailed Environmental Impact Assessment for the “[Insert project name]” shall include:

- An inception report describing the detailed approach to the study. The approach shall be accepted by the client and MCET, DID and DOE before the commencement of the main body of the study.
- A report describing the development project that documents:
 - Why the project has been approved at the concept and preliminary EIA stage
 - Overall design of the island, sizes and function.
 - Project location showing regional and local setting in a recognised co-ordinate system
 - Planar aerial photograph or high-resolution remote sensing image of the site showing the boundaries of the project and pertinent local features.
 - Shore and inter-island connections
 - Pre- and post-project bathymetry
 - Volume requirements for reclamation, types and sources
 - Perimeter protection design, material requirements, types and sources
 - Planned exploitation, type, number of employees, number of visitors, housing, etc.
 - Utilities: water supply, power supply, sewage treatment, solid waste disposal
- A report describing the results of the field campaign. All data must be captured in digital form and supplied to TRPD for updating the baseline environmental database. All spatial data must be presented in maps with appropriate scale and clearly marked co-ordinate system.
- A report describing the results of the calibration of the appropriate numerical models, including collected data and the existing conditions (baseline).
- A report describing the results of the Environmental Impact Assessment as outlined in the previous sections. The report shall include a description of the recommended mitigation actions and revised plans whenever the need for mitigation actions makes it necessary.
- A report containing the baseline data required for the monitoring, and describing the monitoring programme that is considered necessary to ensure compliance with the environmental criteria during and after the accomplishment of the project.

All reports shall be provided with a short executive summary that resumes the problems, methods used, and the basic findings, conclusions and recommendations. The executive summary shall be written in an easily accessible form with a parallel copy in Malay.

Five copies of the draft report and 10 copies of the final report shall be submitted.

8. QUALITY ASSURANCE AND QUALITY CONTROL

Upon tendering, the consultant is required to document in brief the quality assurance and quality control procedures to be adopted. Within 2 weeks of commissioning the consultant is required to produce a full quality control manual for review and acceptance by the client. The following points should be considered essential components of the quality manual:

- Quality control procedures for laboratory analysis
- Quality control procedures for the capture and analysis of field information
- Quality control procedures for numerical model simulations
- Document control

9. TENDER REQUIREMENTS

9.1 Description of the Environmental Impact Assessment

The consultant shall describe the Detailed Environmental Impact Assessment to be performed. The description shall include but need not be limited to the following items:

- A brief description of the environment at site. The pertinent physical, ecological and socio-cultural features, which the consultant feels likely to be important to the feasibility of the project and impact assessment, should be highlighted.
- A description of the field investigations, coverage and techniques to be employed.
- A description of the modelling tools to be set-up with particular reference to the spatial coverage and resolution and the temporal coverage.
- A description of how the data from the field campaigns and numerical models will be analysed and integrated to form a multi-sectoral impact assessment.
- A description of the preliminary impact assessment criterion upon which the environmental feasibility of the project will be judged.
- A description of how mitigating measures will be introduced into the models and impact assessment and how the performance of these measures will be assessed.
- A description of the system for data management.
- A preliminary quality assurance plan.

9.2 Organisation

9.2.1 Consulting Team

The consultant shall provide details of personnel engaged, field investigation methods, and numerical models to be used to provide the various input for the Detailed Environmental Impact Assessment of the “[Insert project name]”.

9.2.2 Work Plan

The consultant shall provide a detailed, realistic work plan for the accomplishment of the project. The work plan shall indicate important milestones that enable the client to monitor the progress of the work.

9.2.3 Management

The consultant shall assign the consultants’ project manager, who should be experienced in Environmental Impact Assessment.

A project Steering Committee shall be appointed by the client to steer, manage and coordinate the project. The Department of Town and Regional Planning, Drainage and Irrigation Department, and Ministry of Culture, Environment and Tourism of the state of Sabah shall be represented in the Steering Committee. At regular intervals the Steering Committee shall meet with the consultant's project manager to discuss the progress of the Detailed Environmental Impact Assessment.