

## 7 Economic Valuation Analysis

Notwithstanding the economic benefits flowing from this project, the reclamation and construction of the facilities, along with associated project activities, will negatively impact the flow of environmental services that are currently benefiting various stakeholders. Many of these impacts will be effectively minimized, when various mitigation measures proposed in the DEIA are implemented. However, some of the negative impacts cannot be completely mitigated thus justifying the need to quantify in monetary terms, the reduction in environmental services flows from the altered environment during reclamation, construction and operation. This section addresses this need.

Note though, that even though the economic valuation of environmental impacts presented in this report is not a complete cost-benefit analysis, it will provide a quantified assessment of the expected loss or gain in services.

The objective of this valuation exercise is provided next, and is followed by a summary of the methodology, and subsequently the identification and valuation of environmental impacts is provided. This section concludes by providing an overall assessment of impacts over the valuation period. The details provided here are a summary and the full report is available in Appendix M.

### 7.1 Evaluation Objectives

The economic valuation of environmental impacts aims at assessing the impacts of the proposed project on the flow of environmental services. This objective is achieved by quantifying the change in service flows from environmental resources (if any) arising from project implementation.

### 7.2 Methods

A critical step in the valuation process revolves around the need to ensure valid attribution of impacts on environmental services to the proposed project. In order to satisfy this requirement, the approach required is the establishment of a clear link between project impacts on the physical functions of the environment and the alteration of the quality and quantity of streams of environmental goods and services. The Guidelines on the Economic Valuation of the Environmental Impacts for EIA Projects requires the establishment of explicit links between physical impacts on the flow of environmental goods and services on the one hand, and project development on the other, by undertaking to...*identify and quantify the changes in the flow of environmental goods and services... which are impacted by a development project, and then to monetize these changes into costs or benefits.*

The valuation procedure can be broken down into nine sequential steps as follows:

Step 1: Determine the project stakeholders.

Step 2: Define the “with project” and “without project” scenario.

Step 3: Depict the physical impacts.

Step 4: Quantify the impacts on the environment over the duration of the project.

Step 5: Monetize the impacts.

Step 6: Discounting.

Step 7: Determine the Net Present Value.

Step 8: Perform sensitivity analysis using different discount rates (2%, 6% and 10%)

Step 9: Make a recommendation based on magnitude of Net Present Values at different levels of discount rates.

### 7.3 Identification of Incremental Gains and Losses

As indicated earlier, only incremental or marginal impacts on environmental services (losses or gains) are considered in the analysis. Considering only incremental losses and gains means that only changes in environmental services as a result of choosing the “with project” option (instead of “without project”) is included in the study.

Table 7.1 below provides a list of nine environmental services that could potentially be affected by the project. It also shows the corresponding location/s, extent and nature of impacts for each of the component. Further explanations are given for those impacts that require evaluation.

### 7.4 Valuation of Gains and Losses

Of the ten items listed in Table 7.1 five give rise to potentially significant negative environmental impacts that can be quantified and therefore evaluated in this study. These are items:

- 1. Marine biology - Reclamation
- 2. Marine biology - Dredging
- 3. Terrestrial biology – Loss and regeneration of mangrove
- 8. Socio-economy - Loss of fishing ground and direct access to sea
- 9. Aesthetic/Recreation - Loss of sea-view and recreational value

Further description of the impacts and a summary of the valuation methodology are also provided in the same table.

Table 7.1 Summary of Environmental Services Effected by the Project

Components	Environmental Services Affected <sup>1</sup>	Location and Extent of Impacts /Stakeholders	Additional Notes
Marine Biology (Reclamation)	Productive and consumption services of the mudflat or muddy seabed of the reclamation area (total loss).	Footprint of the reclaimed area. Fishermen and locals.	The loss quantified using benefit transfer method

<sup>1</sup> Environmental services refer to qualitative functions of natural non-produced assets of land, water and air. They are typically categorized into: a) disposal services which reflect the functions of the natural environment as an absorptive sink, (b) productive services which reflect the economic functions of providing natural resource inputs and space for production and consumption, and (c) consumption services which provide for physiological as well as recreational and related needs of human beings. (Source: Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997).

Components	Environmental Services Affected <sup>1</sup>	Location and Extent of Impacts /Stakeholders	Additional Notes
Marine Biology (capital and maintenance dredging)	Loss in productive and consumption services due to removal	145 hectares will be dredged during Phase 2 to the east of the reclaimed land.  Fishermen and locals.	Assume maintenance dredging every 4 to 5 years, and benthic communities recover at a constant rate throughout each cycle
Terrestrial Biology	Loss of disposal, productive and consumption services due to removal of mangrove area for bridge construction.  Some compensated by regeneration of mangrove area	Bridge construction, area approximately 0.17 hectare in size.  Regenerate 115 hectares of mangrove.	Regeneration of mangrove is expected since the reclamation and the berthing structures are seen to provide protection from the incoming wave energy.
Air Quality	Air emission of TSP, NO <sub>2</sub> , SO <sub>2</sub> , CO and VOC will affect the general health of the population.	Surrounding area of up to 5 km.  Surrounding population.	The maximum incremental GLC of all pollutants are low No valuation is necessary.
Water quality	Increased in suspended TSS during dredging and reclamation.	Water bodies at and around the dredging and reclamation area.  Other biological ESAs	With mitigating measures maximum TSS concentrations of above 250mg/l are confined to the immediate work area.  No valuation is necessary.
Coastal Morphology	Erosion and sedimentation due to the effect of reclaimed land and jetty to the coastal area	Findings of the hydraulic study suggest that erosion is insignificant. Some positive impact of mangrove regeneration on the eastern coastline	No valuation is necessary
Human Safety	Major hazards associated with storage and handling of hazardous substance.	The quantitative risk assessment indicates that the $1 \times 10^{-6}$ per year IR is within the 300 m Primary Buffer Zone. The IR contour does not encompass involuntary recipients of industrial risk	The probable damage to human life is negligible and thus no valuation is necessary.
Socio-economy	The loss in fishing ground to make way for the reclaimed land.	Reclaimed area as well as the area that will be declared as marine exclusion zone for terminal security.  The directly affected stakeholders are 373 fishermen	The value of loss in fishing ground and direct access to the sea is estimated by the additional fuel cost to go to alternative grounds.

Components	Environmental Services Affected <sup>1</sup>	Location and Extent of Impacts /Stakeholders	Additional Notes
Aesthetic/ Recreational Value	Loss of sea-view, recreational value of waterbody fronting Tg Piai Resort.	Tg Piai state park and Tg Piai Resort. /Visitors (locals or outsiders) to the area.	The loss in aesthetic and recreational value using hedonic pricing method.

#### 7.4.1 Marine Biology (Loss of Mudflat and Muddy Seabed due to Reclamation)

Reclamation will result in permanent loss of the mudflat/muddy seabed. The total area that will be affected (i.e. the footprint of the reclamation) is 1,411 hectares (72.6 hectares of mudflat in Phase 3 and 1,338.4 hectares of muddy seabed on all phases). The loss of this area, and hence the environmental services obtainable from it, is permanent.

Some fishery resources like cockles, bivalves and gastropods/snails and shrimps use the mudflat/muddy seabed as habitat. Some of these organisms are food source for fish. The mudflat/muddy seabed also serves as crustacean feeding ground.

The total size of mudflats in Peninsular Malaysia is estimated at 35,064 hectares. The direct use value of mudflat per year is determined by dividing the estimates on the annual value of the production by the total size of mudflats. The loss in environmental service (RM/Hectare/Year) by type of organisms due to a reduction in the size of mudflat (adjusted for price increase at the rate of 3% per year) is shown in Table 7.2.

Table 7.2 Estimated Resource Value of Mudflat (2014 price)

Type	Unit Value (RM per hectare per year)
Cockles	2,704.53
Bi valves	1,809.13
Gastropods/snails	17.69
Shrimps	148.71
Fish and prawn	94.01
<b>Total</b>	<b>4,774.08</b>

Aggregating the losses across organisms gives a total of RM 4,774.08/hectare per year. For the current project, the value of environmental services forgone from the loss of mudflat is obtained by multiplying the size of the affected area (1,411 hectares) by the estimated value of environmental service (i.e. RM4,774.08/hectare/year).

#### 7.4.2 Marine Biology (Loss of Mudflat or Muddy Seabed in the Dredged Area)

Removal of muddy seabed due to dredging works (capital and maintenance dredging) will take place in an area of 145 hectares during Phase 2 of project implementation, to the east of the reclaimed land. The benthic communities are however known to be relatively quick to recover. This study assumes that the benthic communities recover at a constant rate throughout each dredging cycle.

The estimation of the environmental services lost due to dredging work follows the method used to determine the loss of mudflat due to reclamation (i.e. RM4,774.08/hectare per year). However, unlike the impact due to reclamation, the benthic communities are expected to recover after each dredging cycle. Hence, the loss is reduced as the benthic communities recover until the next maintenance dredging. This method implies that the loss of RM4,774.08/hectare only happens in the first year of dredging and is assumed to gradually

fall at a constant rate until no more loss is registered in the fifth year after the area is dredged. The cycle of losses are then repeated again throughout the project period.

### 7.4.3 Marine Biology (Loss and Regeneration of Mangrove)

A small loss in mangrove area is expected to make way for bridge construction. The area is approximately 0.17 hectare in size. In this evaluation it has been assumed that this loss will be compensated by regeneration of mangrove area once the reclamation footprint is completed. The mangrove areas within the Ramsar site on the coastline east of Tg Piai National Park (North of Tg Piai Monument) fronting the reclaimed land is expected to regenerate. The size is approximately 115 hectares.

Mangroves that are part of the coastal ecosystems that provide a wide range of economic and ecological services. The environmental services provided by mangrove forest (and hence affected by the proposed project) include:

- a Production of charcoal and poles
- b Provision of feeding and breeding grounds for shrimp, fish, crab and mollusk
- c Tourism and recreation
- d Provision of traditional goods
- e Carbon sequestration function
- f Shoreline protection
- g Option, existence and biodiversity values

Table 7.3 provides the estimated environmental cost of mangrove removal per hectare. The total estimated environmental value from the mangrove area is RM14,669 per year. This rate is applied to both the loss in mangrove area for bridge construction as well as mangrove regeneration on the eastern coastline of Tg Piai Ramsar area. However, in the case of regeneration, the gain of 115 hectares of mangrove is assumed over a period of 20 years.

Table 7.3 Estimated Environmental Value of Mangrove Area by Service Type (2014 price)

Environmental Services	Unit Value (RM per hectare per year)
Production of charcoal/poles	2,714.73
Feeding and breeding ground and habitat for shrimp/fish/crab/molusc	5,861.94
Tourism and recreation	1,467.10
Traditional use	-
Carbon sequestration	422.80
Shoreline protection	4,081.10
Biodiversity values	121.41
<b>Total</b>	<b>14,669.08</b>

### 7.4.4 Loss of Fishing Ground and Direct Access to the Sea

Fishing grounds will be lost to make way for the reclaimed land. There will also be additional loss of fishing grounds when the terminal and its port limit is declared as a marine exclusion zone. The reclaimed land mass will also hinder direct movements of fishing vessels. The directly affected stakeholders are 373 fishermen. These fishermen can no longer fish in the area. They will incur additional cost of going to and back from alternative fishing grounds. The additional cost is estimated by the fuel cost to go to alternative grounds.

In estimating this impact, double counting the loss in catch due to a reduction in fish feeding ground must be avoided since it is already captured in the computation of the loss of mudflats and muddy seabed. Hence, the loss of fishing ground in the reclaimed and jetty area cannot be regarded as a loss in fishery resources beyond that computed in the loss of

mudflats and muddy seabed. A critical assumption is that local fishermen do still have other alternative fishing areas. However, they can only do so at a higher cost since they will have to travel further to the fishing ground. In a sense, the reclamation and the construction of the jetty lead to the fishermen losing a type of environmental service from an unhindered coastal area (i.e. direct passage to fishing ground).

Note that for economic evaluation, the relevant cost is the world market price of a resource, not the subsidized price. In order to assess the likely increase in the cost of fuel, the following assumptions are employed:

- The number of fishing days is 26 days in a month.
- 1/3<sup>rd</sup> of boats belong to the three horse power categories of 60, 30 and 15 horse power.
- The additional fuel cost to alternative fishing grounds is 50% of the current cost.

The resulting increase in fuel cost per month is RM 251,472 (60 hp boat), RM 125,736 (30 hp boat) and RM 62,868 (15 hp boat). The total additional fuel cost per year is estimated at RM 5,280,912.

#### 7.4.5 Recreational/Aesthetic Value

Another environmental service obtainable from the area is that it provides a place for water-based recreation. Tg Piai Resort is one stakeholder that relies on water-based recreational activities as its main attraction. Because of the close proximity of the resort to a large scale industrial area following reclamation and operation of the proposed project, it will no longer be feasible for the resort to continue operation. Water sport activities which is the main feature of the resort are no longer safe to be carried out in the area.

The recreational service value that will be lost following project implementation can be estimated based on the current revenue generated by the resort. Based on a discussion with the resort operator in December 2013, the business is expected to lose an annual income of approximately RM3.0 million from room rentals and another RM2.5 million from the sale of food and beverage at the resort annually following project implementation.

Another related environmental service provided by the area is (non-extractive) visual aesthetics enjoyed by visitors to Tg. Piai National Park. The visual impact of the project from the vantage point of Tg Piai National Park is due to the project footprint that is parallel to the entire east coast of Tg Piai. When viewed from this vantage point, visitors will see the increased activity generated by the project especially the during the reclamation and construction phases. After reclamation, the viewscape of the Straits of Johor, will be partly hindered and permanently altered since the reclaimed land will be directly visible.

In 2011, 65,000 people visit Tg. Piai National Park to be at the “southern-most tip” of the Asian continent, to enjoy the board-walk within a mangrove forest and to appreciate the unhindered natural view-scape of the straits. The entrance fee is currently set at RM5 for adult.

Previous studies for mangrove area tend to place the recreational value of mangrove forest (for example Ahmad (2009) for Matang Mangrove Forest) in the region of RM25 to RM50 per visit. For the purpose of this study, a value of RM2 is taken as the value of unhindered natural view-scape of the straits. In order to project the loss over the evaluation period of 50 years, the number of visitors is assumed to grow at an annual rate of 2%.

### 7.5 Overall Assessment

The total value of changes in environmental service flows for a 50-year valuation period at eh three discount rates are provided in the

The complete list of annual accounting is provided in Appendix M.

Table 7.4 Estimates of the total discounted loss in environmental services at the three rates used in the assessment

Discount Rate for 50 Years	Loss of Mudflat (Reclamation)	Loss of Mudflat (Dredged Area)	Loss of Mangrove Area (Bridge)	Mangrove Regeneration (Gain)	Loss of Fishing Ground - Additional Fuel Cost	Aesthetics/ Recreational Value	Net Loss
2%	161,015,310	8,769,687	78,362	-39,001,734	165,945,297	19,852,941	316,659,864
6%	74,884,064	4,232,854	39,306	-15,565,358	83,236,999	8,645,516	155,473,381
10%	43,328,695	2,549,880	24,725	-7,755,343	52,359,263	4,946,425	95,453,645

Changes in service flows were discounted at 2%, 6% and 10% rate. It will be seen that all items register losses in environmental service flows except for mangrove regeneration, noting that this assumption of complete regeneration is somewhat optimistic. The 10% rate is supposed to reflect the market rate of interest usually used for project evaluation. The lower rates of 2% and 6% are more suited for social welfare assessment.

At 2% discount rate, the present value of the net environmental loss amounts to RM316.7 million. The corresponding values for 6% and 10% rates are RM155.5 million and RM95.5 million respectively.

It is clear from results of the evaluation exercise that a significant amount of environmental service loss is to be expected following project implementation. If so desired by the authority, some of the losses could be offset by compensating environmental enhancements elsewhere, the monetary quantum of which may be based on the computed values.