Special Environmental Impact Assessment for Tg. Aru Eco Development, Kota Kinabalu, Sabah

Final Terms of Reference

Tg. Aru Eco Development Sdn. Bhd.

62800657-2-RPT-01 Rev. 07

June 2015

This proposal has been prepared under the DHI Business Management System certified by Bureau Veritas to comply with ISO 9001 (Quality Management)

Special Environmental Impact Assessment for Tg. Aru Eco Development, Kota Kinabalu, Sabah

Final Terms of Reference

Prepared for Tg. Aru Eco Development Sdn. Bhd.

Represented by Executive Director

Sunset at Tg. Aru Beach

Current Revision Approvals

	Name / Title	Signature	Date
Prepared by	Wong Lie Lie		May 28, 2015
Reviewed by	Tania Golingi		Jun 21, 2015
Approved by	Tania Golingi		Jun 23, 2015

Classification

☐ Open	☒ Restricted	☐ Confidential

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Document Information

Project No.	62800657-2		
Project Title	Special Environmental Impact Assessment for Tg. Aru Eco Development, Kota Kinabalu, Sabah		
Subject	Terms of Reference		
Client	Tg. Aru Eco Development Sdn. Bhd.		
Document No.	62800657-2-RPT-01	**Rev**	07

Distribution	**Type of Data**	**No of copies**
Tg. Aru Eco Development Sdn. Bhd.	Digital	1
Jurutera Perunding Campo Sdn Bhd	Digital	1
Environment Protection Department (EPD), Sabah	Hardcopy	2
DHI Water & Environment (M) Sdn. Bhd.	Digital	1

Document Revision History

Rev	**Rev Date**	**Description of Change/ Reason for Issue**	**Prepared by**	**Checked by**	**Approved by**
1	Aug 30, 2013	Draft for Client review	VVS/WLL	TAG	TAG
2	Feb 13, 2014	Draft final for Client review	WLL	TAG	TAG
3	May 9, 2014	Final for EPD review	WLL	TAG	TAG
4	June 16, 2014	TOR for Special EIA for EPD Submission	WLL	TAG	TAG
5	Aug 15, 2014	Revised TOR for Client review	WLL	TAG	TAG
6	Oct 17, 2014	Revised TOR for EPD Submission	WLL	TAG	TAG
7	June 23, 2015	Final TOR for EPD Submission	WLL	TAG	TAG

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1 Introduction

The present Terms of Reference (TOR) report was prepared to describe the requirements of the Special Environmental Impact Assessment (SEIA) for the proposed **Tg. Aru Eco Development** (TAED or "the Project") along Tg. Aru Beach, Kota Kinabalu Sabah (Figure 1.1). These have been determined based on scoping of the sensitivities of the receiving environment at the project site and potential environmental impacts arising from the implementation of the project.

1.1 Project Proponent

The Project Proponent is Tg. Aru Eco Development Sdn. Bhd. (TAED), also referred to hereafter as the "Proponent." TAED is a fully government-owned company established for the express purpose for the implementation of the Project. Contact details pertaining to the Project Proponent are as follows:

Tg. Aru Eco Development Sdn. Bhd.
H-0-10, Lot 10, Block H, Metro Town
Jalan Bunga Ulam Raja, Off Jalan Tuaran
88100 Kota Kinabalu, Sabah, Malaysia

Tel: 088 425 896
Fax: 088 434 773

Email: lipthou.tsen@taed.com.my

Contact Person:
Mr. Paul Tsen, *Project Coordinator*

1.2 Legal Requirement

The proposed development requires an SEIA under the Environment Protection Enactment 2002, Environment Protection (Prescribed Activities) Order 2012, Second Schedule:

Item 5 Land Reclamation:

Reclamation of land in the river or sea or within the foreshore area or wetland forests for development of housing, commercial or industrial estates, resorts, recreational or tourism facilities, construction of major roads, or buildings for public purposes.

and

Item 10. Resorts and Recreational Development

i) Development of resorts, recreational or tourism facilities covering an area of 30 hectares or more;

iii) Development of golf courses;

v) Development of resorts, recreational or tourism facilities involving earthwork with a volume of 40,000 cubic metres or more.

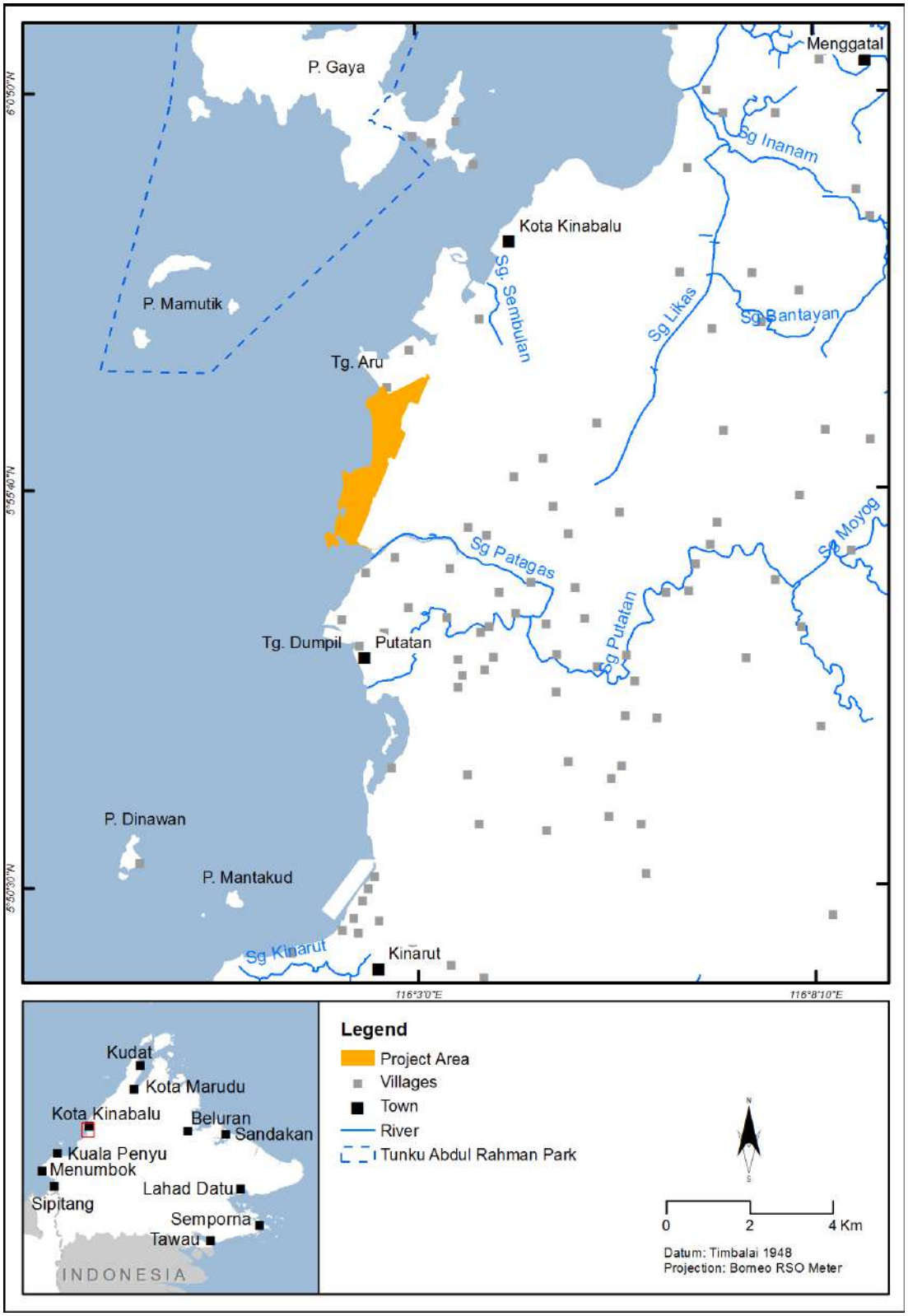

Figure 1.1 Location of the proposed development.

1.3 SEIA Consultant

The Lead Consultant for the SEIA study is:

DHI Water & Environment (M) Sdn. Bhd. (592006-K) – EPD No. F008 (30/09/2014)
11th Floor, Wisma Perindustrian,
Jalan Istiadat,
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Contact Persons: Tania Golingi, S*EIA Team Leader - EPD No. S0027 (30/09/2016)*
Wong Lie Lie, *Project Coordinator – EPD No. S0083 (23/09/2015)*

1.4 TOR Outline

The TOR details the purpose of the assessment and aims to identify the key potential environmental impacts of the proposed project in order to focus the SEIA study on the significant issues related to the development of the project. As such, this TOR includes the following:

- Project description: background information and a detailed description of the project location, concept, development and construction activities (Section 2).
- A description of the environmental setting of the project (Section 3).
- Key issues identified during the scoping exercise (Section 4).
- Proposed approach and scope of work for the SEIA study including details of the methodology for the baseline data collection and existing situation analysis, impact prediction and evaluation, identification and assessment of mitigation measures and monitoring programmes (Section 5).
- The SEIA Study Team (Section 6).

2 Project Description

2.1 Project Location

The Project site is located along Tg. Aru beach, approximately 6.5 km southeast of Kota Kinabalu. The Project boundary points are shown in Figure 2.1 with the corresponding coordinates listed in Table 2.1. These boundary points are based on the land area above water, while the toe of the revetment (i.e. where the slope of the reclaimed land meets the seabed) is also indicated in yellow in Figure 2.1.

It must be noted that the hydraulic study and detailed design works may result in some changes to the Project footprint along its seaward perimeter, in order to optimise the layout.

The Project as indicated in this Special TOR will cover a total area of approximately 739 acres (299 ha) and extends at its furthest point approximately 1 km out to sea.

Table 2.1 Coordinates of key boundary points shown in Figure 2.1.

Point	BRSO (m)		Geographic coordinates (WGS84), decimal degrees	
	Easting	Northing	Latitude (N)	Longitude (E)
1	705521.7957	655278.1539	5.9163202	116.0479335
2	703939.5344	655004.8680	5.9139138	116.0336327
3	704292.6856	656862.2798	5.9306958	116.0368980
4	704829.7366	658459.4378	5.9451167	116.0418137
5	705181.2596	658891.2688	5.9490073	116.0450062
6	705271.6886	658939.5548	5.9494402	116.0458249
7	705378.5366	658730.4378	5.9475448	116.0467813
8	706331.4836	659231.1628	5.9520336	116.0554086
9	706391.5881	659108.0293	5.9509177	116.0559464

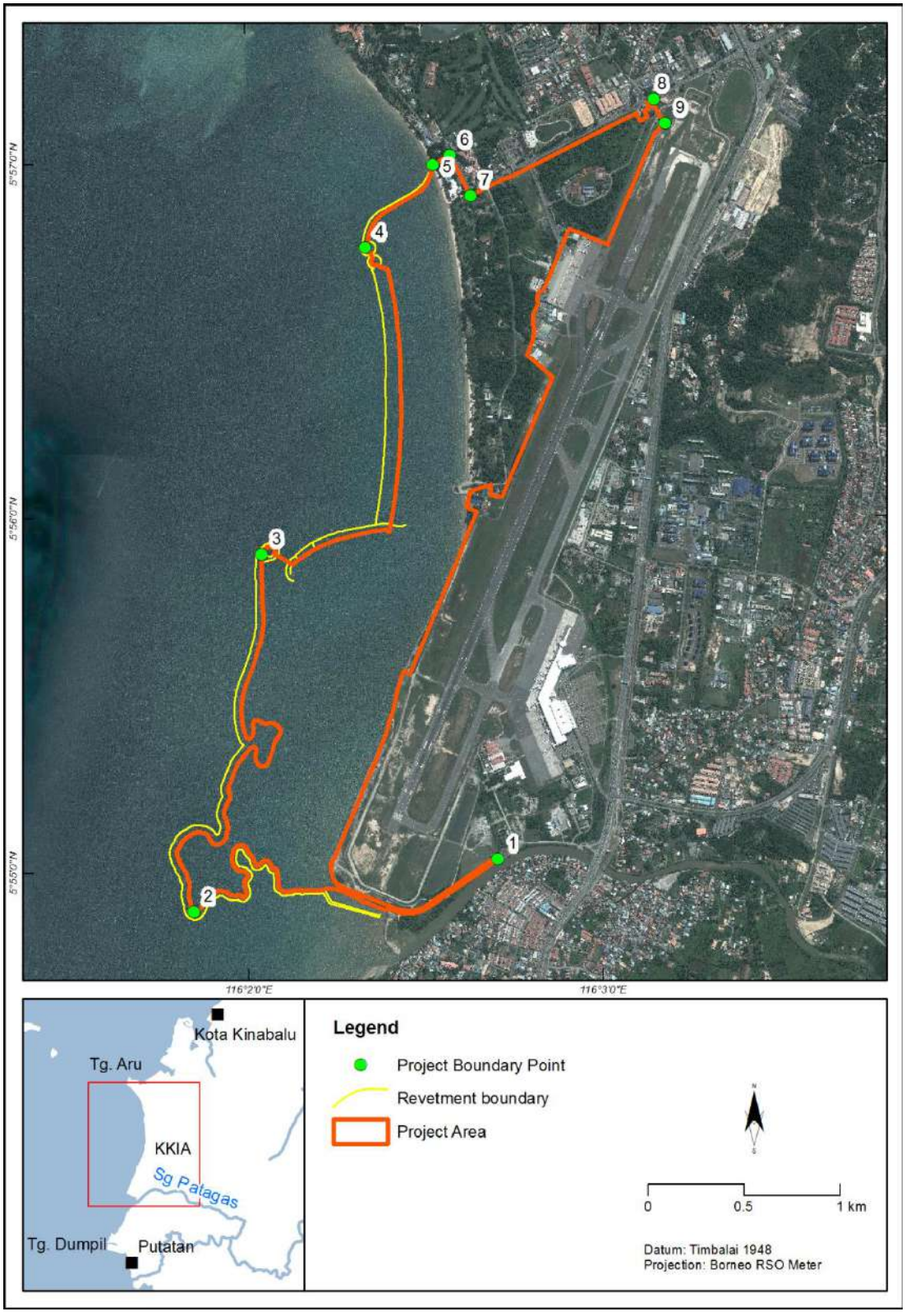

Figure 2.1 Project boundary. Coordinates of the project boundary points indicated are given in Table 2.1. Revetment boundary refers to the 'toe' or bottom of the revetment slope at the seabed.

2.2 Project Concept

The Project is a Masterplan which provides the framework for an integrated, mixed-use development incorporating residential, commercial, cultural, recreational, open space and institutional uses including a marina. In recognition of the socio-cultural identity and heritage value of the Tg. Aru beachfront to the people of Sabah, a key element of the Project is to improve the beachfront and associated amenities for the public, as a perpetual heritage to be enjoyed by all generations.

Site preparation, infrastructure, landscaping and public use areas will be developed by the Proponent; while for the residential and commercial areas, individual land parcels will be marketed and sold to third party investors for development within the framework of the Project Masterplan.

The Masterplan will provide development control over all individual development components in terms of type of development, design concept and environmental performance.

Development control guidelines will be introduced to each development parcel to incorporate strategies and requirements for sustainable development. Among other potential initiatives to be incorporated in the Masterplan are:

- Promotion of Green Globe / LEED[1] certification with the hotel operators
- Blue Flag Marina and Beaches
- Mandatory energy/water efficiency baseline (standard compliance) for specific buildings using locally applicable standard or international standard like ASHRAE 90.1:2007
- More than 50% of the residential total development Gross Floor Area (GFA) to achieve GBI certification.

2.2.1 Conceptual Development Plan

The conceptual land use and development plan for the Project is shown in Figure 2.2 while the breakdown of the proposed land use components and their relative areas is given in Table 2.2.

Figure 2.3 shows the architect's rendering of the latest project concept dated June 2014.

[1] Leadership in Energy & Environmental Design (LEED) is a rating systems developed by the U.S. Green Building Council (USGBC) as a guideline to implement development in ways that are environmentally responsible and resource-efficient in the design, construction, operation, and maintenance of the buildings.

Table 2.2 Proposed project land use components.

Component	Area (hectares / acres)	%
Hospitality	26.7 / 66.0	8.9
Residential	60.3 / 149.0	20.2
Mixed-Use	23.2 / 57.3	7.7
Marina	7.1 / 17.5	2.4
Utility	5.9 / 14.6	2.0
Recreation	72.8 / 179.9	24.4
Green	43.4 / 107.2	14.5
Road	23.5 / 58.1	7.9
Water	36.0 / 89.0	12
Total	**298.9 / 738.6**	**100**

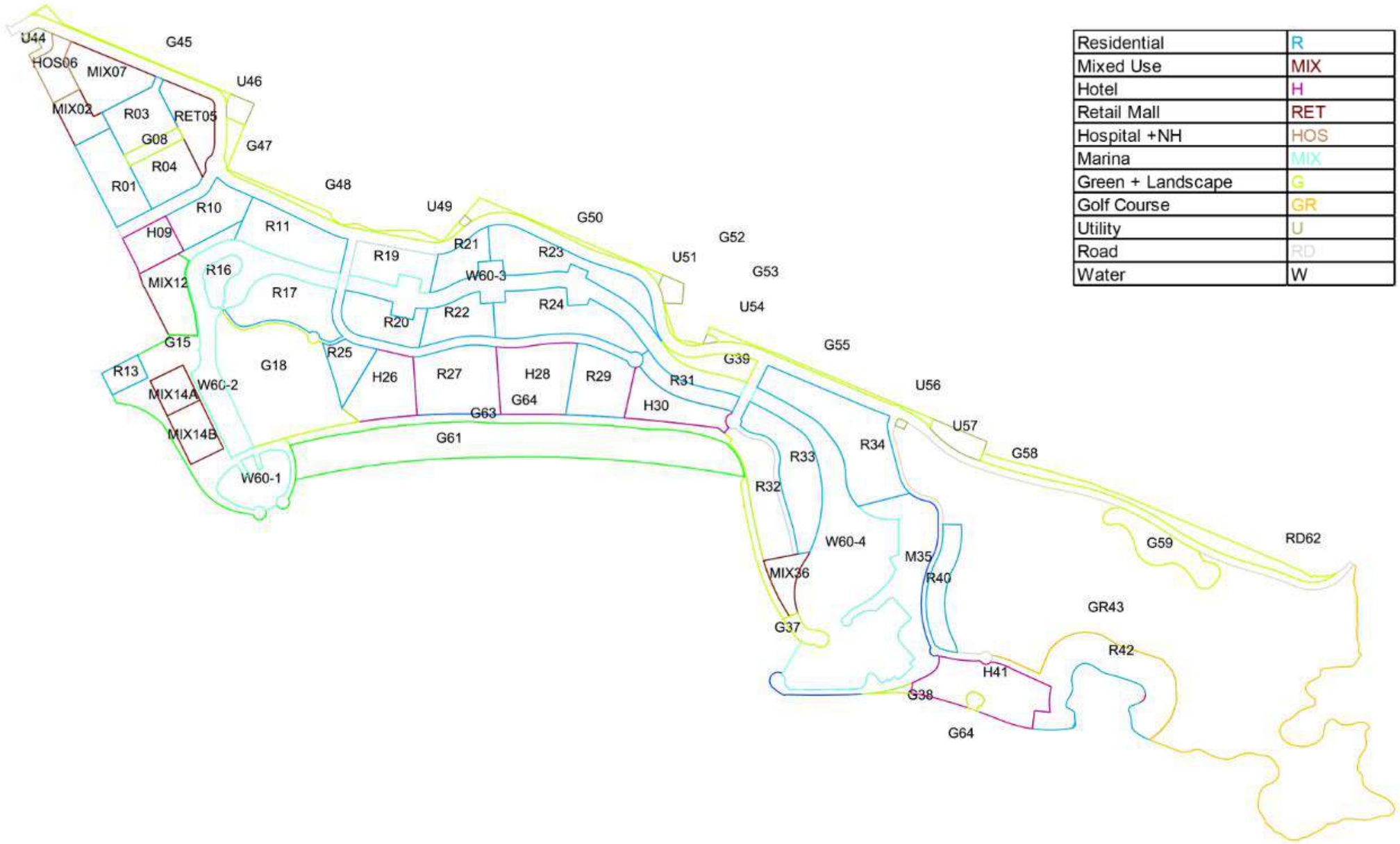

Figure 2.2 Proposed project component layout plan dated June 2014. Image courtesy of Benoy

Figure 2.3 Architect’s rendering of the project concept (Project area outlined in red). Image courtesy of Benoy – Latest Development Masterplan June 2014.

2.2.2 Project Components

The Project Masterplan includes the following key components:

- Beach for public use
- Prince Philip Park
- Breakwaters, public/ commercial mooring areas, marina and berthing areas
- Commercial, residential and resort areas
- 18-hole golf academy
- Reclamation
- Internal water channel and basins
- Road link to the Kota Kinabalu International Airport (KKIA).
- Infrastructure and utilities

The main project components are described further in the following subsections.

2.2.2.1 Beach

The existing 1.68 km long beach at Tg. Aru will be replaced with a new beach seaward of the existing and made wider with imported sand as part of the land reclamation in order to improve the quality and the width of the beach.

The new 1.35 km long beach will be retained by the headlands/ breakwaters of the Fishermen's Wharf in the north and the marina to the south. The beach width is anticipated to be a minimum of 50 - 110 m at MSL and detailed design work is on-going to determine the appropriate slope and beach sand grain size in order to ensure beach stability.

An indicative cross section of the beach is shown in Figure 2.4. Subject to further detailed design, the main features are:

- Beach crest around 50 m wide.
- Retaining wall will be provided at the rear of the beach
- Low level rock revetment provided on the seaward face (below ground) to protect the wall and prevent erosion in the event of significant each lowering.
- Public promenade around 20 m wide

Apart from improvement in the beach sand quality and width, the extension of the beach out into deeper waters aims to improve water exchange with consequent improvement in water quality along the beach.

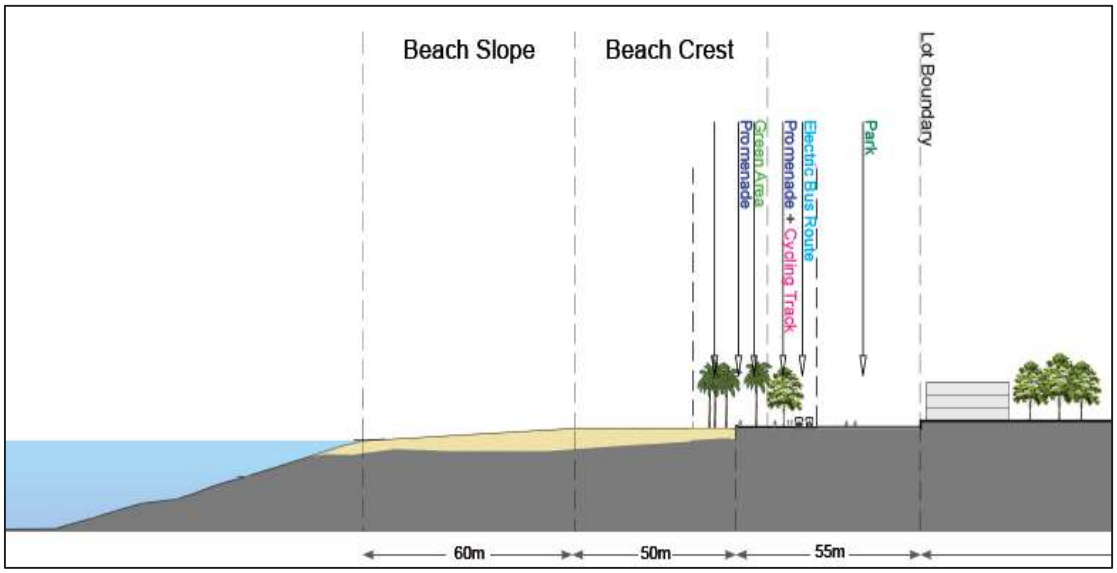

Figure 2.4 Indicative cross section of beach (Source: Benoy Masterplan Final Report January 2014).

2.2.2.2 Public Park and Amenities

An area of 27 acres is allocated for the refurbishment of Prince Philip Park, which is almost double the size of the present Park area (14.5 acres). The following are the anticipated facilities to be provided within the park:

- Community park
- Children's playground
- Open-air theatre in the park
- Jogging trail
- Integrated cycling paths

Figure 2.5 shows the existing Prince Philip Park area and the new proposed area.

Figure 2.6 shows examples of the public amenities and recreational spaces considered for the project. Meanwhile, Figure 2.7 provides an overview of the proposed visitor attractions and community facilities in relation to the project concept.

These visitor attractions include an 18-hole golf course / academy in the south part of the development; sailing club and yacht club (Figure 2.7).

Figure 2.5 Prince Philip Park area – Top: existing area; Bottom: New area.

Figure 2.6 Examples of public amenities and recreational spaces considered for the Project. Top Left: Amphitheatre; Top Right: Integrated bicycle lane; Bottom Left: Pedestrian park; Bottom Right: Parcourse. Images courtesy of MLA.

Figure 2.7 Visitor attractions and community facilities provided in the TAED Masterplan (Source: Benoy Masterplan Final Report 2014)

2.2.2.3 Marina Development and Marine Structures

The Project will feature two headland /breakwater areas with provision for marine vessels. The northern area is designed around a public and commercial area; termed “Fishermen’s Wharf”, with facilities for water taxis, island transfer and day visitors, while the southern promontory comprises a marina development. These are described further below.

Fishermen’s Wharf

The Fishermen’s Wharf at the northern end of the development comprises two equal breakwaters to provide a safe harbour for vessels of 15 m or less in length with clearance depth of -3 m CD.

Amenities and services will be provided for:

- Waterbus tour boat and water taxi base
- Landing stage for visiting boats
- Sport fishing centre,
- Dive boat operation
- Day-sailing charter centre.
- Car parking area

Pedestrian access will be provided along both breakwater arms, see example of similar structure in Photo 2.1.

The adjacent onshore areas will be a commercial / public use waterfront development, with shops, restaurants and amenities along the channel.

Photo 2.1 Breakwater with pedestrian access. © URS 2013.

Marina

The marina concept design provides for a total of 191 berths, ranging in size from 12 to 110 m.

The marina comprises:

- Outer basin for superyachts which range from 60 m to 100 m in length with a clearance depth of -6 m CD. This basin may require some dredging at the shallow areas and to the underside of the breakwater structures to enable the -6 m CD level to be obtained throughout the basin.
- Inner basin for vessels 12 m to 40 m length with a clearance depth of -5m CD.

The mooring system will be floating pontoons with finger docks.

The marina will also be equipped with a boatyard and dry stack facilities. Onshore, marina buildings will include the Capitainerie, Customs, Immigration and Quarantine (CIQ), washrooms, laundry, security and boatyard workshop.

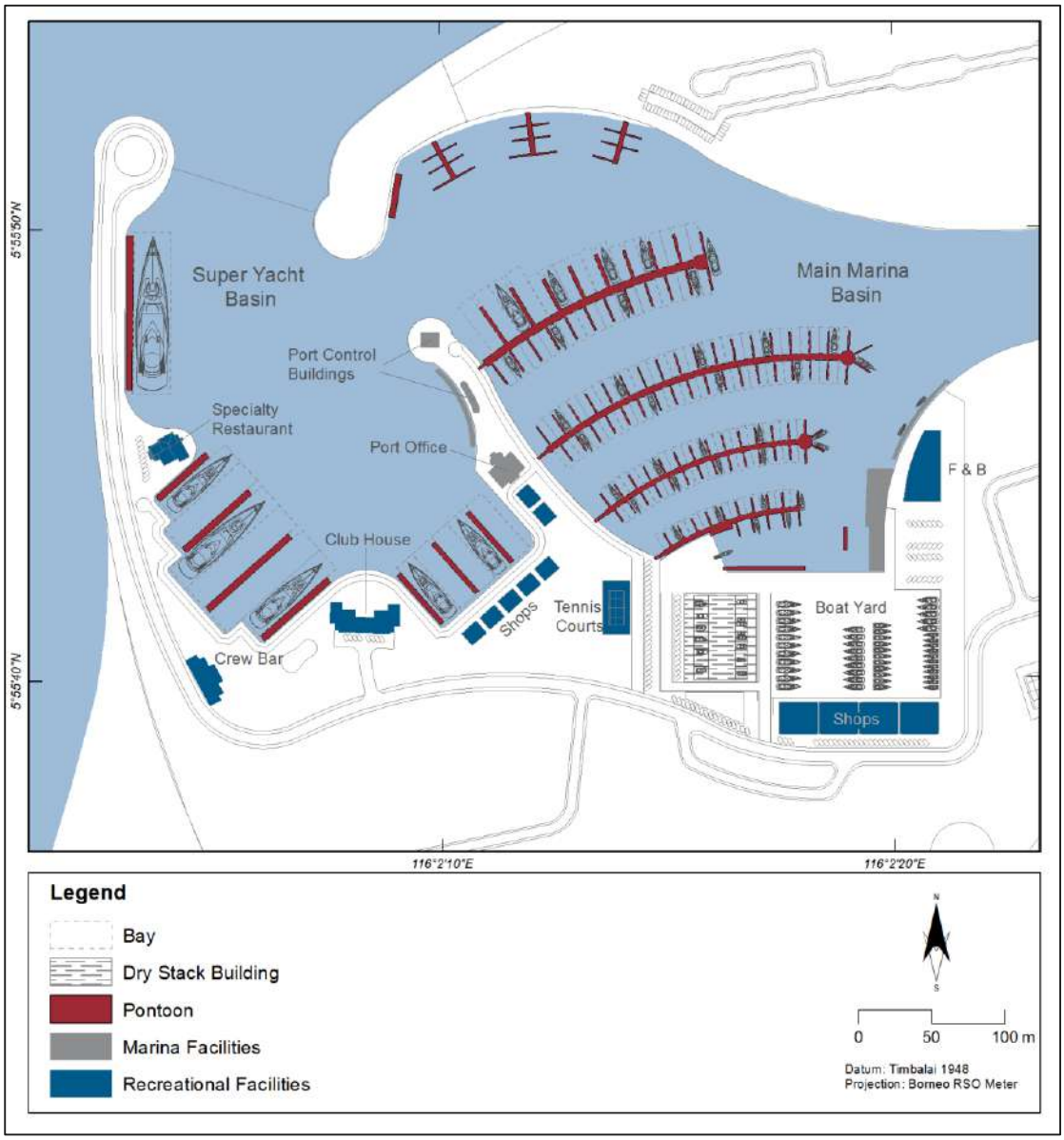

Figure 2.8 Design concept showing the marina features

2.2.2.4 Commercial, Residential and Resort Areas

As indicated in Figure 2.2, the Masterplan incorporates commercial, residential and resort areas. These are described in Table 2.3.

Table 2.3 Summary of development within the planned commercial, residential and resort land uses.

Planned Land Use	Development
Resorts	• Mix of hotels – 4 new hotels, budget tourist, MICE facilities, 5 Star and luxury • Branded residence • Beach resort • Hotel villas • Serviced apartments
Residential	• Domestic town house • Domestic condominium • International condominium • International townhouse • Villas • River Town • Apartments and luxury homes and private moorings on the new marina
Commercial	• Fishermen's Wharf will be the main commercial areas that incorporates a wharf, boutique hotel, apartment with restaurants, shops etc. • A north cluster of retail and F&B and South Commercial cluster around the new marina • Sea and river front properties • New marina with boat yard and yacht club

2.2.2.5 Reclamation

Within its overall 739 acre development footprint, the project involves reclamation of approximately 444 acres (180 hectares), extending the existing shoreline between 100 m to 1,000 m further west (Figure 2.9). The land reclamation areas will be designed to a level taking into account sea level rise and storm surge, with estimated ground levels varying between +2.1 and +4.0 m MSL depending on the assets to be protected and subject to detailed design. Based on these ground levels the required fill volumes as estimated by URS Consulting /1/ is approximately 17 million m^3 of which approximately 16 million m^3 of fill material will be imported for the reclamation and beach nourishment, broken down as follows:

- 15.8 million m^3 reclamation material
- 0.45 million m^3 beach material
- 0.88 million m^3 dredged from the Fishermen's Wharf area

Material for the beach will be sourced from offshore with potentially a combination of land-based and marine sources for the land reclamation. A study is currently underway to identify potential sources of fill material and a separate EIA study for the borrow activity will be carried out if required. Further details of the material properties will be provided in the SEIA.

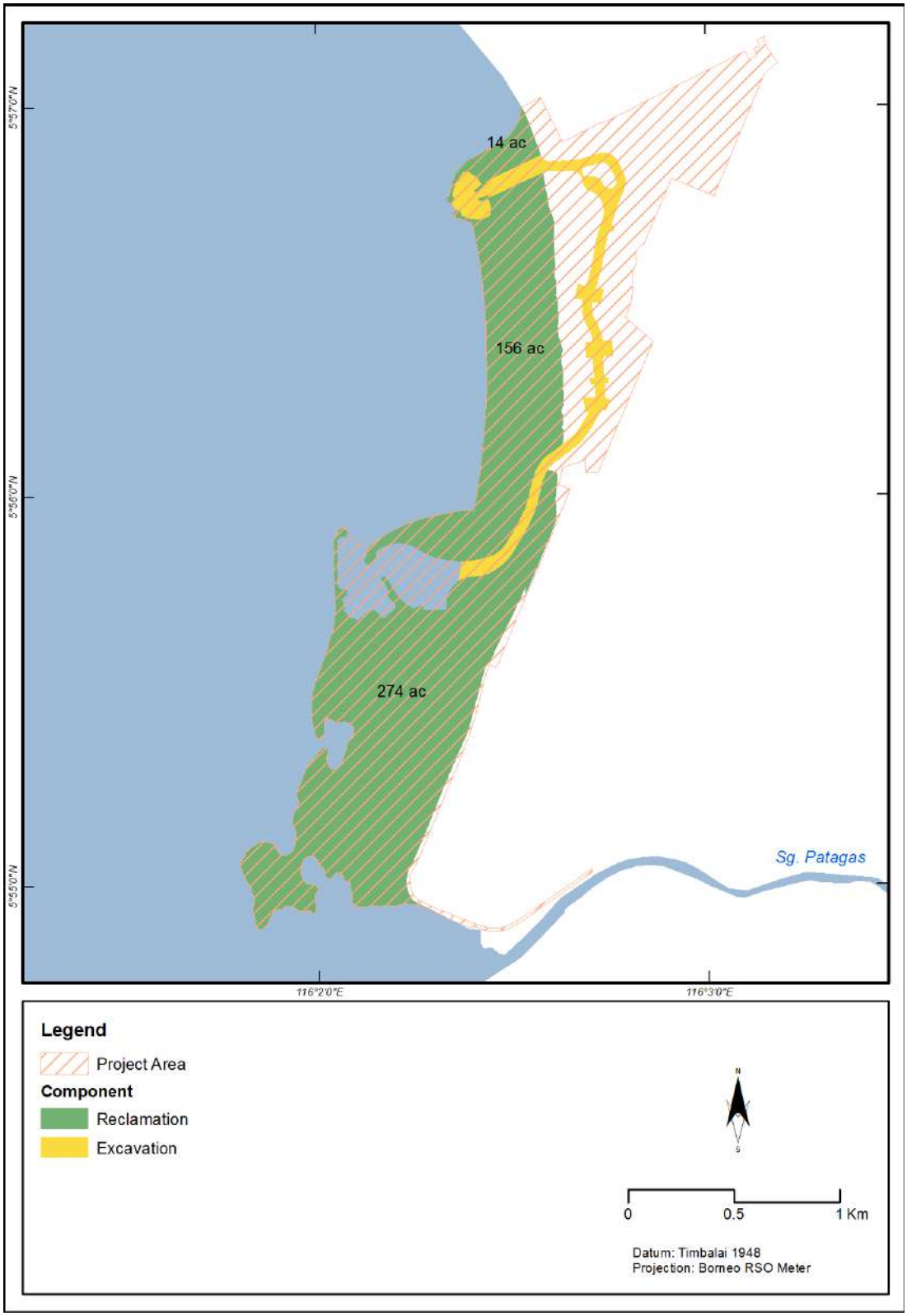

Figure 2.9 Reclamation and excavation areas.

The preliminary construction sequence and method as suggested by URS Consulting is summarised as follows. Further details can be found in the Marine Engineering Final Report, URS Consulting, dated 17th February 2014 /1/.

The reclamation sequence is detailed in URS Consulting Report Section 9 and the overall marine works construction sequence is shown progressively in the following figures. The

main objective is to try and complete the Prince Philip Park and the public areas of the Fisherman's wharf as soon as possible as well as trying to reopen sections of beach as the work progresses.

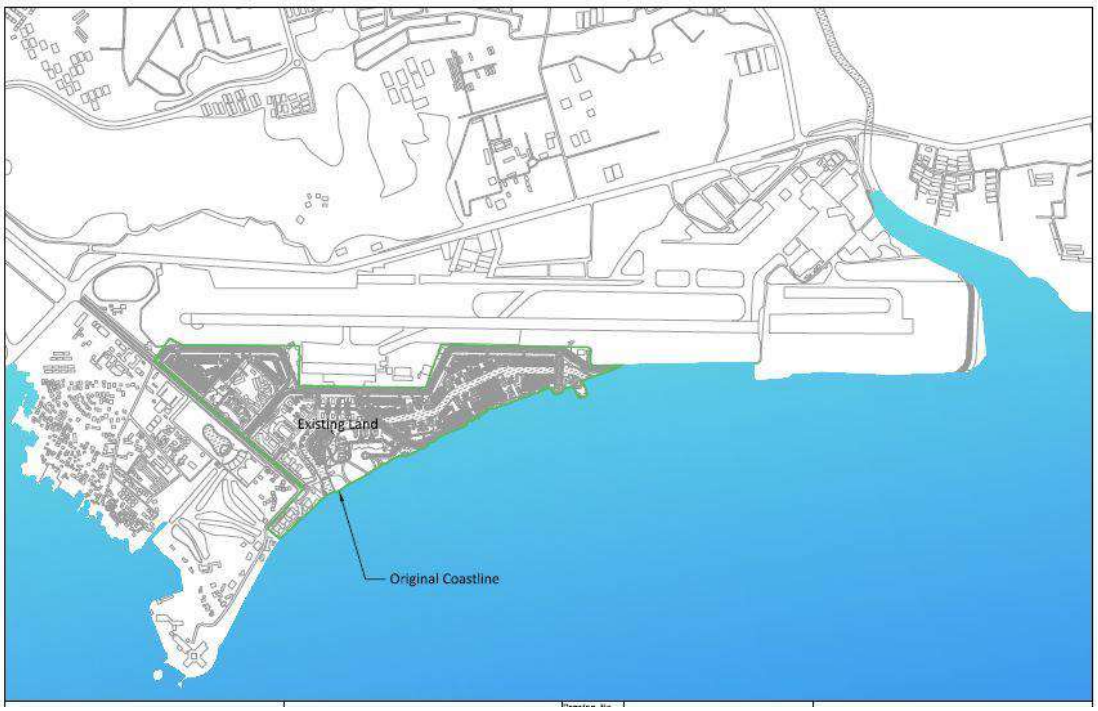

Figure 2.10 Drawing No 100 original coastline before reclamation

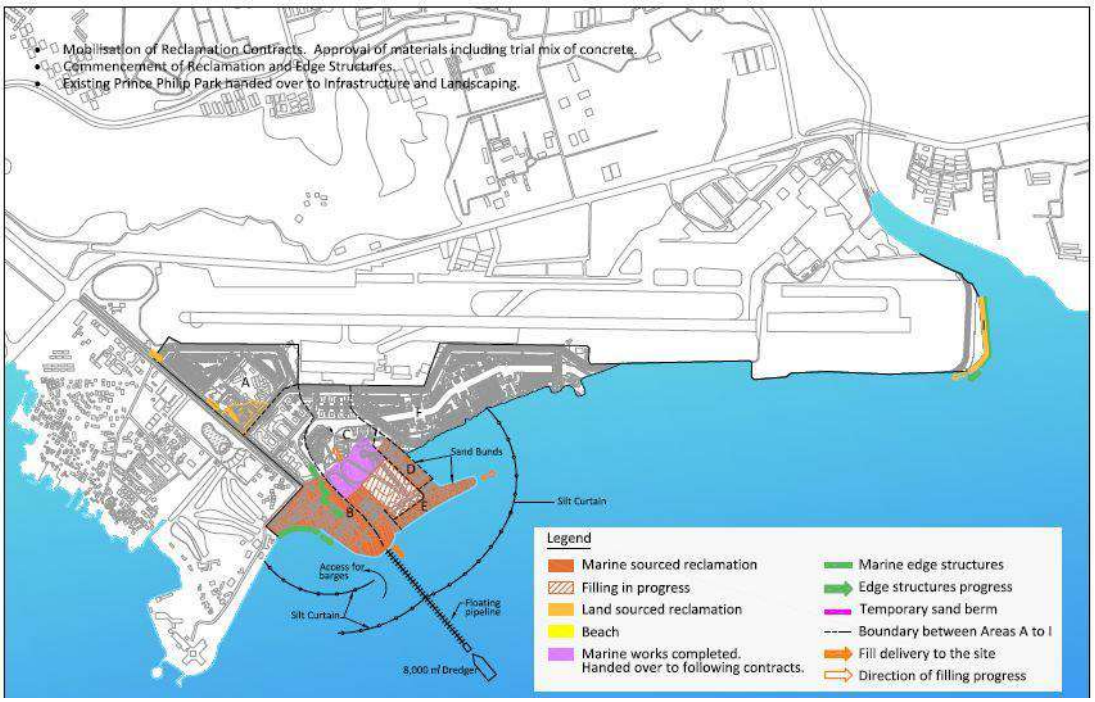

Figure 2.11 Drawing No 101 - works begin at Fishermen's wharf area with land fill material being used at Area A and the access road to the south of the airport

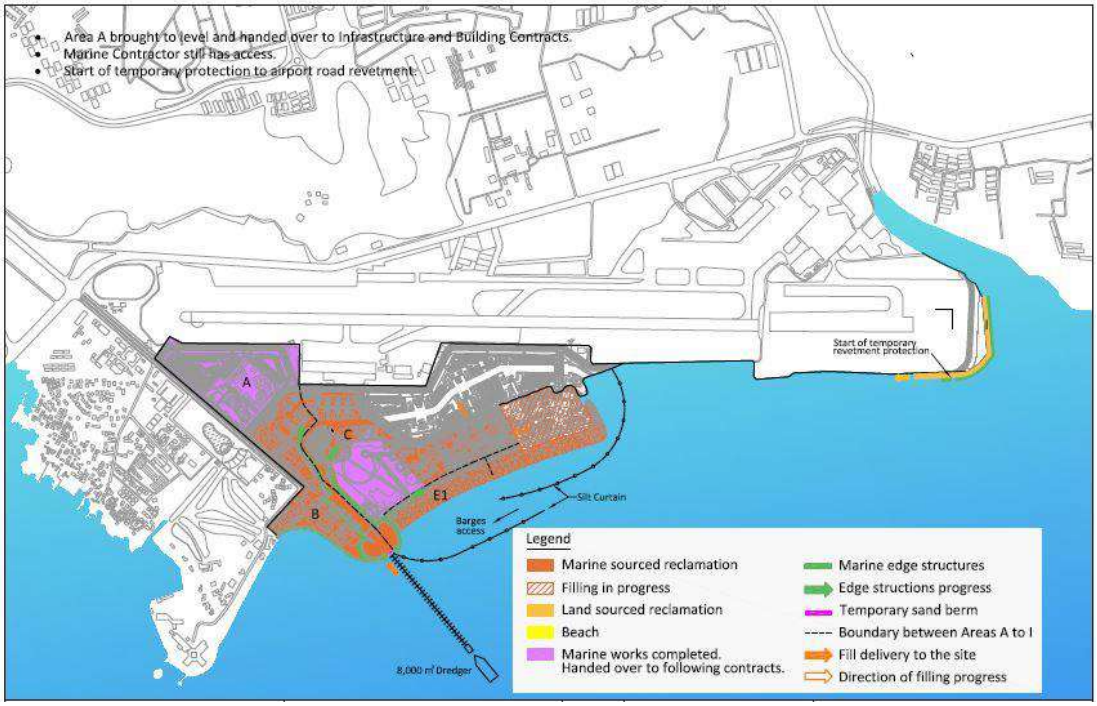

Figure 2.12 Drawing No 102 - works progressing south with Prince Philip Park and the first section of beach filled

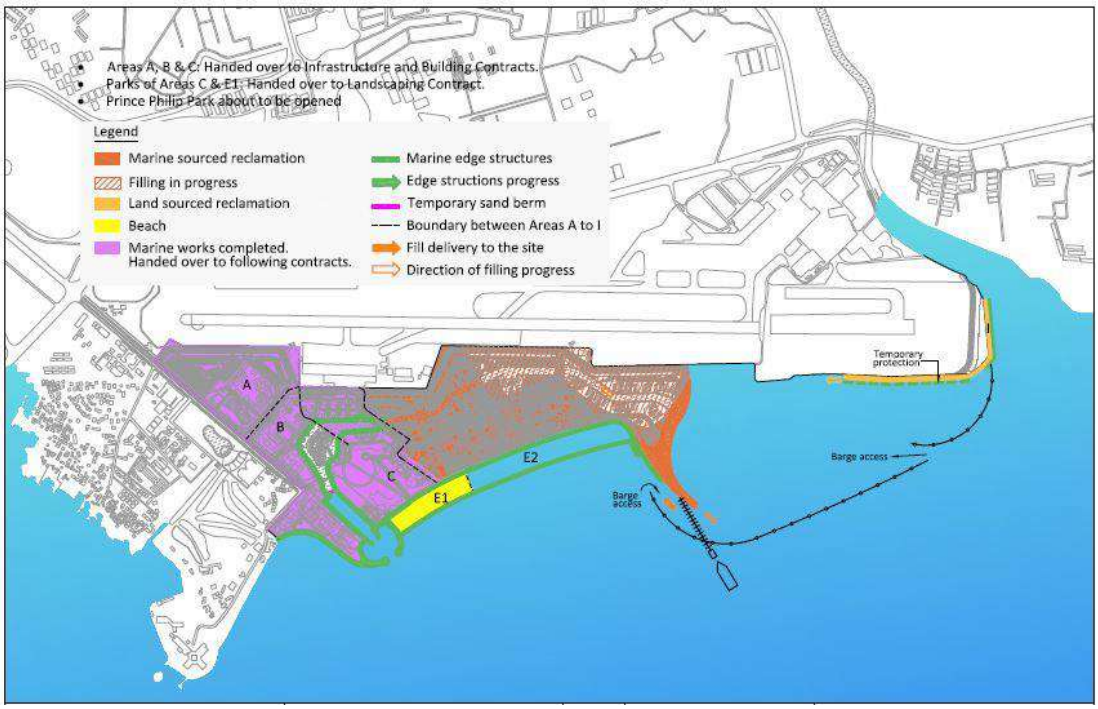

Figure 2.13 Drawing No 103 - works progressing south with the first section of beach sand placed

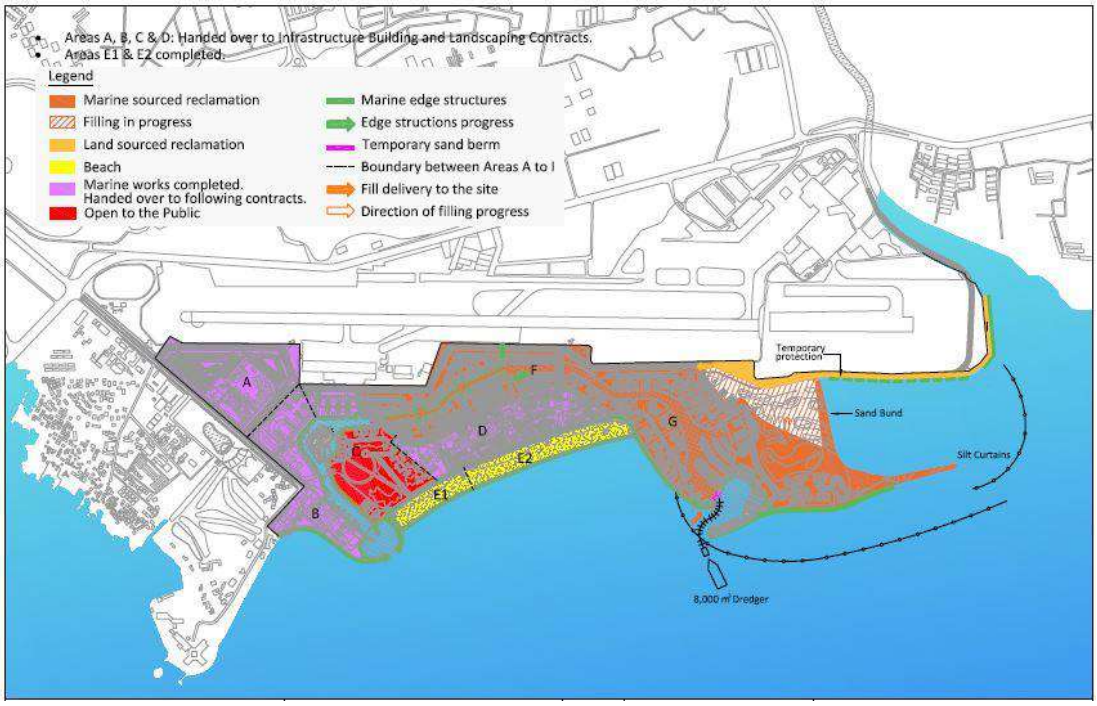

Figure 2.14 Drawing No 104 - Prince Philip Park open to the public and all the beach sand placed for potential opening of the beach, main works continuing south.

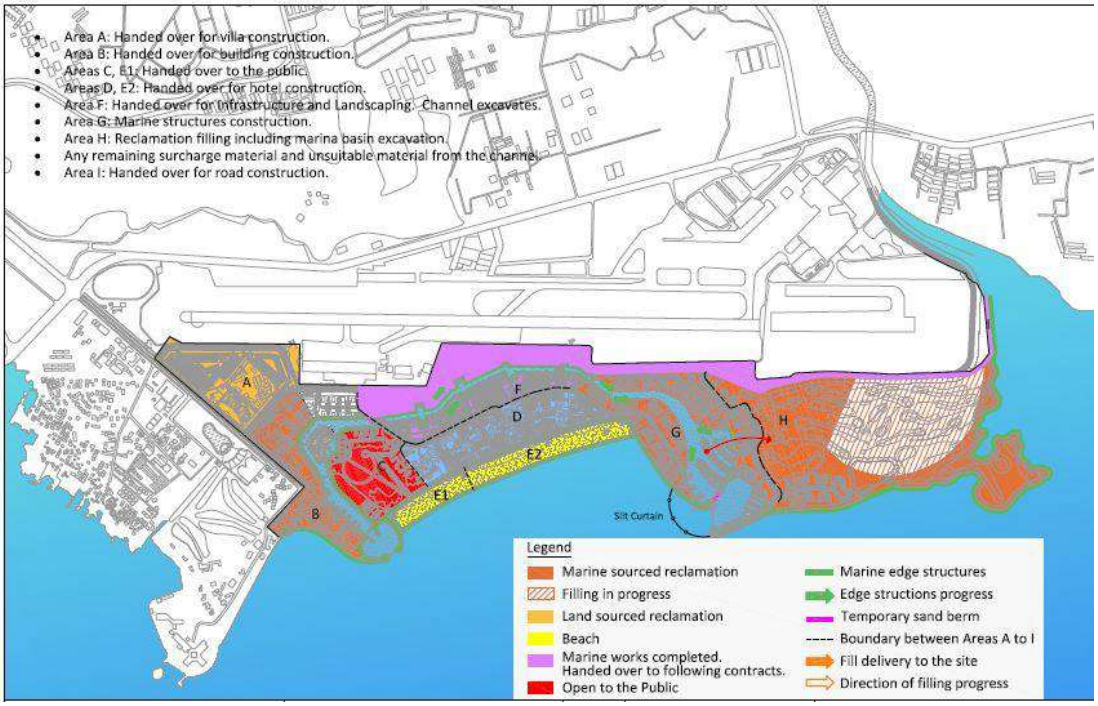

Figure 2.15 Drawing 105 - works being completed at the far south end with the filling of the golf course area

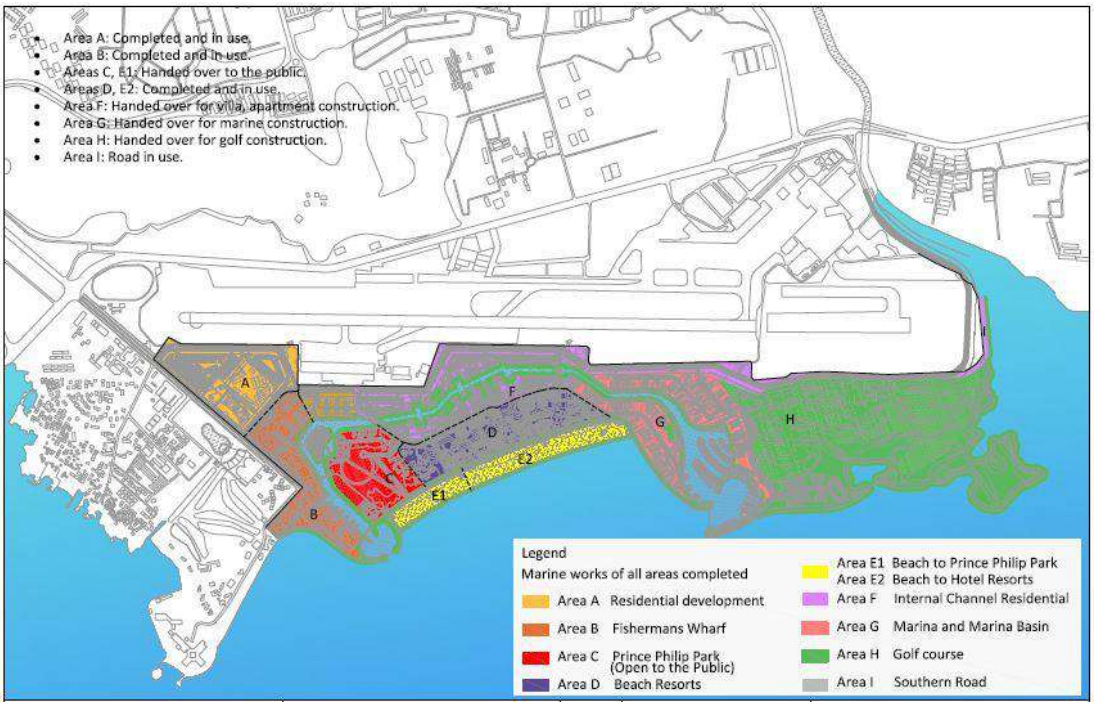

Figure 2.16 Drawing No 106 – the marine works of all areas are completed

The perimeter of the reclamation will be protected principally with rock fill that will form a bund prior to filling behind with the sand fill. Some means of preventing leaching of the fill material through the rock bund may be incorporated such as with the use of geotextiles. This bund will remain as permanent structure to all of the reclaimed areas and will be armoured using larger rocks to protect it and the reclamation from being damaged by storm waves. The only area that will not be protected by an exposed rock revetment will be the amenity beach but this will have its own protection in the form of the beach and incorporate a low level (below beach level) backstop protection in the form of a rock revetment and sea wall (Figure 2.17).

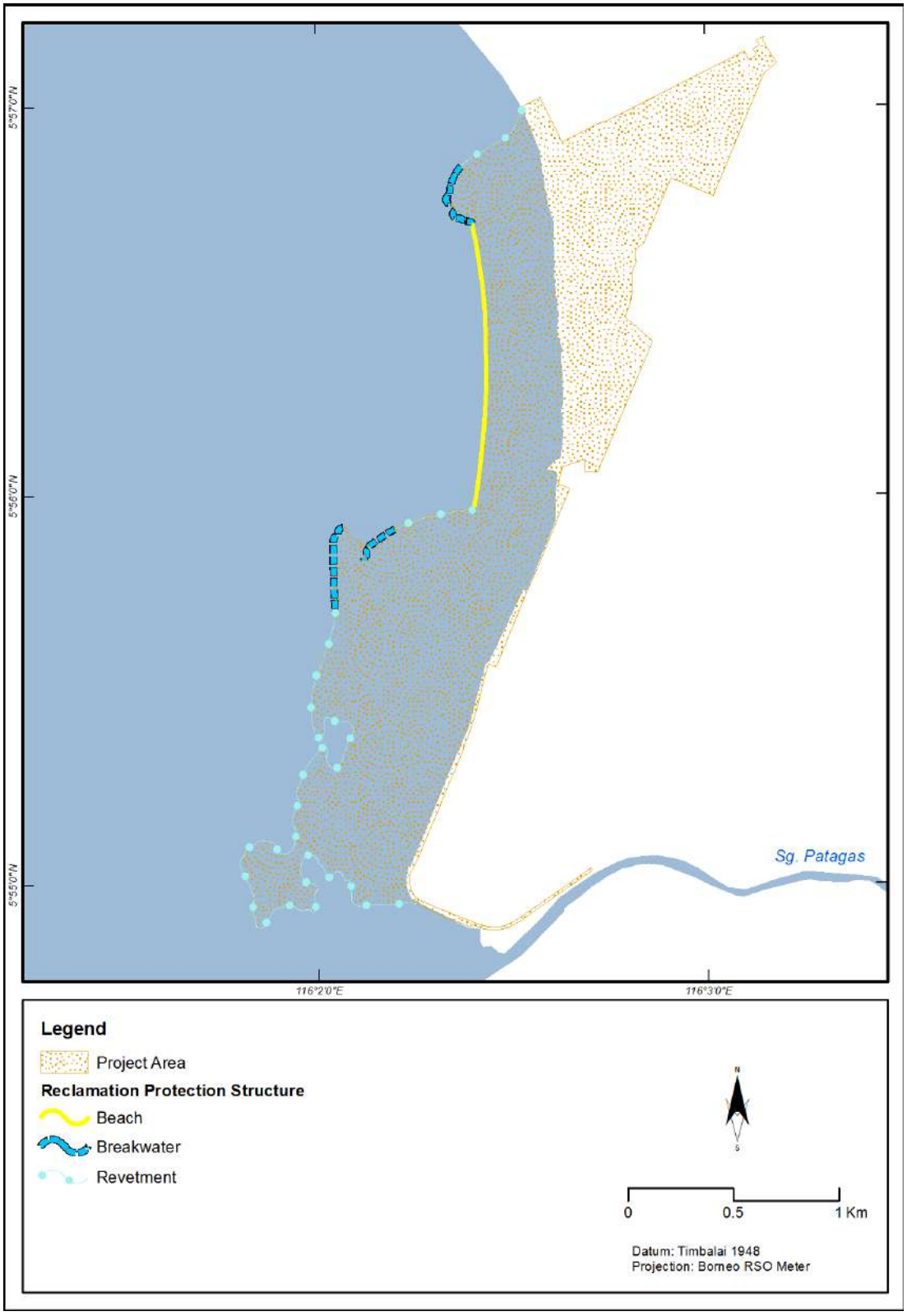

Figure 2.17 Type of reclamation protection structures proposed for the project.

2.2.2.6 Proposed Dredging and Filling Method

Based on the information supplied by URS Consulting /6/ the assumed preferred method of reclamation and construction programme is based on the use of Trailer Suction Hopper Dredgers (TSHD) that either pumps material directly to shore through floating pipelines or by

delivering dredged material to a Cutter Suction Dredger (CSD) which then pumps the material ashore through floating pipelines. Placing the material by “rainbowing” has been considered but it was noted as having environmental concerns. The proposed method suggested by the design Consultant for undertaking the reclamation and beach placement is listed as follows:

- TSHD 8000 m^3 capacity
- Material pumped ashore direct from the TSHD’s through floating pipelines or via a CSD
- Loaded draft 5.5 m
- Pipeline connection offshore at 6.0 m CD
- 3 barge trips per day, 24 hours per day, 7 days per week
- Steaming distance up to 60 km
- Volume placed per day 24,000 m^3

Sediment control has not been decided at this stage but will be investigated in detail during the hydraulic modelling as part of the EIA, however the design Consultant’s proposed options comprise the use of one or more of the following:

- Bunded areas
- Silt traps / Sediment ponds
- Controlled release of water
- Geotextile used as filters at final exit point
- Silt curtains

2.2.2.7 Internal Channel

Dredging/ excavation works will be undertaken to create an internal channel through the development area as shown in Figure 2.9. The internal channel is designed to cater for boat access through the development, and will be a minimum of 41.5 m wide with a depth of at least -3 m CD to cater for 15 m length boats.

The channels will be suitable for navigation only by motor yachts below 20 m LOA. There will also be provision for berthing and turning areas at selected locations along the channel, primarily to cater for residential berths (see examples in Figure 2.18).

Figure 2.18 Examples of residential berth options considered for the Project. © Camper & Nicholsons International 2013.

Based on the above specifications, the volume of excavated/ dredged material is estimated to be approximately 500,000 m^3, however the detailed design and construction sequence has not been determined at this stage and hence this figure may change.

The excavated material will be used on the Project area for the top fill and landscaping, including creation of bunds and screens between the site and the airport.

2.2.2.8 Southern Road Link

Existing access to the project site is via Jalan Mat Salleh. A new access road approximately 3.6 km long will be created to connect the project development to the existing road network in the area as shown in Figure 2.19. A new internal road network will be established within the site and connect to the Kota Kinabalu International Airport (Terminal 1) to the south.

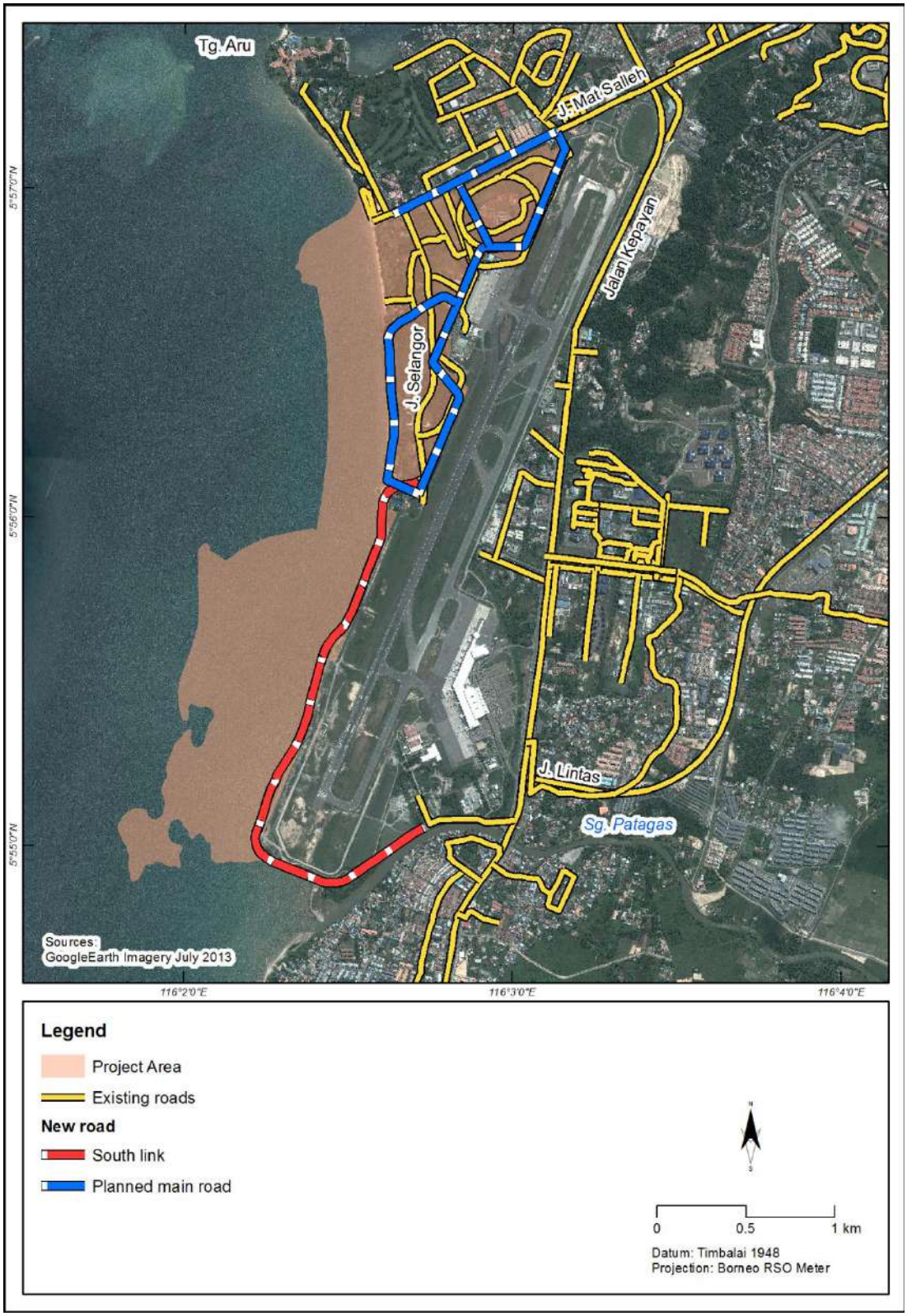

Figure 2.19 South link road of the project development.

2.2.3 Phasing

The Project development will be implemented in successive stages, with the preliminary programme as detailed in Table 2.4 below and illustrated in Figure 2.20. In considering the development sequence, priority has been given to re-provisioning the Prince Philip Park and

the beach as early as possible in the programme. These proposed stages are subject to the findings of the soil investigation and detailed engineering design.

Table 2.4 Stages of project development

Stage	Project Development
1	• Construction of marine edge structure • Start of reclamation of Area 2, 4 and 5 • Construction of infrastructure and landscaping for Area 1 and 3
2	• Continuation of infrastructure and landscaping for Area 1 • Start of reclamation of Area 5 • Start of temporary protection to airport road revetment
3	• Start of construction of infrastructure and landscaping for Area 2 and 3. • Start of landscaping for parks Area 3 and part of Area 5.
4	• Start of construction of infrastructure and landscaping for Area 4. • Completion of Area 5.
5	• Start of villa construction for Area 1. • Start of building construction for Area 2. • Area 3 and part of Area 5 to be handed over to public. • Start of hotel construction for Area 4 and part of Area 5. • Start of construction of infrastructure and landscaping for Area 6 including excavating of channel. • Start of marine structures construction for Area 7. • Start of reclamation filling including marine basin excavation for Area 8. • Start of road construction for nearby Area 8.
6	• Completion of Area 1, 2, 4, 5 and road near Area 8. • Area 2 and remaining part of Area 5 to be handed over to public. • Start of apartment construction for Area 6. • Start of marine construction for Area 7. • Start of golf construction for Area 8.

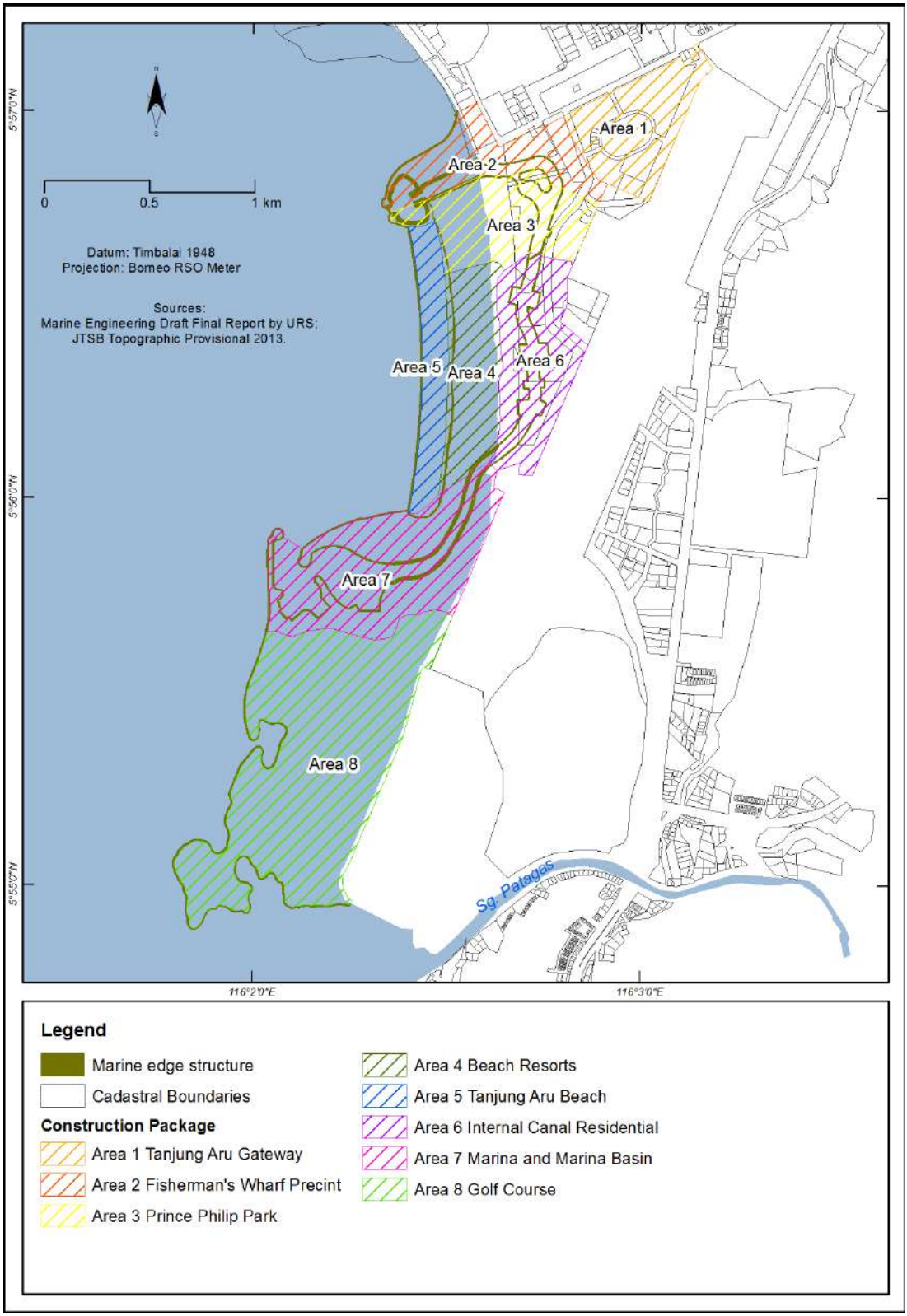

Figure 2.20 Project development stages

2.3 Project Status

2.3.1 Project Masterplan Development

The project is currently in the master planning stage and amendments to the internal layout and components shown in Figure 2.2 may be required depending on the findings of the detailed design and EIA studies.

To date, the project proponent has initiated several studies such as masterplan design, marketing, surveys and preliminary engineering studies. A sand source study is on-going to determine a suitable source of fill material for reclamation and beach sand.

The following feasibility studies are on-going or will be carried out:

- Marina Feasibility Study by Camper & Nichols
- Marine Engineering feasibility study by URS Consulting
- Hydraulic Study by DHI Water & Environment

Other project approvals needed are:

- Marine Traffic Risk Assessment to Ports and Harbours Department/Marine Department for the Marina
- Traffic Impact Assessment to Dewan Bandaraya Kota Kinabalu
- Drainage design to Department of Irrigation and Drainage (Masterplan)
- Erosion and Sedimentation Control Plan to Department of Irrigation and Drainage
- Development Plan (Masterplan) approval by Town and Regional Planning Department.

The detailed design stage will commence in parallel to the SEIA. Additional works for the detailed design stage include:

- Geological and soil investigation surveys
- Golf course design
- Detailed engineering design including drainage design, earthworks plan and Erosion and Sediment Control Plan for the Masterplan areas.

It is noted that the development of hotels, resorts, etc. on the individual lots will be subject to individual project approvals as required according to their development plans.

2.3.2 Land Status

The project area comprises Government and private land, which will be acquired by the Government for this project.

The Proponent intends to surrender the foreshore reserve and Prince Philip Park areas back to the State Government.

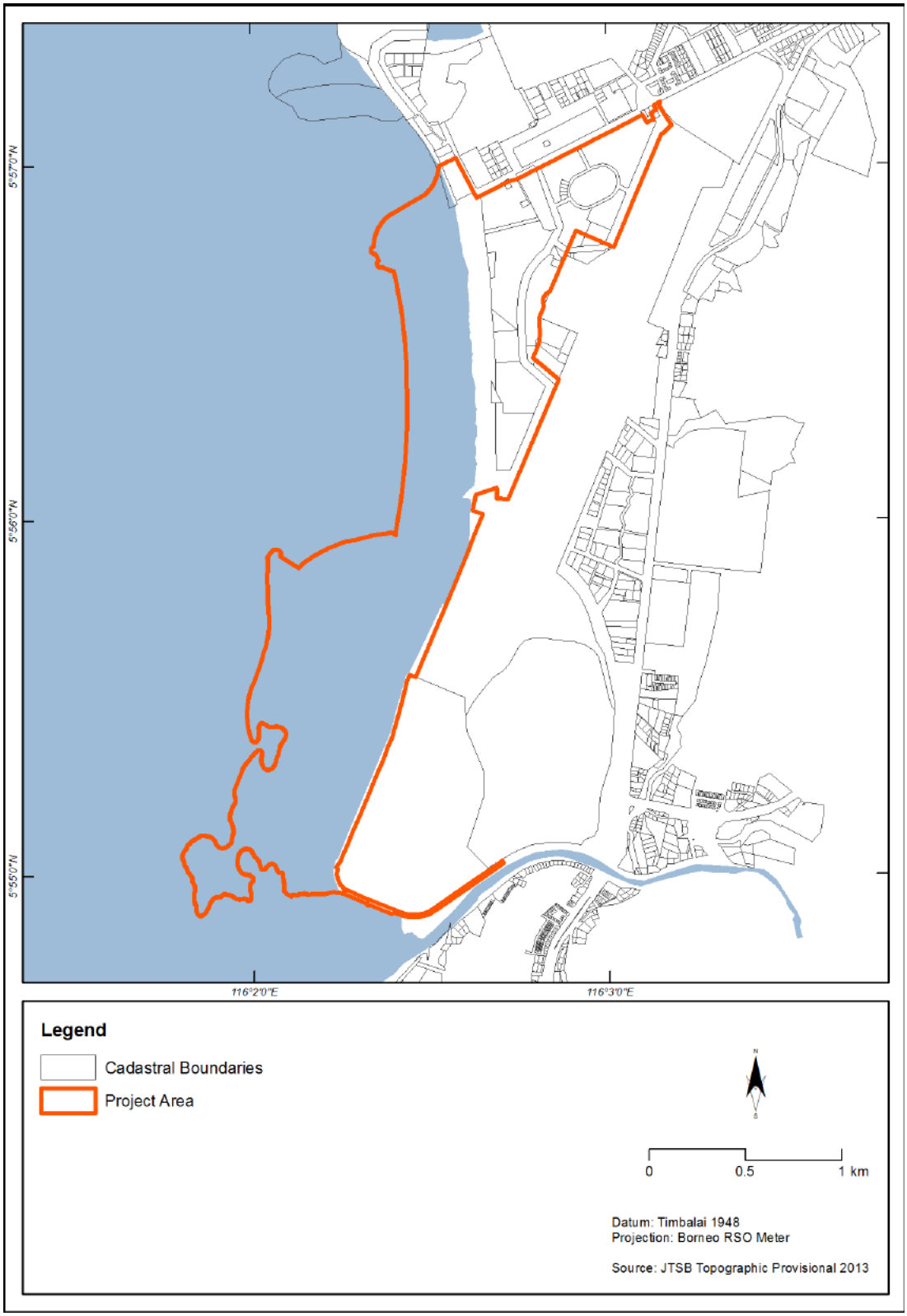

Figure 2.21 Land parcels in project area.

2.3.3 Zoning Status

2.3.3.1 Local Plan

The Draft Kota Kinabalu Local Plan supersedes previous draft schemes including the previous Draft Tanjung Aru Local Plan. Therefore, the Draft Scheme namely Draft Kota Kinabalu Local Plan 2020 is the current statutory document used by DBKK to monitor the land use zoning and planning standard to be imposed in any submission of subdivision plan and development plan.

The draft Kota Kinabalu Local Plan 2020 zones the project area for as hotel and resort (Figure 2.22).

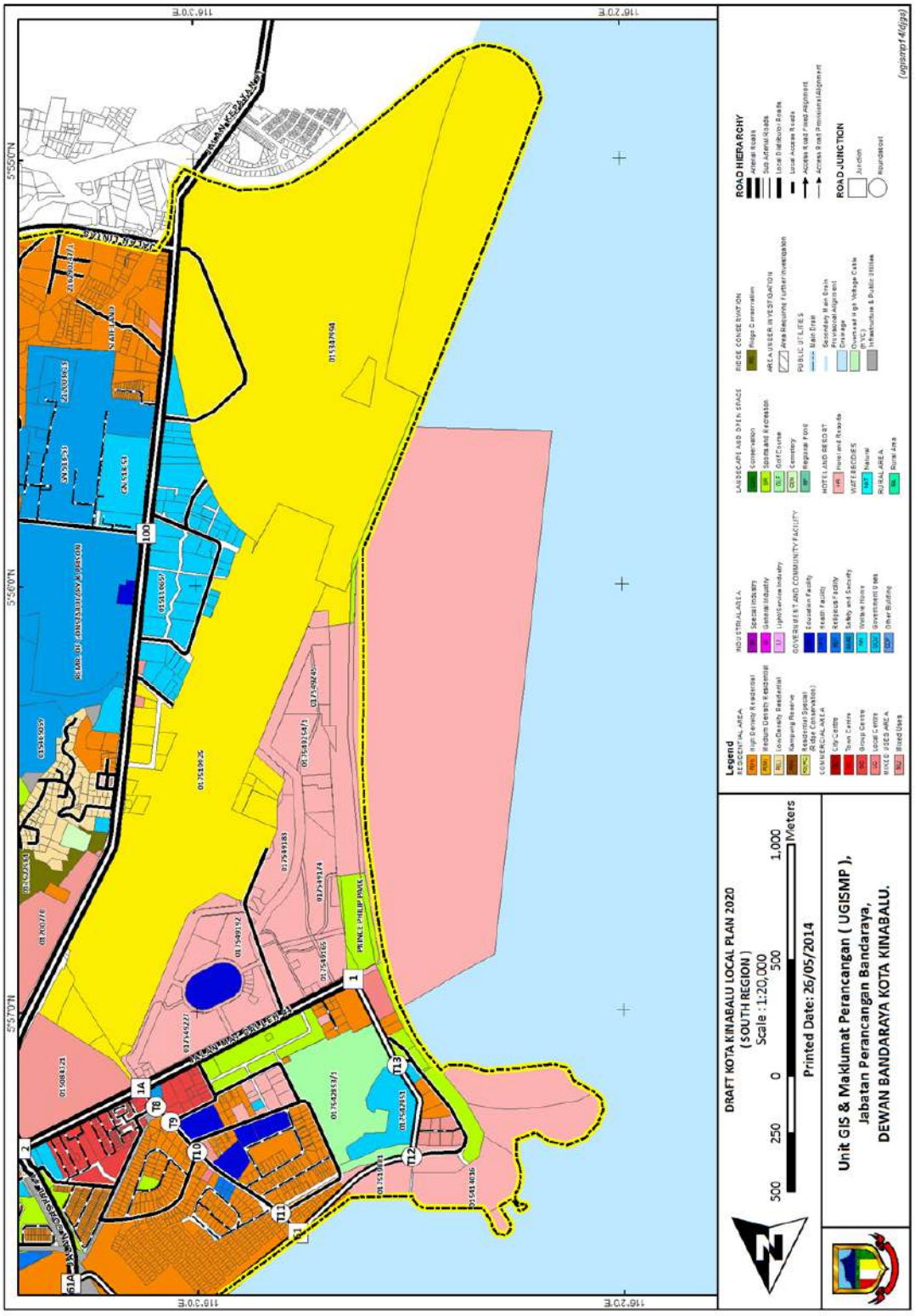

Figure 2.22 Draft Kota Kinabalu Local Plan 2020

2.3.3.2 Sabah Shoreline Management Plan

The Sabah Shoreline Management Plan (SMP) is a planning guideline for the shoreline adopted by the Sabah State Cabinet in 2006. Under the SMP, the coastline has been divided into management units, and management strategies applied for each unit.

The development area lies partially within Management Unit C5-19 of the SMP /2/ which is designated as **Promoted**: ***Low / medium Density Tourism*** (Figure 2.23). The recommendation for this management unit is to retain the beach for public leisure and recreational uses, while upgrading of the hinterland between the beach and the airport for public use was also recommended, i.e. a larger public park or some low density tourism facilities with a proper setback from the beach.

It was also recommended that the management unit be upgraded by providing more visitor facilities in order to enhance its tourism and recreation potential. Any development should cater to public use and ensure free public access to the shorelines all along this stretch.

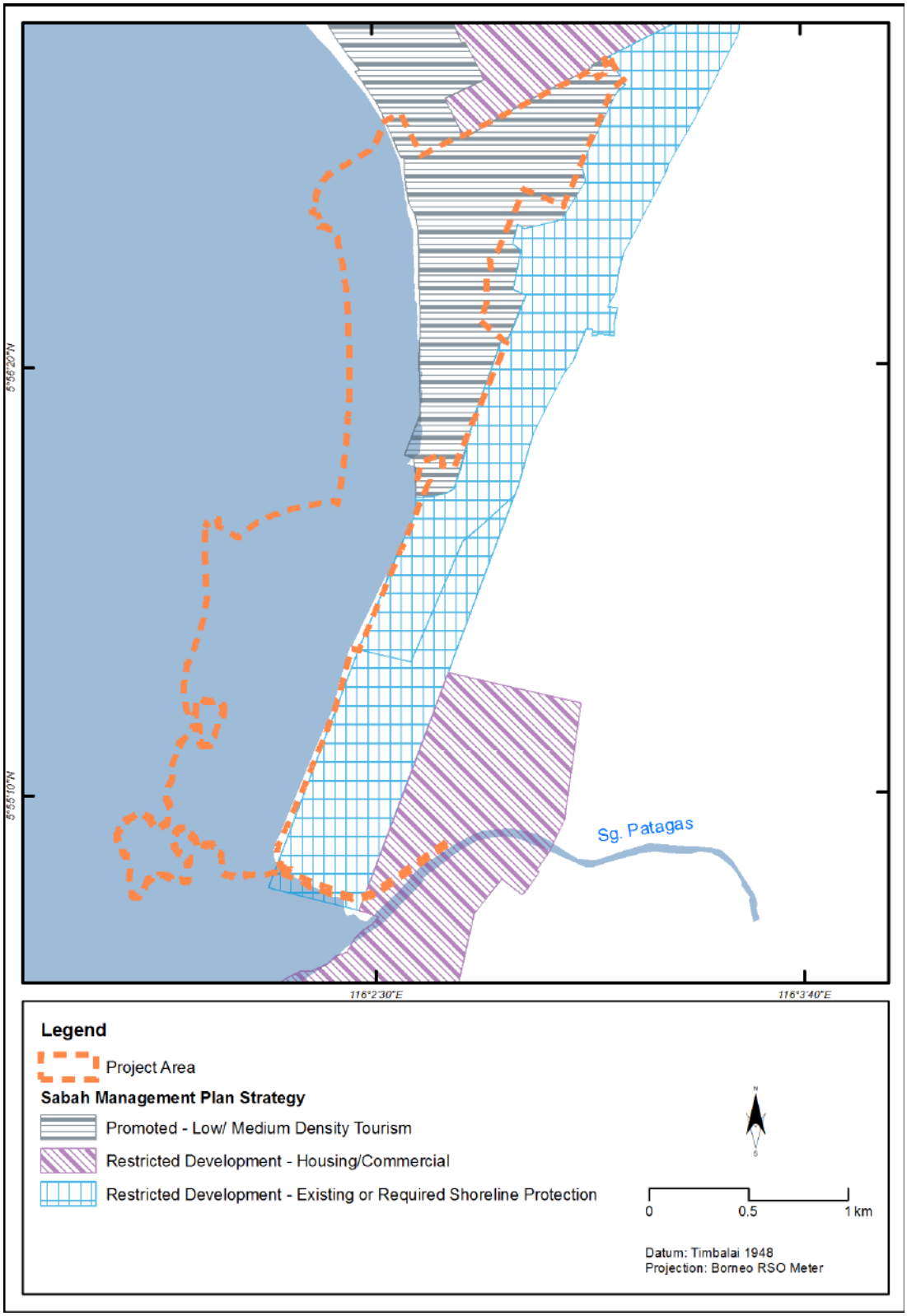

Figure 2.23 Management units and their management strategies within the vicinity of the Project – Sabah Shoreline Management Plan (SMP, 2005).

2.4 Project Activities

2.4.1 Pre-construction Phase

Activities during this phase include:

- Topographic survey;
- Hydrographic survey;
- Geotechnical investigation;
- Design;
- Traffic Planning
- Agency approvals; and
- Environmental assessment.

The following studies are currently underway and the findings will be used in the SEIA:

1. Bathymetry and topographic survey (Jurukur Tempatan, in progress)
2. Numerical modelling for masterplan layout (DHI, in progress)
3. Sand source study (DHI, in progress)
4. Traffic Study (Perunding Trafik Klasik Sdn. Bhd., in progress)
5. Landscape planning (Malik lip & Associates)

2.4.2 Construction Phase

The development will be carried out in four (4) stages:

1 Setting up construction infrastructure
2 Dredging/ excavation, reclamation and general earthworks.
3 Construction of marine structures
4 Construction of onshore development.

The anticipated activities associated with these four stages are described in Table 2.5 below.

Table 2.5 Summary of activities during the construction phase.

Component	Details
Setting up construction infrastructure	• Temporary site offices and construction workshops Utilities such as water, power supply, sanitation will be provided by portable unit. There will be no direct discharge of domestic sewage and construction waste into the sea.
Reclamation and earthworks	• Controlled clearing of vegetation within project area to retain as much vegetation as possible; in particular old growth trees. • Excavation of inner channel and basins a. Excavated material to be placed within the project site. • Reclamation activities will include: a. Perimeter bund construction except for dedicated beach area b. Hydraulic filling using imported fill and / or dredged material and incorporating sediment discharge control c. Filling using land based fill material for certain components d. Construction of shore protection works e. Ground improvement works • The perimeter bunds for the reclamation will be constructed in stages as

Component	Details
	the reclamation works progress. These are envisaged to be sand bunds and will be rock armoured on the exposed faces as the reclamation works progress • Reclamation will be carried out using trailer suction hopper dredgers • All material will be pumped or placed directly into the reclamation area • Sediment discharge control will be set up using for example settling ponds and / or silt curtains • Vertical drains will be inserted through the reclaimed land and soft subsoil strata, and preloading by filling the reclamation above the design levels may be used to accelerate settlement. • The rock armoured reclamation protection, promenades and walls etc will be finally completed to design levels after completion of the reclamation.
Construction of marine development i.e. breakwaters and shore protection structures	The key activities involved will include: • Installation of a geotextile on the seabed • Placing of rock core material for the structure • Placing the armour rock • Fabrication and placing concrete units if required Construction material will be transported to the project site by road but principally by barge where possible.
Construction of marina and facilities	The key activities involved in construction of the marina and fishermen's wharf will include: • Development of vessels berthing, boat storage and repair site • Berth pontoon marina facility • Installation of precast concrete components and/or appropriately treated woods for boardwalk, wharf and marina piers • Provision of services such as electricity, water etc.
Construction of onshore development i.e. condominiums, resorts, golf course, infrastructure and utilities.	Key construction activities include: • Piling • Buildings and services • Internal roads • Drainage system • Landscaping

2.4.3 Operational Phase

2.4.3.1 Residents, Guests and Staff

The proposed built development will bring in tourists, residents and employees, increasing the population size in Tg. Aru. Based on the development ratio dedicated for residential, hospitality and mixed use, with a total of 35% (104.7 hectares / 258.7 acres), the population to the project area is expected to approximately 12,000 residents when fully developed, excluding hotel guests.

The hotels will accommodate 1,670 keys in the five hotel properties plus an additional 766 in the hotel's branded residences and villas.

The number of staff on site on a daily basis is presently expected to be between 2,700 – 3,000 once the project is at full operational level.

In addition to the above staff requirements, it is expected that indirect jobs will also be created as a result of the development; these are usually calculated on a 3:1 to 5:1 ratio, which equates to a range of between 540 to up to 1,000 indirect jobs.

2.4.3.2 Public Areas and Facilities

The proposed development will give back to the public through the upgrading and expansion of Prince Philip Park and enlargement of Tanjung Aru Beach as well as public facilities in the area. The TAED will create over 2,600 m of publicly accessible waterfront, including a beach length of 1,350 m.

Figure 2.24 Publically accessible waterfront areas of the Project.

2.4.3.3 Solid Waste and Wastewater Treatment

The treatment of the wastewater will be an important task so that effluent does not pollute the nearby Tunku Abdul Rahman Park.

As mentioned above in Section 2.2, the development aims to achieve environmental performance certification and will adopt strategies such as Water Strategy and Waste Strategy. The water strategy aims to achieve the interdependent goals of reducing site water demand and reducing site waste water generation. The goal of the waste strategy is not simply to minimise waste generation but to provide facilities and management that will maximise the recovery of recyclable waste streams and ultimately to minimise the extent of waste going to landfill.

2.4.3.4 Navigation

The marina, maritime square and private berthing areas within the project will increase marine traffic in the area. Marine traffic from the development area will contributed from the water taxis, recreational boats to the islands and private vessels.

2.4.3.5 Land Traffic

Increase in land traffic around the project area is expected during operational phase. The development site will be accessible to the general public from the north, while road access from the south is linked only to the KKIA Terminal 1. A large increase in traffic along the main access road, Jalan Mat Salleh, therefore be expected.

2.4.3.6 Golf Course

During the operation stage, the main on-site activities are routine maintenance of the golf course and operation of the recycling water plant for turf irrigation purposes. The use of fertilisers and pesticides on the green will be optimised according to best management practices.

2.4.3.7 Marina Operations

As there are no boat servicing facilities nearby, a boat yard at the marina is an integral component of the development. Provisions for power, water, solid and liquid waste treatment/ handling and drainage will need to be made. The waste services will have the capability to pump out wastewater, consisting of grey and black water, from the vessels to the overall TAED sewer system.

To attract visitors, the marina will have Port of Entry status and hence a customs and immigration post is required. As many as 180 – 200 of yachts / boats are expected to visit the marina facilities during the operation stage.

2.4.3.8 Beach Maintenance

The maintenance of the new beach will be undertaken throughout the operation stage. The increased number of people utilising the beach will require the beach to be maintained periodically to keep it in optimum condition. Beach sand maintenance such as re-nourishment, if required, as well as cleaning up the beach shore will be proposed as part of the Beach Management Plan.

2.4.4 Abandonment

Upon completion or abandonment of the project works, the vehicles / machinery and associated equipment would be removed. There will be staff demobilisation and the workers' quarters and other temporary buildings will also be removed along with any other raw material stockpiles or waste materials.

In the event of project abandonment and site closure, construction waste material and machinery would be removed from the development area; however, partially completed reclamation, open space or partially completed buildings may subsequently be fronting the sea.

2.5 Development Schedule

The overall project development duration is expected to be in the order of four years. Table 2.6 shows the tentative outline project schedule. Under the pre-construction stage, other concept and design studies will be carried out in parallel with the SEIA study and are expected to be completed in ten (10) months.

An initial estimate of the reclamation and earthworks duration is approximately 26 months, with potentially an extra four months for ground treatment. Again, it is noted that the construction and development schedule can only be confirmed following detailed engineering design, which will be carried out in parallel with the SEIA study.

Table 2.6 Tentative project development schedule

Stage	Duration
Pre-construction Concept and Design	To May 2016 10 months
Construction Infrastructure and Buildings	2016 – 2019 30 months

3 Description of Existing Environment

3.1 Physical-Chemical Environment

3.1.1 Bathymetry

The seabed at the site is generally flat and shallow, reaching a depth of less than -10 m MSL approximately 1 km from the shoreline (see Figure 3.1).

3.1.2 Coastal Hydraulics

Tanjung Aru beach is exposed to waves from the west-south-westerly direction. The area around Tg. Aru and the Kota Kinabalu International Airport (KKIA) is fairly sheltered against northerly waves by the islands in the Tunku Abdul Rahman Marine Park. During NE monsoon conditions, the coastline is partly protected from the northerly and north-westerly waves and only a certain percentage of waves penetrate through the channel between Pulau Manukan and Pulau Sulug, causing weaker north-westerly waves to reach this stretch of beach.

The current regime around the west coast of Sabah is generally weak and is mostly wind induced current. Current speeds in the project vicinity are generally low with the highest current speeds occurring around the Tg. Aru headland and between Pulau Manukan and Pulau Gaya where the currents are contracted/ restricted to narrower channels while other areas can get as low as 2 cm/s especially in sheltered embayments.

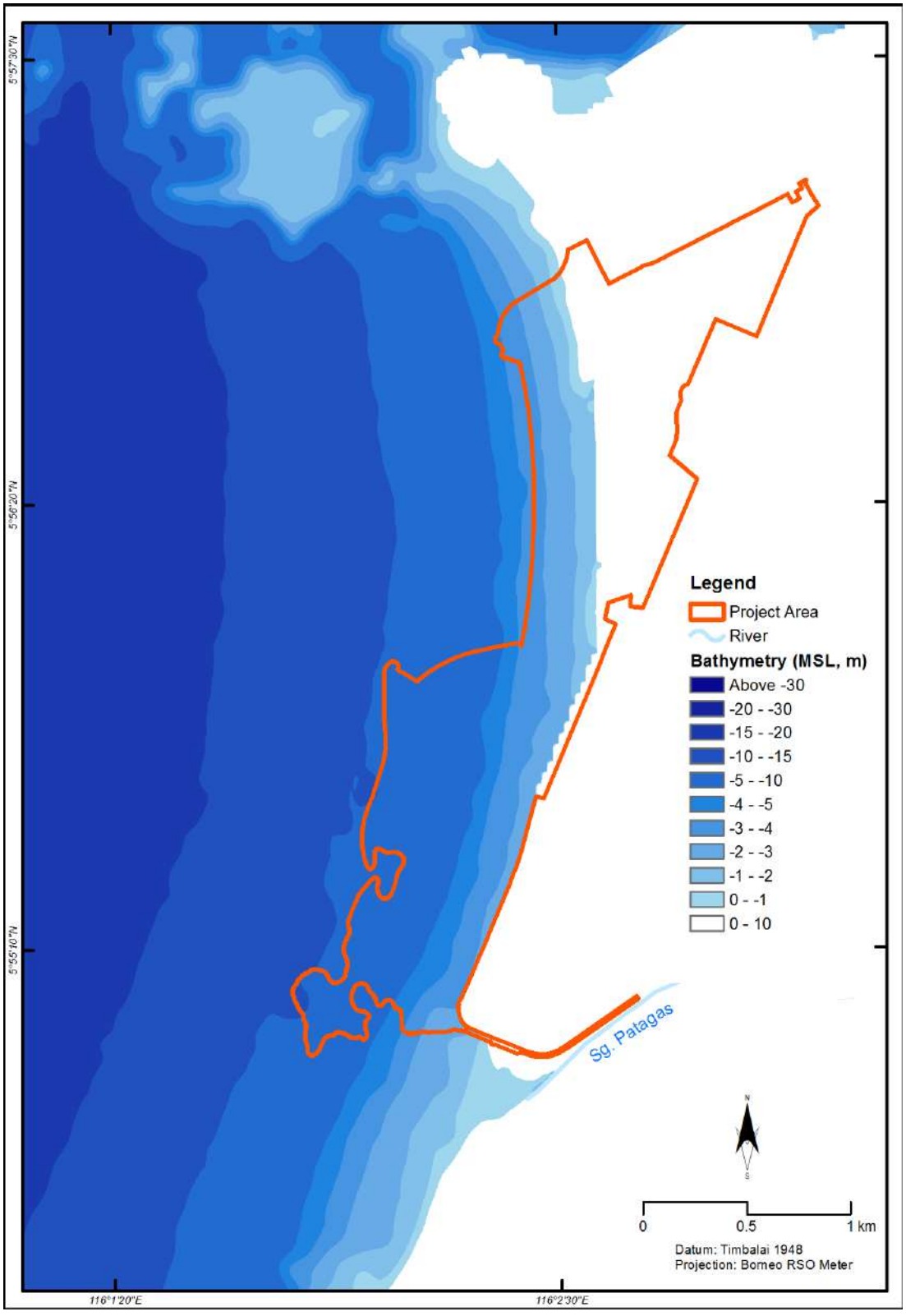

Figure 3.1 Bathymetry at Project site.

3.1.3 Shoreline Condition

The shoreline condition along Tg. Aru beach is deteriorating in a number of ways. It is the intention of the TAED project to try and address each of the problems identified which are discussed briefly here.

The most talked about topic is the amenity loss due to erosion and the coverage of the usable beach by the sea at high tide. This is obviously a major factor as to why the shoreline condition is deteriorating but the project frontage is also no longer a pleasant beach or a safe beach with respect to six other major factors:

- The beach sand quality is deteriorating due to the collection of silts and muds.
- The eight (8) drains that currently discharge onto and over the beach contain effluents and organic matter that could be hazardous to users.
- The Sg. Patagas River to the south of the project site currently discharges effluents and organic matter that during the right tidal regime reaches the amenity beaches.
- The concrete debris that now litters the Tg. Aru beach in places is not safe for swimmers or other water use activities. At high tides access is cut off along the beach therefore beach users either have to walk back through the sea or walk inland through areas that are not very conducive for walking.
- Large quantities of litter and other debris is a common site along the complete length of Tg Aru beach.
- The low lying land behind the Tg. Aru beach is susceptible to flooding in the event of severe storms and will be made worse by sea level rise caused by global warming. The loss of beach is further reducing the coast protection capability.

3.1.3.1 Erosion

The erosion at Tg. Aru beach has been well documented over the last 30 years in several studies. The National Coastal Erosion Study (NCES) undertaken in 1985 identified erosion along the frontage and gave the beach an Erosion Category 2. This means that it was identified as having significant erosion which states: *Areas where the shoreline is eroding at a rate whereby public property and agriculture land of value will become threatened within 5-10 years unless remedial action is taken.*

The Shoreline Management Plan (SMP) undertaken in 2005 and the Integrated Shoreline Management Plan (ISMP) undertaken in 2011 both identify the erosion, specifically along 3rd beach and the Erosion Category of 2 was retained.

To verify the erosion rate DHI undertook a survey on 3rd July 2014 in addition to that undertaken by the licensed land surveyor Jurukur Tempatan in 2013. In both cases the surveys of the frontage derived what is considered to be the erosion line (in some cases the vegetation line). Both surveys are almost identical and the one from Jurukur Tempatan is shown for reference in Figure 3.2, Figure 3.3 and Figure 3.4. The erosion line has been duplicated with that from a satellite image taken in 1966 for comparison of the erosion over this period of 48 years.

It is very important to note that we are assessing the “Project Coastline” and not the entire coastline along the Tg Aru frontage and this is extends from approximately Jalan Mat Salleh to the end of the KKIA runway.

To summarise the erosion identified as follows:

- The beach is eroding more in the southern part of the project site Figure 3.4 and eroding less moving northwards Figure 3.3. There appears to be some accumulation of beach north of the project site from approximately the Golf Club to the STAR.
- There are various sea walls constructed along different parts of the project frontage and these are in different states of dilapidation. The failure of the most major walls constructed in the late 70”s and early 80’s is due to erosion and the subsequent undermining of the structures which has caused their collapse. However these walls

would have slowed any ongoing erosion considerably and we can only surmise what would have been the loss of frontage should they have not been constructed.

- The erosion has continued through the gaps in these seawalls where they have collapsed (see following photographs) which can be seen to be a minimum of 6m to 8m of further erosion behind the protecting structures. The erosion therefore would very likely to have been considerably more given that the structures, even when collapsed, significantly reduce the wave impacts.

- The estimated erosion based on 48 years (1966 – 2014) is estimated to be:
  - Up to 40 m on Third beach which equates to 0.8 m/year on average
  - Up to 16 m on Prince Philip Park and Second beach which equates to 0.3 m/year

Figure 3.2 1st, 2nd and 3rd beach shoreline evolution over the period of 48 years.

Figure 3.3 1st and 2nd beach shoreline evolution over the period of 48 years.

Figure 3.4 2nd and 3rd beach shoreline erosion over the period of 48 years.

It is clear that with future sea level rise and increased storminess that this will exacerbate the erosion and potential flooding problem that the Tg. Aru beach currently faces. Even today at high tide very little beach, if any, is left for public amenity use as the sea encroaches completely up to, and behind the old defences and vegetation line as shown in Photo 3.1 and Photo 3.2. Even north of the project site where the beach is said to be stable and sufficient, it does not provide any significant coast protection as can be seen Photo 3.3.

Even on a very calm day with no storm surge or waves the sea has encroached right up to the grass area with very little margin in ground height above sea water level to prevent flooding of this area. Most of the land behind the Tg. Aru beach frontage is low lying with little threshold above high water mark should there be a storm event with high surge levels.

Photo 3.1 Sea encroaching behind the old seawall at high tide and covering the amenity beach

Photo 3.2 Sea encroaching right up to the old seawall at high tide and covering the amenity beach

Photo 3.3 North of the project site showing the high water line reaching the grass and tree areas, there is very little margin above high water line to prevent flooding.

The old seawalls have subsided and collapsed due to lowering of the beach that has undermined the foundations of these structures. Where there are gaps in the seawall the sea has penetrated through and started to erode behind as can be seen in Photo 3.4 and Photo 3.5. The amount of erosion behind the old primary defences varies from 9m-16m from the outer defence to the inner one and a further 6m-8m through the gaps in the second line of defence. However without these old seawalls the rate of erosion would very likely to have been much worse and even in their dilapidated condition provide some protection from wave attack.

Photo 3.4 Erosion extending behind the line of the existing concrete sea wall

Photo 3.5 Erosion extending behind the primary line of defence and through the second line of defence (concrete piles)

3.1.3.2 Beach sand quality

The silts and muds being deposited onto Tg Aru beach from the Sg Patagas river and the drains are collecting on the foreshore and reducing the quality of the sand. Certainly at low tide and just offshore the sediment sampling undertaken shows a high proportion of fine silts and muds that not only reduce the water quality in terms of visibility but are not the material normally visualised as an amenity beach. Redirecting the effluent from the drains and the river away from the area and increasing the wave activity by moving the beach into deeper water are ways of improving and self-cleaning the sand. Photo 3.6 shows the silty foreshore that is typical of the Tg Aru frontage at low tide, note the sand crab (ghost crab) activity that enjoy silty areas and typically distinguish a beach with higher organic content.

Photo 3.6 Silt and mud along the beach

3.1.3.3 Drains

There are eight (8) drains that currently flow onto, and across Tg. Aru beach and at least five (5) of them are within the project frontage. These have shown high levels of organic matter (Enterococci & E. Coli) that could be damaging to health, some of which have a powerful smell, discolour the sands and are visually unsightly. All the drains should have some measure of water quality control and / or be redirected away from the amenity beach areas.

Photo 3.7 Grey / black water discharging onto the beach south of the Sugarbun.

Photo 3.8 Drain outfall discharging onto the beach north of the Sugarbun

Photo 3.9 Grey / black water discharging onto 2nd beach

3.1.3.4 Sg Patagas River

The Sg Patagas River that flows out to the South of the Project site adjacent to the end of the KKIA runway extension contains high levels of suspended sediment during storm rainfall periods and contains high levels of organic matter (Enterococci & E. Coli). Both of these can spoil the water quality of the amenity beach and be a hazard to beach users. The discharge from the river currently flows along the TG Aru beach foreshore during certain monsoon periods and cause the silt and other contaminants to be deposited near the amenity beaches. During normal flow events, litter from the river is deposited on the beaches. Photo 3.10 shows the image of the Sg Patagas River and the sediment plume can be seen even during normal flow conditions.

Photo 3.10 Latest Google image showing the sediment plume from the river and the aircraft landing lights being constructed south from the runway.

3.1.3.5 Beach User Hazards

There are two issues at present that pose a hazard to beach users. The collapse of the old seawalls along the 2nd/ 3rd beach areas and the erosion behind has now left them offshore and partly or wholly submerged at high tide as can be seen in Photo 3.11. Certainly along the stretch of beach where the outer defences still exist (which extends to approximately 200m of beach) this is not only unsightly but is a hazard to swimmers and other water sport activities.

At high tide it is difficult to walk along the beach due to the high water mark extending up to the old seawalls. Certainly along approximately 350 m of beach this is the case and access is limited unless the sea is calm enough that allows people to walk through the sea. If walking through the sea is not thought possible then another means of walking back has to be found through the undergrowth behind the beach. Photo 3.12 shows the old coast protection structures blocking access along the beach, the route behind through the undergrowth is not a particularly attractive option and bearing in mind that this part of Tg Aru beach is considered unsafe.

Photo 3.11 Submerged concrete structures a hazard to swimmers and other beach users

Photo 3.12 At high tide and with rough seas access along the beach is cut off

3.1.3.6 Litter and debris

A particular problem that the present beach suffers is litter of all sorts being deposited along the whole of Tg Aru beach frontage. The sources of litter are varied and are derived from the Sg Patagas River, various Kampungs and water villages, Kota Kinabalu city and the beach users themselves. Most people expect some litter these days on a beach but certainly not the quantities and the type of litter such as sanitary products and nappies that can be found on an amenity beach such as Tg Aru.

Photo 3.13 Litter is a common problem along the full length of Tg Aru beach

3.1.4 Geomorphology

The project area is defined the bay area delineated by the headlands of Tg. Dumpil in the south and Tg. Aru in the north (Figure 3.5). The area features a long coherent sandy beach which attaches to the protruding reclamation frontage at the Shangrila Tg. Aru Resort (STAR) to the north and the KKIA reclamation to the south.

The river mouth of Sg. Patagas is located immediately south of the KKIA airport reclamation and is a source of fine sediments in the coastal waters.

Figure 3.5 Aerial overview of Tg Aru and its features.

3.1.5 Hydrology / Drainage

There are three main rivers within 3 km radius from the project site namely Sg. Putatan, Sg. Patagas and Sg. Sembulan (Figure 3.6). Several drains also discharge across the beach in the project area.

3.1.6 Water Quality

The nearshore waters along Tg. Aru beach are fairly turbid. Sg. Patagas is a key source of suspended sediments in the immediate project area, while during high rainfall periods, sediments and other pollutants discharged by Sg. Putatan can also affect the beach.

Immediately on the beach, poor water quality along the shoreline is evident due to drains discharging black and malodourous water directly into the sea.

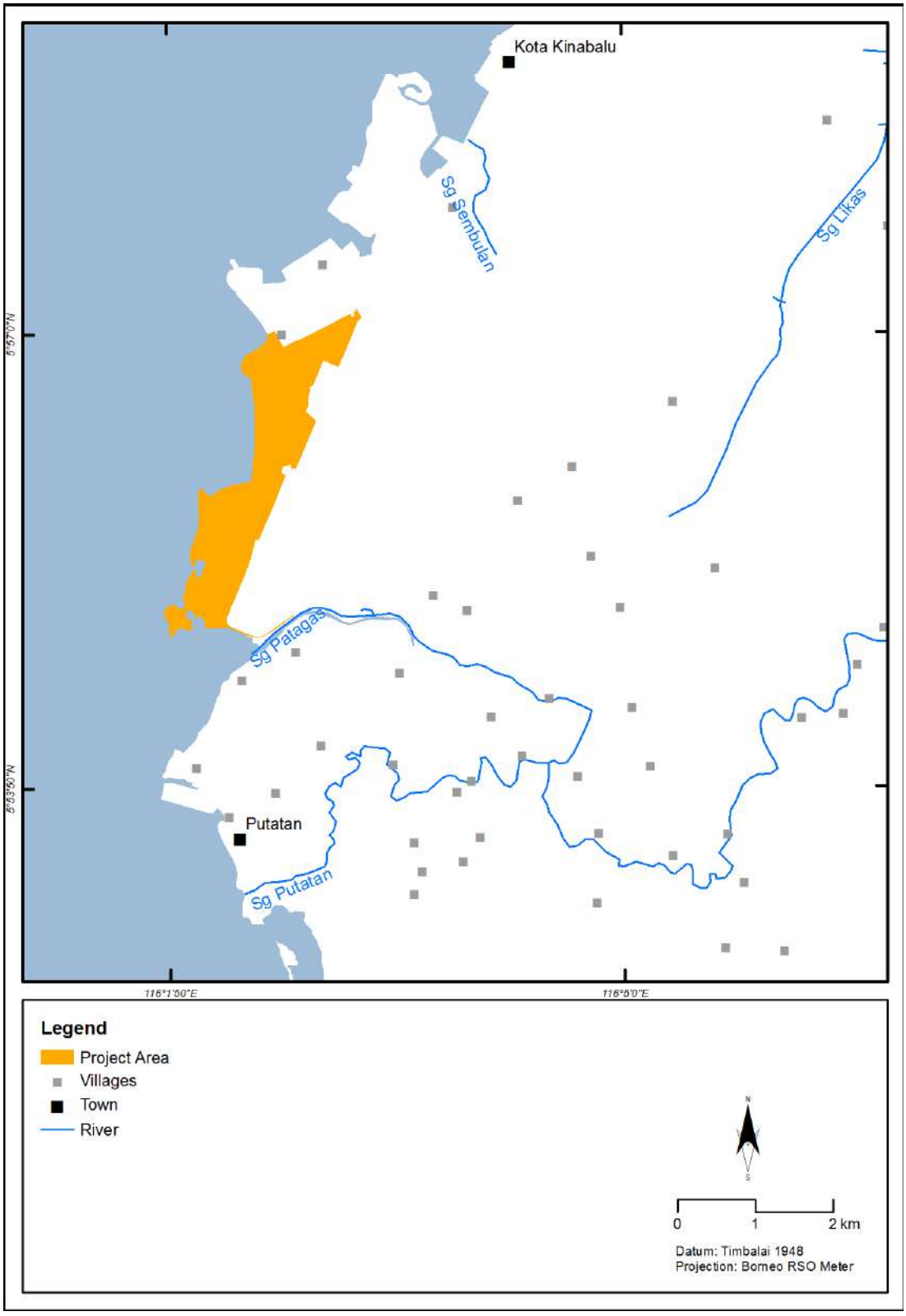

Figure 3.6 Rivers within the project area vicinity

3.2 Biological-Ecological Environment

3.2.1 Shoreline Habitats

Within the project area itself, the vegetation cover is quite extensive (Figure 3.7), and comprises landscaped areas (e.g. Prince Philip Park), grassland or fields, areas of relatively dense secondary vegetation and scrub, and belts of trees along the shoreline. Coastal vegetation within the study area includes beach vegetation common to coastal areas around Sabah, including the project area's namesake, the Casuarina or Aru tree (*Casuarina equisetifolia*) (Photo 3.14).

Photo 3.14 Mixed beach vegetation at Tg. Aru beach area.

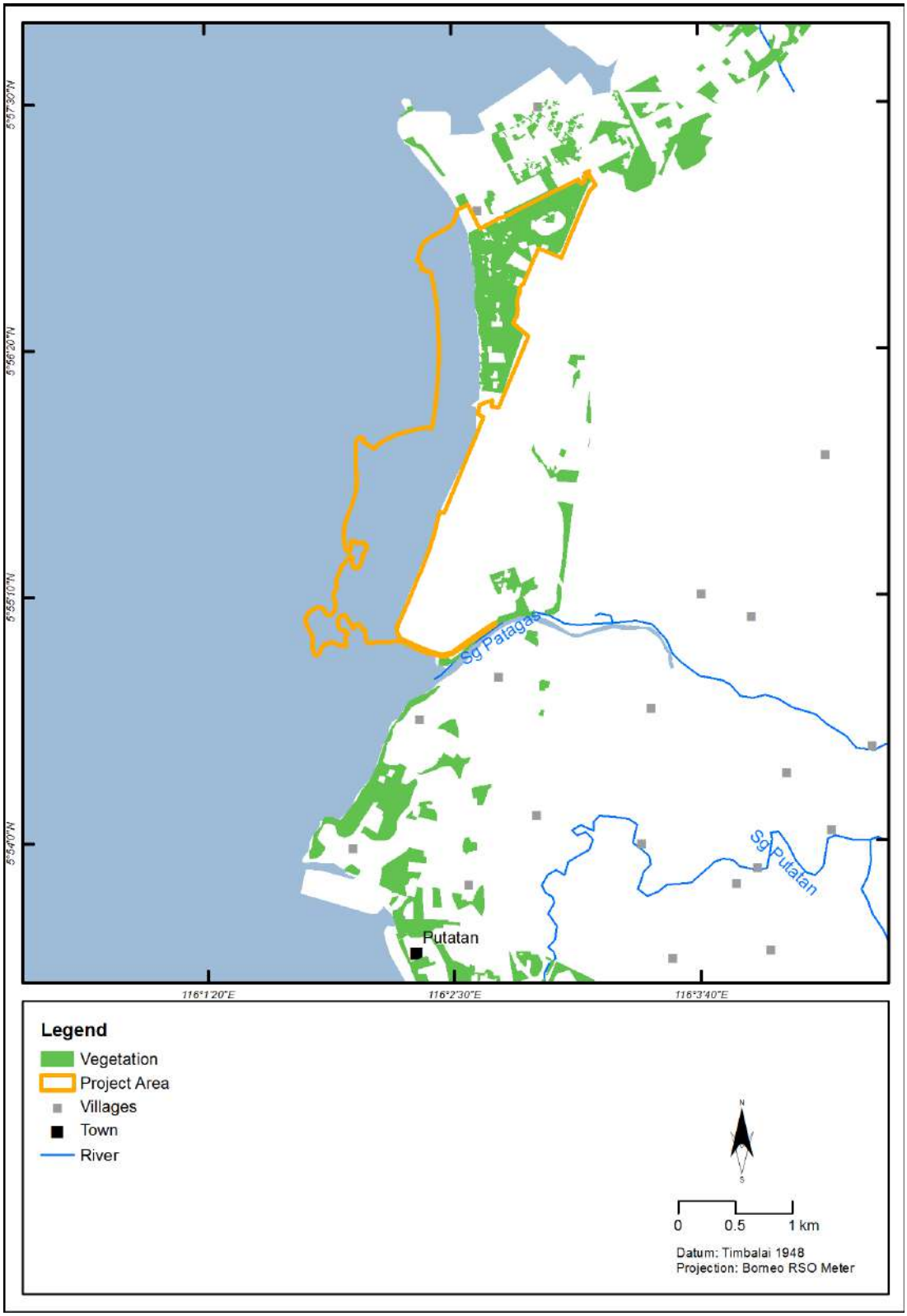

Figure 3.7 Vegetation area within the project area vicinity. Source: World View Satellite Image, July 2011.

Fauna of note within the area are the birdlife (Figure 3.8) with the most notable species such as Oriental Pied Hornbill (*Anthracoceros albirostris*) and Blue-naped Parrot (*Tanyganthus lucionensis*). The parrot feed on seeds in the cones of the Aru trees, as well as the fleshy outer covering of Sea-almond (*Terminalia catappa*) and the fruits of the oil palm that can be found at the Prince Philip Park. Furthermore, the fig trees found in the area is also a source

of food for the hornbills. Other important food trees found in the area include Alexandrian laurel (*Calophyllum*) and the remnant oil-palms and other palms. The older Aru trees found along the beach act as nesting holes for these birds.

Blue-naped parrot | Oriental Pied Hornbill

Figure 3.8 Most notable bird species found in Tg. Aru beach.

Tg Aru beach is the first point of land for many birds, particularly those blown of course by storms during the migration season (October to April) (Birds of Borneo, 2009). This is when birds that normally occur in more northern climates fly south to escape the cold winters when there is less food, to warmer places and which are normally only seen in Borneo during this period, as most of them will fly back north in the northern summer. Most of the migrant birds come from Japan, Korea and China, including species of shoreline wading birds such as egrets, whimbrels, flycatchers, other small insect-eating birds and larger birds of prey such as hawks and eagles. Other rare migratory species are also seen along Tg Aru beach which include the rare Peregrine Falcon, the Honey Buzzard, the Blue-winged Pitta, the Common and Black-capped Kingfishers, the Rosy Starling, the White-shouldered Kite and Brown Shrike as well as the Ashy Minivet.

3.2.2 Marine Habitats and Communities

The nearest coral reefs to the project site are the reefs between Tg. Aru and Tunku Abdul Rahman Park (TARP) as shown in Figure 3.9. The coral reefs off Tg. Aru are primarily in *Poor* condition /2/. These reefs are affected by turbid waters nearshore Tg. Aru beach.

Further afield, there is about 12 to 14 km of fringing reefs, occasional outcrops and small patches of reefs surrounding the TARP /2/. Pulau Manukan, Pulau Mamutik, Pulau Sapi, Pulau Gaya and Pulau Sulug have *Fair* to *Poor* quality reefs.

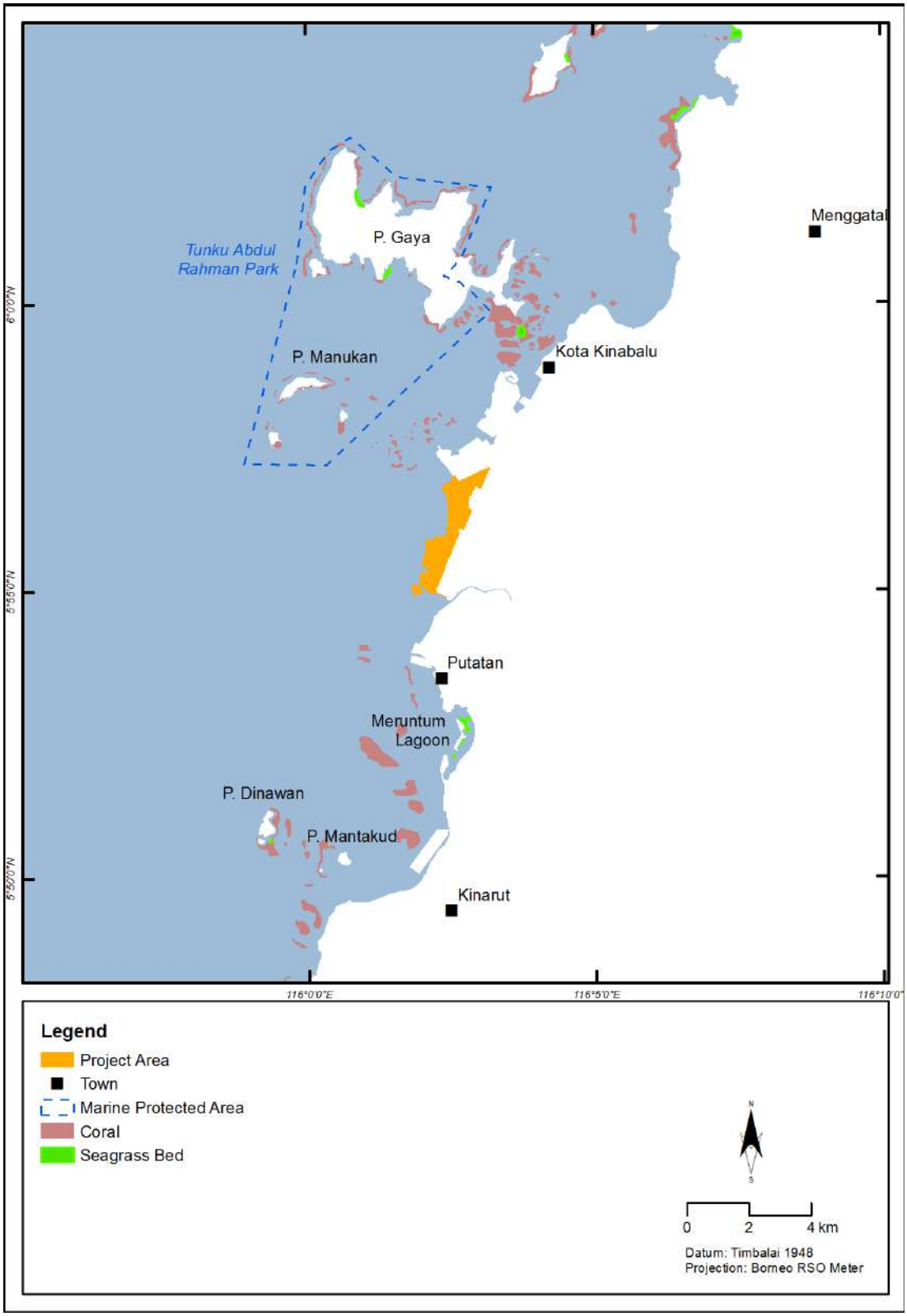

Figure 3.9 Coral and seagrass area within the vicinity of the project area.

Coral reefs also exist close to the city (between Kota Kinabalu and P. Gaya). Although many of these reefs are currently degraded with live coral cover either completely absent or *Poor* (up to 20% live coral cover) /2, 3/. The dominant bottom substrate was a mixture of coral rubble and sand with either scattered live corals (20% cover) or algae growing on the sandy areas (Photo 3.15 and Photo 3.16). Most of the hard corals were covered with silt and

algae. There were a variety of coral species observed, with *Porites* spp. and *Fungiidae* spp. being the most common.

Photo 3.15 Coral rubble

Photo 3.16 Sandy bottom

The major threat to the habitat is the increased amount of suspended matter in the water column. Polluted water runoff from the city may also affect the coral growth /3/.

Seagrass beds are not found within the Project site, with the nearest reported occurrence off Pulau Gaya, approximately 6.4 km to the north (Photo 3.17), and in Meruntum Lagoon, Putatan, approximately 5 km to the south (Figure 3.9).

Seagrass species found around Pulau Gaya within the Tunku Abdul Rahman Park are *Halodule uninervis, Cymodocea serrulata*, and *Cymodocea rotundata* at southern shoreline of P. Gaya /4/, while at Meruntum Lagoon *Enhalus acoroides* predominates.

Photo 3.17 *Cymodocea sp*. at the southeastern side of Pulau Gaya.

3.2.3 Marine Parks

Marine protection areas (MPAs) or any protected areas are regions in which human activity has been placed under some restrictions in the interest of conserving the natural environment, its surrounding water and the occupant systems that may require preservation or management.

The nearest MPA to the project site is Tunku Abdul Rahman Park (TARP) as shown in Figure 3.10 with the approximate distance of 3.1 km from the nearest point of the project boundary to the nearest point of the MPA boundary. TARP is a state park located in Gaya Bay, 3 km offshore from Kota Kinabalu. The park consists of 4,844 ha of protected area. Its main objective is to protect fauna, flora, and marine eco-systems within the boundary.

The reefs within the park support a variety of coral growth containing a large diversity of species. A general survey carried out by the Marine Research Unit of Sabah Parks in 1998 showed that more than 50% of the coral reefs in TARP have between 11 – 30% live coral cover, and only about 16% of the coral reefs located at the monitoring stations have 31 – 75% live coral cover /5/. The coral conditions within the boundary of the marine park are better compared to the reefs outside of the boundary, which consists of poor quality coral reefs for example, the eastern side of P. Gaya.

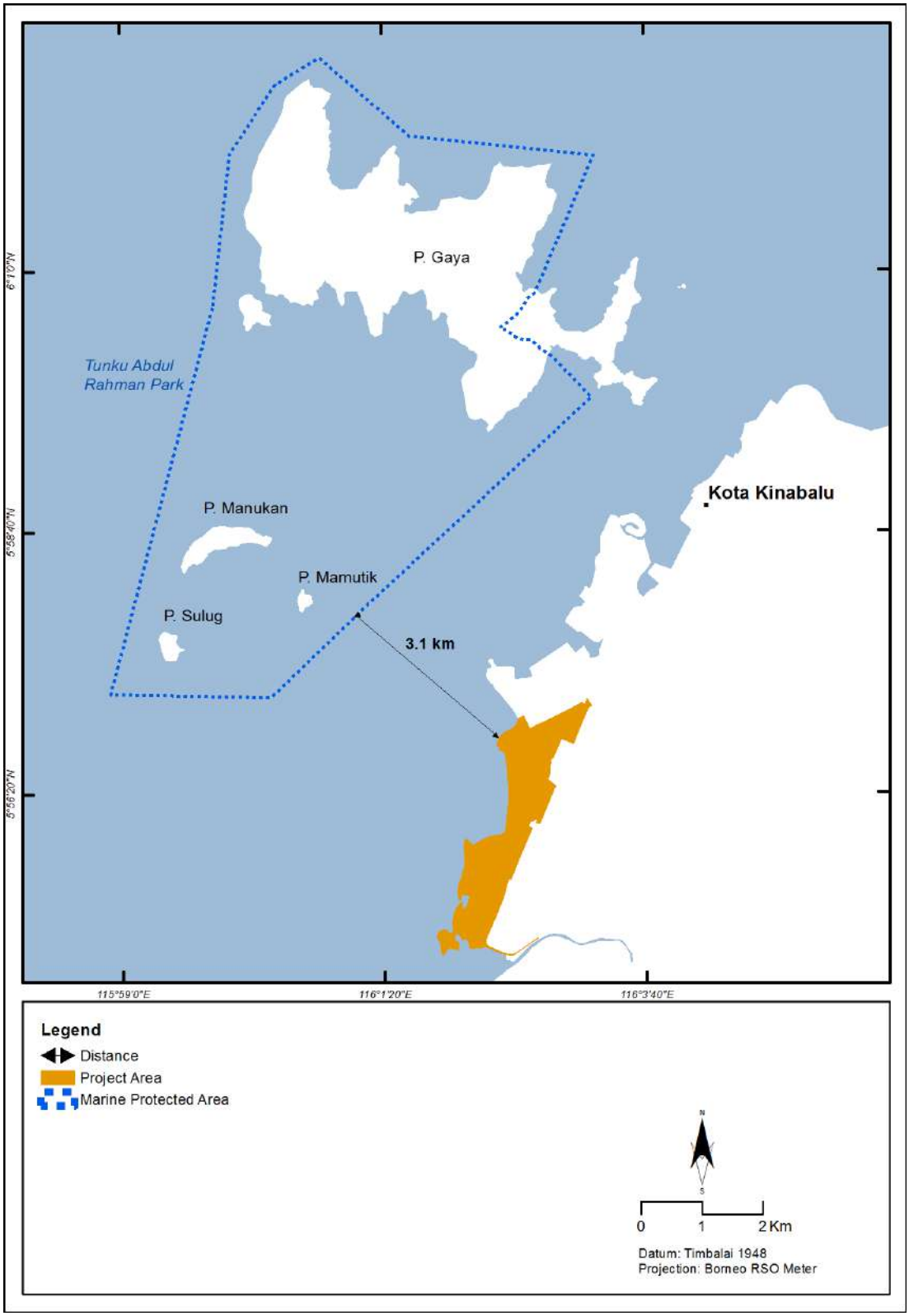

Figure 3.10 Marine Protected Area

3.3 Human Environment

3.3.1 Landuse

The immediate project area is an existing recreational area. The Tanjung Aru Beach is a popular public beach with facilities available to the public. The beaches of Tanjung Aru, popularly known as 1st, 2nd, and 3rd beaches, also includes Prince Philip Park, Sugar Bun Plaza (restaurants and food stalls), the Kinabalu Golf Club (KGC) and Kinabalu Yacht Club, open spaces and a number of private plots. On Tg. Aru headland itself, the Shangri-La Tanjung Aru Resort (STAR) bounds the northern end of the beach.

Prince Philip Park (Figure 3.11) is located along the second beach, a popular leisure and recreation area for both locals and visitors. The Park is named after Queen Elizabeth II's husband, who together with the Queen visited Sabah in the early 1970s. The Park has landscaped gardens set with walking path, ponds and stone bridge and fountains. There are also picnic huts, children's playgrounds, and shower/ toilet facilities.

Figure 3.11 Overview of Prince Philip Park

At the end of the park is the Third Beach. It extends from the border of the Prince Philip Park to the end of the Kota Kinabalu International Airport boundary. Despite a litter problem, the area is a very popular place for leisure and recreation.

Inland, there are several private buildings such as schools and residential facilities for the police force and army chiefs.

Immediately outside the project boundary is the Kota Kinabalu International Airport (KKIA). KKIA consists of two terminals. Terminal 1 is the main terminal located at Kepayan area while Terminal 2 located in Tanjung Aru is on the other side of the runway from Terminal 1. To the north of the project area is a resort area, with the Shangri-La Resort on Tg. Aru approximately 1 km from the project boundary, and further north the Sutera Harbour Resort which is approximately 2 km from the project boundary.

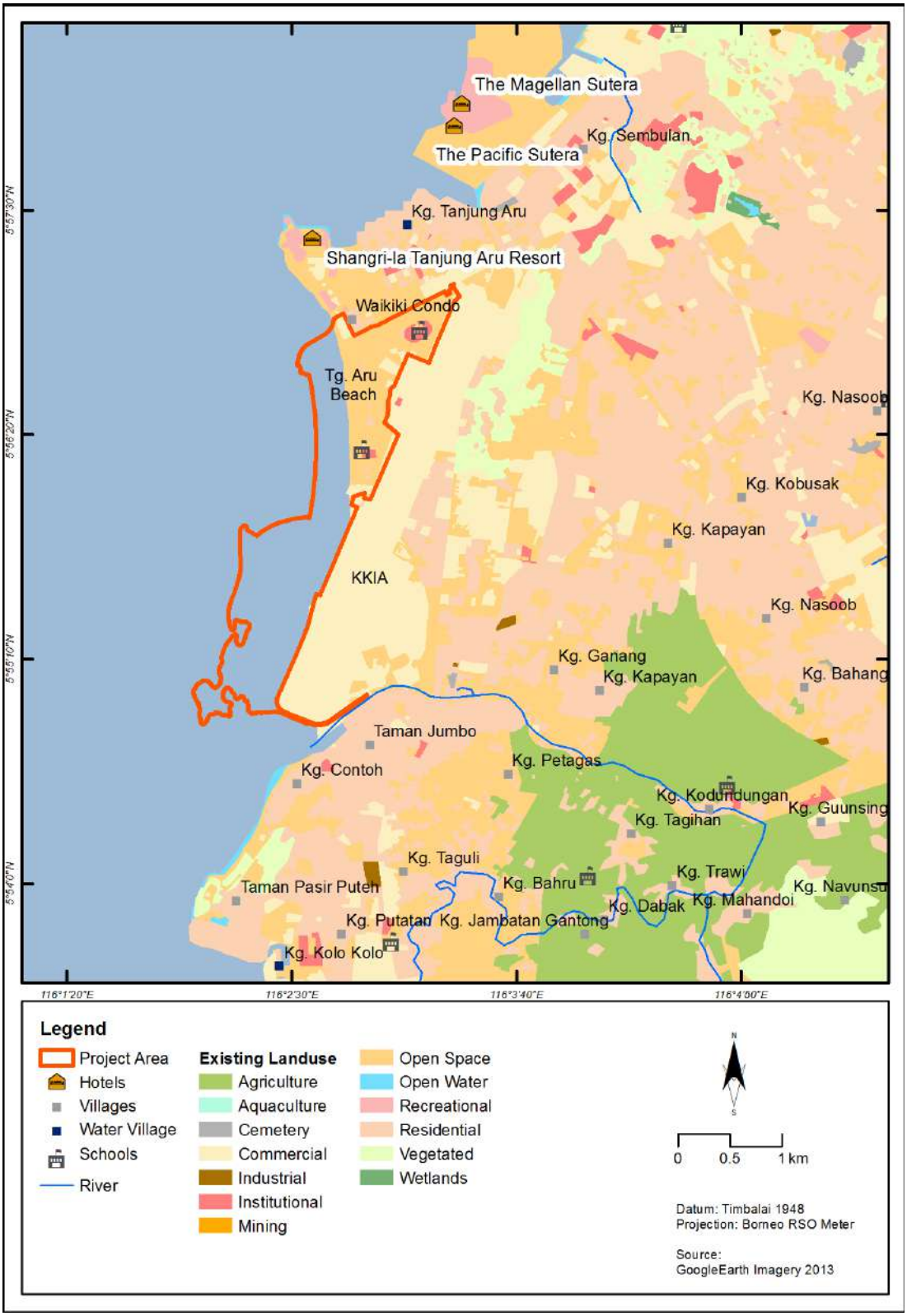

Figure 3.12 Existing land use of the study area

3.3.2 Settlements

The nearest residential areas, apart from the official government residences within the project area, are the Waikiki Condominium and a private house immediately north of the project area. Other settlements are Taman Jumbo and Kg. Contoh which are located south

of the project boundary next to the proposed road and Kg. Tg. Aru which is approximately 500 m north of project boundary (Figure 3.13). Tg. Aru Town is located approximately 145 m north of the project boundary. Other villages or settlements are located more than 1 km from the project boundary.

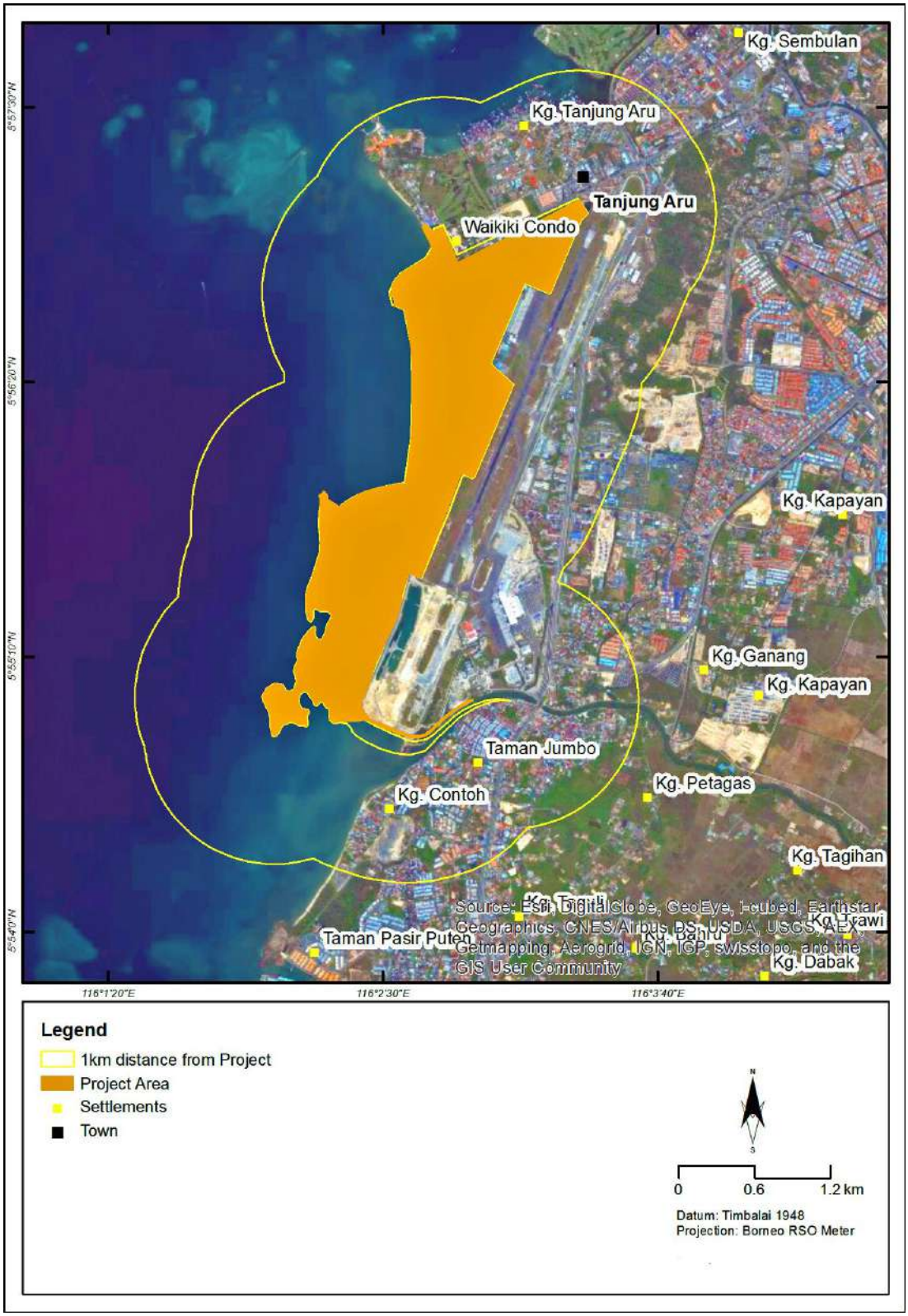

Figure 3.13 Location of nearby villages / settlements.

3.3.3 Socioeconomics

The project area is within the Kota Kinabalu district. According to Department of Statistics Malaysia in 2010, the Chinese community is highest in Kota Kinabalu, followed by Bajau and Kadazan/Dusun.

Kota Kinabalu is the major business centre for Sabah. Most of the economy is driven by private investment. New commercial developments are expanding rapidly either in the town area or within the suburbs. A high proportion of the population works in the commercial and trading sectors.

3.3.4 Navigation

The Project lies outside of the Kota Kinabalu Port Limit, which is limited to Gaya Bay and waters to the south west bounded by a line joining Tanjung Aru and the northern point of Pulau Gaya and a line to Tg. Gaya /6/.

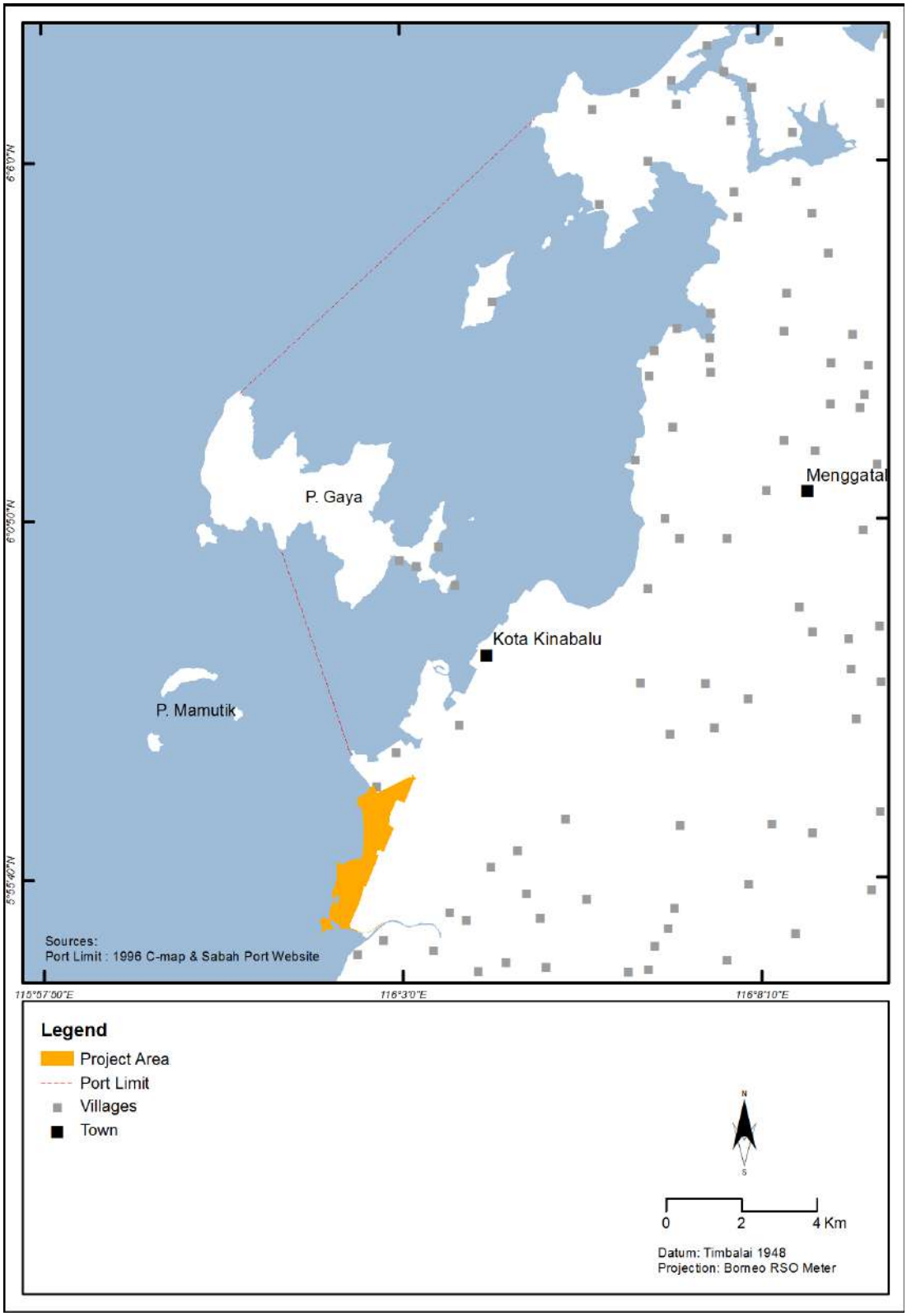

Figure 3.14 Kota Kinabalu Port Limit.

3.4 Environmental Sensitive Receptors

A summary of the key sensitive receptors as described above and their distance from the Project site is given in Table 3.1.

Table 3.1 Key sensitive receptors within the study area

Receptor	Approx. Distance from Project Area	Description
Physical Environmental Features		
Beach	0 m - 630 m to Tg. Aru	First beach
Sg. Patagas river mouth	250 m	Road extension around runway
Biological Receptors		
Corals	1 km	Off Tg. Aru
Seagrass	5 km along the coastline 6.4 km along the coastline	Meruntum Lagoon Off P. Gaya
Scrub vegetation	Within project site	Direct impact area
Birds	Within project site	Avian species of conservation significance that uses the site as habitat.
Tunku Abdul Rahman Park (TARP)	3.1 km to border of TARP 3.8 km to P. Mamutik	Marine protected area under Sabah Parks
Human Environment		
Beach users	Within project site	Area along the project footprint
Waikiki Condominium	50 m	Private residential
Private residence	Within project site to 50 m	Private residential
Seri Mengasih Centre	Within project site	School
SK. Tg. Aru 1 & 2	Within project site	School
STAR	800 m	Shangri-La Tg. Aru Resort and Spa
Airport	< 100 m	Kota Kinabalu International Airport (KKIA) and Low Cost Carrier Terminal (LCCT)
Meteorological Department	< 10 m	Weather station operated by the Meteorological Department located alongside the airport runaway
KGC	150 m	Kinabalu Golf Club
Yacht Club	150 m	Kinabalu Yacht Club
Business and commercial interests	Within project site	Windbell Restaurant Anjung Perdana Tg. Aru
	< 1.5 km	Korean, Table No. 1 restaurant near Perdana Park, Beach bums, First Beach Café, etc.

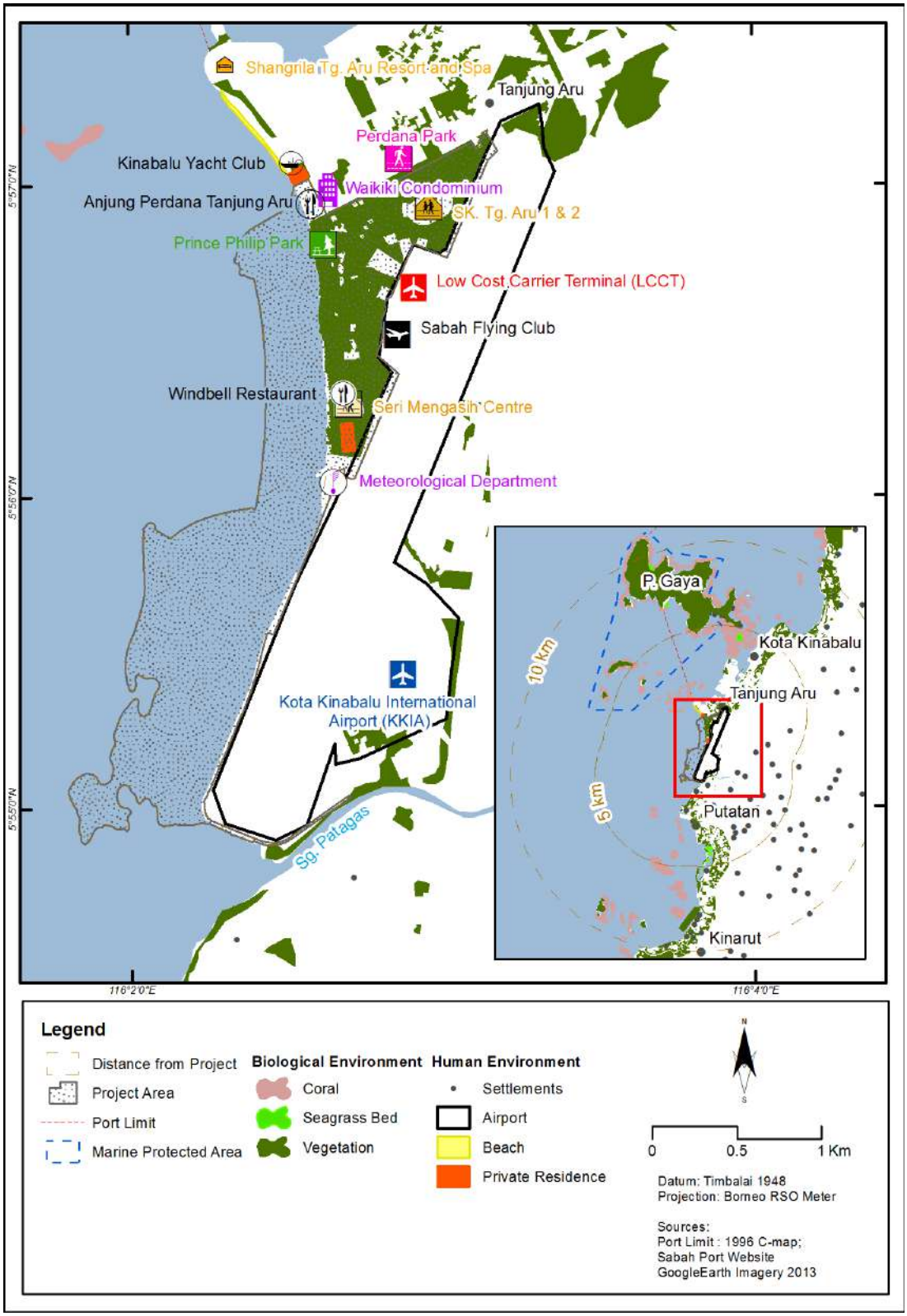

Figure 3.15 Summary of identified sensitive receptors.

4 Scoping of Environmental Issues

4.1 Long List of Environmental Issues

The scoping exercise has identified environmental issues as listed below based on the activities for each stage of the project development.

4.1.1 Pre-construction Stage

The study stage consists of hydrographic and geotechnical surveys of the site and is considered to have minimal impacts to the surrounding environment when compared to the piling and construction works. Field surveys for the present SEIA study are generally non-invasive and hence will not cause any impacts

4.1.2 Construction Stage

The potential negative environmental impacts arising from the proposed project during the construction phase are detailed in the following subsections. It is noted that permanent impacts arising from the footprint of the proposed development are discussed under the post-construction or operational stage, although these may be incurred during the construction stage.

4.1.2.1 Physical-chemical issues

- Suspended sediment plume impacts from reclamation, dredging and earthworks.
- Possible flooding due to blockage of storm drains, sedimentation during rain events
- Oil and grease spillage from machinery
- Water pollution due to dredged release
- Noise pollution
- Air pollution (dust, particulate matter)
- Waste generation and disposal
- Geotechnical/geohydrology impacts from dredging and earthworks.

4.1.2.2 Biological issues

- Sediment plume impacts on marine organisms
- Direct smothering/removal of benthic habitat
- Sedimentation impacts on benthos and other sessile marine organisms due to settling of suspended sediments
- Clearance of coastal vegetation, including old growth figs and *Casuarina*
- Impacts to birds and other wildlife
- Impacts of lighting and noise during construction stage to marine megafauna
- Impacts of barges transporting sand from marine sand sources on marine megafauna such as sea turtles in the area.

4.1.2.3 Socio-economic components

- Navigation safety for small boats travelling along the coastline
- Economic impacts arising from sediment plume effects on fish stocks in the localized fishing grounds
- Aesthetic impacts due to construction activity

- Loss of beach and park area during construction works
- Impacts to tourism and recreation (STAR, Yacht club, etc) from construction
- Socioeconomic impacts due to construction workforce and workers' quarters
- Traffic congestion
- Impacts to health from dust, noise
- Air navigation safety due to airborne dust and lighting from construction activities

4.1.3 Operation Stage

The impacts associated with the operational stage include those impacts arising from the daily activities within the site that may be considered permanent in nature, for example, impacts due to the project footprint, as well as the activities associated with the resorts and private housing, marina and recreational activities.

4.1.3.1 Physical-chemical issues

- Water quality impacts due to spills/ releases of untreated wastewater/sewage
- Water quality impacts due to marina operations (oil and grease, biofouling treatments, paint, etc.)
- Water quality impacts due to golf course maintenance (fertilisers & pesticides)
- Impacts on local wave and current climate
- Impacts on sediment transport and shoreline morphology
- Impact of reclamation on discharges of Sg. Patagas (hydrology)

4.1.3.2 Biological issues

- Potential impacts on marine communities due to water pollution from runoff, domestic or commercial wastes discharges, oil and grease
- Loss of coastal vegetation, old growth trees
- Loss of nesting and feeding habitat for birds
- Loss of benthic community
- Impact of boat movement on marine mammals

4.1.3.3 Socio-economic components

- Land traffic
- Marine traffic
- Air navigation safety due to operation of golf course.
- Restrictions on alongshore travel by local fishing boats and other vessels
- Aesthetic impacts and change in character of the area
- Social impacts due to change in cultural nature of the area
- Social impacts – increased cost of living, land prices, increased visitor prices (e.g. parking, availability of cheap stalls, etc.
- Provision of recreational amenity to public (positive)
- Economic benefits due to increase in tourism

4.1.4 Abandonment Stage

Impacts arising from project abandonment are expected to be limited primarily to the socioeconomic, including navigation such as limited access to areas around the Tg. Aru area. In addition, there are also potential safety issues due to the use of the area by for illegal activities such as fires or fishing, which is reported to be a problem in the area.

4.2 Long List Scoping Matrix

The scoping matrix is based on EPD's recommended SEIA matrix. The assessment criteria are described below.

Magnitude	1: change/effect only within the project site 2: change/effect to local conditions and/or to areas immediately outside 3: regional/national/international change/effect
Permanence	1: no change/not applicable 2: temporary 3: permanent
Reversibility	1: no change/not applicable 2: reversible 3: irreversible
Cumulative	1: no change/not applicable 2: non-cumulative/single 3: cumulative
Overall Rating	1: Minor impact 2: Moderate impact 3: Major impact

The matrix is given separately for the pre-construction and construction phases (Section 4.2.1), the operational phase, which includes all permanent impacts due to the project footprint (Section 4.2.2) and the abandonment phase (Section 4.1.4). The matrices provide a preliminary assessment of the importance of each of the environmental issues identified above in order to prioritise specific areas of works for investigation during the SEIA study.

4.2.1 Construction Stage

Environmental Issues	Magnitude	Permanence	Reversibility	Cumulative	Overall Rating
Physical/chemical components					
Increased suspended sediments due to dredging, reclamation and earthworks	2	2	2	3	2
Possible flooding due to blockage of storm drains, sedimentation during rain events	1	2	2	2	1
Decreased water quality due to oil and grease pollution	1	2	2	2	1
Water pollution due to release of contaminants from dredged material	2	2	2	3	2
Emissions from construction vehicles/machineries	1	2	2	3	1
Impact of airborne dust to nearby airports due to reclamation	1	2	2	3	1
Geohydrology impact to the groundwater table due to dredging and earthworks	1	2	2	2	1
Increased noise	1	2	2	2	1
Sedimentation	2	2	3	3	2
Biological/ecological components					
Impacts on fish fauna due to increased suspended sediments	2	2	2	3	2
Impacts to benthic community due to direct removal from dredging	2	2	2	3	2
Loss to benthic community due to sedimentation	2	2	2	2	2
Algae bloom due to increase of nutrients (from sewage)	2	2	2	2	2
Impacts on coral due to suspended sediment plumes	2	2	2	3	2
Impacts on corals due to sedimentation	2	3	3	3	3
Impact on marine megafauna due to disturbance from construction activities such as dredging, reclamation and earthworks, including vessel movement/barge transport of fill material	3	2	2	2	3
Impacts on marine fauna from water pollution	2	2	2	3	2
Effect of piling works (underwater noise and disturbance) on marine fauna	2	2	2	2	2
Impacts to birds and other wildlife during construction	3	3	3	2	3
Impacts of lighting from construction stage to marine megafauna	1	2	2	2	1
Socio-economic components					
Noise nuisance to nearby human population	1	2	2	2	1
Nuisance to nearby human population with possible health problems due to dust	2	2	2	2	2

Environmental Issues	Magnitude	Permanence	Reversibility	Cumulative	Overall Rating
Increased social problems if foreign labour is used	2	2	2	2	2
Decreased aesthetic value along beach and shoreline	2	2	2	2	2
Decreased aesthetic value due to presence of suspended sediments within water column	3	2	2	3	3
Disturbance to nearby fishing activities	1	2	2	2	1
Navigation risk to small boats travelling along the coastline with the increase in marine traffic & construction vessels	1	2	2	2	1
Limits on water access to areas around Tg. Aru for travel along the coast during construction	1	2	2	2	1
Limits on public access to beach areas around Tg. Aru during construction	2	2	2	2	2
Decreased tourism value due to the construction activities, including barge traffic nearby the TARP	2	2	2	2	3
Decreased tourism value due to aesthetic impacts from suspended sediment plume	3	2	2	3	3
Decreased income due to declined fish stocks in the localized fishing ground due to increased suspended sediment	2	2	2	2	2
Social impacts due to construction workforce and workers' quarters	1	2	2	2	1
Effect of construction traffic on road congestion and road quality	2	2	2	2	2
Dust nuisance and lighting during construction may affect air traffic safety at KKIA	1	2	2	2	1

4.2.2 Operational Stage

Environmental Issues	Magnitude	Permanence	Reversibility	Cumulative	Overall Rating
Physical/chemical components					
Effect of reclamation and breakwater structures on wave climate	2	3	3	2	2
Effect of reclamation and breakwater structures on currents	2	3	3	2	2
Effect of reclamation and breakwater structures on sediment transport and coastal morphology	2	3	3	3	3
Nearshore water quality	1	3	2	2	1
Effect of project on hydrology of Sg. Patagas	2	3	3	2	2
Impacts on water quality due to sewage and waste water spills at the development	2	3	2	2	2
Impacts on water quality (petrol and grease spill/leakage) due to marina operations	1	3	2	2	1
Impacts on water quality due to runoff from golf course	2	3	2	2	2
Biological/ecological components					
Impact on marine fauna (marine mammals, whalesharks and turtles) due to increase in marine traffic and associated noise and disturbance	1	3	2	2	1
Impact on marine megafauna due to habitat exclusion due to project footprint	1	3	3	2	1
Algal blooms / red tides due to run off from the proposed golf course	2	3	2	2	2
Loss of vegetation in project footprint	3	3	3	2	3
Risk of invasive species brought on the hulls of yachts	2	3	2	3	3
Loss of roosting, feeding sites for birds in project footprint.	3	3	2	3	3
Effect of bilge or vessel waste water discharge on aquatic communities	1	3	2	3	2
Effect of oil and grease spill/leakage on aquatic communities	2	3	2	3	2
Loss of benthic community due to reclamation footprint	1	3	3	2	1
Socio-economic components					
Effect of sedimentation or erosion on nearby land uses	1	3	3	3	1
Effect on navigation	2	3	2	2	2
Nuisance to nearby human population due to noise emissions from daily activities	1	3	2	2	1
Restrictions on alongshore travel by local fishing boats and other vessels	1	3	3	2	1

Environmental Issues	Magnitude	Permanence	Reversibility	Cumulative	Overall Rating
Road safety risk due to increased land traffic	1	3	2	2	1
Air traffic safety risk due to lighting from golf course	1	3	2	2	1
Change in character of beach (from primarily natural to built up).	2	3	3	2	3
Change in cultural nature of the area due to large tourist and residential population	1	3	3	2	2
Creation of improved public beach and provision of recreational and public amenity	1	3	3	2	Positive
Impact on local and regional tourism	3	3	2	3	Positive
Increased employment opportunity	2	3	2	2	Positive
Changes in cost of living for locals	2	3	2	2	2
Increased local business opportunities especially in regards to the need for services	3	3	2	3	Positive

4.2.3 Abandonment Stage

Environmental Issues	Magnitude	Permanence	Reversibility	Cumulative	Overall Rating
Physical/chemical components					
Effect of development on wave climate	2	3	3	2	2
Effect of development on currents	2	3	3	2	2
Effect of development on sediment transport and shoreline morphology	2	3	3	3	3
Biological/ecological components					
Ecological impacts to marine fauna due to partially built structures in the sea	2	3	2	2	2
Socio-economic components					
Effect on shoreline access and navigation for small vessels in the vicinity	2	3	2	2	2
Limits on access to areas around Tg.Aru for fishing	2	3	2	2	2
Use of area for illegal activities	1	2	2	2	1
Visual impacts from partially built structures in the sea	1	2	2	1	1
Health and safety impacts to the public from partially built structures in the sea	1	3	2	1	2

4.3 Environmental Issues Categorisation

Based on the long list environmental issues and scoping matrices provided at Section 4.1 and Section 4.2, the potential environmental issues have been categorised into three (3) categories:

- **Focus Issues**: These are negative issues of greatest concern that require the most attention during the SEIA study that entails detailed analysis. This is represented by impacts considered to be 'High'.
- **Issues of Note**: These issues do not have the same priority as the Focus Issus, but require serious consideration and a substantive analysis. These are represented by impacts considered to be 'Medium'.
- **Remaining Issues**: These issues are not considered to require in-depth analysis beyond showing that significant impacts can be prevented with standard mitigation or regulatory conditions. These are represented by impacts considered to be 'Minor'.

4.3.1 Focus Issues

4.3.1.1 Natural Habitat Impacts

Permanent impacts will include the controlled clearing of vegetation at Tg. Aru area, including clearance of sparse woodland areas along the shoreline. The clearance and habitat conversion may affect the birds in the area that depend on the flora for food and habitat. A number of these birds are found only at Tg. Aru.

The development takes place close to corals which are productive and diverse ecosystems. The potential sediment plume impacts described above will affect the marine environment albeit temporarily during the construction phase. Both construction and operational marine traffic may also have impacts on marine megafauna.

4.3.1.2 Change in Beach and Landscape Character

Although the Project will address existing erosion problems and improve the beach quality, the development will inevitably change the nature of the environment from primarily natural and vegetated beach and immediate hinterland areas to a more built up landscape including resorts. This affects the cultural and aesthetic character of the area. Given the increasingly urbanised nature of Kota Kinabalu City, natural areas are increasingly limited and are in general highly valued by the residents of KK. The visual impacts and balance of hard and soft landscapes within the Masterplan is therefore a key issue that will be considered in the SEIA.

4.3.1.3 Morphological Impacts

The long term impacts on coastal morphology arising from the breakwaters, reclamation and the new flushing channel needs to be investigated. The introduction of the breakwaters in particular will result in changes to existing hydrodynamic conditions and sediment transport along the remaining stretch of beach from the Kinabalu Golf Club to Tg. Aru (the headland itself). This will therefore need to be assessed through predictive numerical modelling as part of the SEIA study.

4.3.1.4 Sediment Plume Impacts

During reclamation of coastal line, dredging and earthworks, disturbance to the seabed will lead to release of fine sediments into the water column. Sediment plume impacts will affect

the pelagic environment for fish and other marine organisms. In particular, the coral reefs off Tg. Aru and in the TARP could be adversely impacted.

4.3.1.5 Loss of Beach Front during Construction

Depending on the detailed construction methodology and phasing, the beach areas and Prince Philip Park will be closed to the public for some period of time. The overall ground works period is estimated to be 18 months, with the beach being off limits to the public for this entire period in the worst case scenario.

It is noted that the beach area from the Kinabalu Golf Club up to the STAR will not be closed; however, some water quality and general aesthetic impacts may be incurred in these areas.

4.3.2 Issues of Note

4.3.2.1 Water Pollution

The piling works, oil spills, sedimentation, etc. from the construction activities of the proposed project can have some impacts on the water quality which in turn will affect the sensitive marine habitat in the area. Sources of water borne pollutants such as soil erosion, sewage treatment, waste handling facilities, chemical storage, etc. will be identify and these sources will then be reviewed for precautions taken to prevent loss of pollutants to the environment. The magnitude of the risk of water quality contamination will be investigated in the SEIA study.

During the Project operations there will be some risk of leakages or oil spills from vessels and marina operations that can have some negative impacts on the water quality of the area and potentially beyond towards the TARP. Nutrient loads from wastewater releases, runoff from built-up areas and the golf course also could contribute to eutrophication and impacts to marine benthic communities as well as algal blooms. Best operational practices will need to be identified to address these potential issues.

4.3.2.2 Socioeconomic impacts

Socioeconomic impacts which require attention include disturbance to fishing activity and navigation in the area, both during construction and operational stages. These are not highlighted as priority impacts due to the absence of any major fishing grounds in the vicinity of the project site; however, this will be verified during the SEIA study.

Aside from that, other socioeconomic impacts include socio-cultural issues due to the influx of construction workers in the area to the public, and overall tourism value, including tourism at the TARP, which may be affected by marine transportation of construction material and sand fill. These will also be verified during the SEIA study.

4.3.2.3 Noise

Noise is expected to increase during the construction and operation of the TAED. Standard mitigation measures are expected to be implemented during the construction phase to reduce the noise impact to the sensitive receptors which will be identified during the SEIA study.

4.3.3 Remaining Issues

4.3.3.1 Navigation

Navigation obstacles and traffic will increase during construction and operation of the TAED, particularly with the relatively close proximity of the heavily frequented Tunku Abdul Rahman Marine Park.

During operations, standard and emergency operation plans are however expected to be in place, as identified through a Marine Traffic Risk Assessment study to be carried out prior to the start of operations.

4.3.3.2 Ambient Air Quality

Vehicular or machinery emissions during the construction period are expected to decrease the ambient air quality in the immediate area of the project site. Airborne dust due to reclamation activity of the golf course may also affect the airport in terms of aircraft visibility during landing.

Standard mitigation measures are expected to be implemented to mitigate the impact.

4.3.3.3 Land Traffic

The increase in the land traffic in the area during the construction and operation of the TAED will also result in the increase accident risks to road users. A Traffic Study is being conducted in parallel with the Masterplan and detailed design phases; this study will assess and mitigate operational traffic impacts arising from the increased traffic volume associated with the development, taking into account existing bottle necks and traffic issues found during peak traffic times at weekends and during school opening and closing times

4.3.3.4 Geo-hydrology

The location of the proposed dredged channel may affect the existing ground water level in the area and risk saline intrusion to the ground water table. The dredging may also affect the stability of adjacent properties such as the airport runaway. These possibilities will be further assessed during the SEIA study.

4.3.3.5 Lighting

The installation of additional lights during the construction stage will pose a threat to turtles and hatchlings at nesting beaches specifically. Tg. Aru Beach is not a turtle nesting beaches and no turtle nesting has been recorded in the past 20 years.

However, the impact of light and measures to minimise light impacts to marine fauna will be addressed during the SEIA study.

5 SEIA Scope of Work

5.1 General Approach

5.1.1 Approach

This SEIA will address the construction and operation stages of the project, including the reclamation and earthworks, dredging works, building construction and finally the resort and recreational, commercial, marina and residential activities during operations, based on the assumed project details given in Section 2.2. In addition, given the many public submissions requesting that options for Tg. Aru beach rehabilitation be addressed, project options will also be included in the SEIA.

This SEIA assesses only the Masterplan concept and design. Details of individual development components (commercial developments, resorts, condominiums and residential estates) are not available at this stage. The project concept or level of detail anticipated for the SEIA will cover the following components:

- Project layout/components, including internal channel, reclamation, breakwaters and beach layout (fixed).
- Land use development plan and lot plan (fixed)
- Road layouts and landscape concept (fixed)
- Development density, building heights, building edges and setbacks (guidelines)
- Estimated demand of electricity and water supply during operations
- Designs of public areas (hard and soft landscaping, new public spaces, street furniture) (guidelines).

The components above indicated as fixed are those that are or will be firm at the SEIA stage while the others will be subject to detailed design and implementation by the individual developers/ investors.

Sand sourcing is not addressed in this SEIA. A separate EIA will be conducted for the sand sourcing activity, however inshore transportation routes will be assessed.

5.1.2 Zone of Potential Impact

The zones of potential impact or sensitive receptors are described in Table 5.1 below. Based on these sensitive receptors, the SEIA spatial boundaries have been developed as shown in Figure 5.1. There are a number of different spatial levels of the study depending on the study component, as the zone of primary impact and potential interaction pathways differ according to these components (e.g. marine vs. terrestrial); these are further explained in Table 5.2. It must be highlighted that the spatial boundaries or study areas represent the area of focus for the baseline studies; however impacts beyond these boundaries will also be assessed should they be predicted to occur.

Table 5.1 Zones of potential impact.

Zone of Impact (ZOI)	Approx. Distance from Project Site	Potential Impact Associated with the Project
Marine		
Sg. Patagas river mouth	250 m	• Hydrological impacts due to project encroachment on river mouth area with potential upstream flooding impacts.
Corals	1 km	• Increased suspended sediment and sedimentation during construction
Seagrass off P. Gaya	6.4 km	• Increased suspended sediment and sedimentation during construction
Seagrass at Meruntum	5 km	• Increased suspended sediment and sedimentation during construction
Fishing Activities at P. Dinawan	8 km	• Increased suspended sediment during construction
Tunku Abdul Rahman Park (TARP)	3.1 km from TARP boundary	• Increased suspended sediment and sedimentation during construction
Terrestrial		
Catchment Area	-	• Hydrological impact to the existing drainage system around the project area due to project footprint
Scrub vegetation	Within project site	• Loss of scrub vegetation and habitat.
Birds	Within project site	• Air quality decrease during construction • Noise increase during construction • Loss of old growth trees for nesting and feeding during construction and operation. • Potential disturbance and hunting by workers.
Beach users (2nd and 3rd Beach)	Within project site	• Loss of recreational ground due to beach closure during construction. • Improved beach during operation with cleaner sand, increased beach width and provision of improved public amenities.
Beach (1st Beach)	0 m - 630 m	• Socio-cultural conflicts during construction due to influx of foreign workers • Air quality decrease during construction • Noise increase during construction • Water quality decrease during construction • Visual impacts during construction and operations • Increased land traffic during constructions • Shoreline impacts
Prince Philip Park	Within project site	• Loss of recreational ground due to park closure during construction.

Zone of Impact (ZOI)	Approx. Distance from Project Site	Potential Impact Associated with the Project
		• Larger and improved park increases the positive benefit to the users during operation. • Loss / destruction of historical features during channel construction and earthworks.
Waikiki Condominium	50 m	• Air quality decrease during construction. • Noise increase during construction. • Visual impact during construction and operation • Increased land traffic during construction and operations • Impact on property value
Private residences	0 m - 50 m	• Air quality decrease during construction • Noise increase during construction. • Increased land traffic during construction and operations • Security issues during construction and operations
SK. Tg. Aru 1 & 2	Within project site	• Air quality decrease during construction • Noise increase during construction • Increased land traffic during construction
Shangrila Tg. Aru Resort and Spa (STAR)	800 m	• Air quality decrease during construction. • Noise increase during construction. • Water quality impacts during construction (sediment plume) • Increase in land traffic during operation • Shoreline impacts (erosion or sedimentation) during operations
Airport	≤ 100 m	• Buffer zones and height limits to be addressed during operations • Lighting at the golf course at night during operations • Increased land traffic during construction and operations • Risk of flooding due to changes in hydrology and drainage • Risk of geotechnical impacts due to creation of channel resulting in instability of airport runway • Airborne dust nuisance during constructions

Zone of Impact (ZOI)	Approx. Distance from Project Site	Potential Impact Associated with the Project
Kinabalu Golf Club (KGC)	150 m	• Air quality decrease during construction. • Noise increase during construction. • Water quality impacts during construction (sediment plume). • Loss of patronage due to alternative golf course on TAED site during operations. • Increased land traffic during operation • Potential impacts to beach frontage due to morphological impacts post development
Yacht Club	150 m	• Air quality decrease during construction • Noise increase during construction. • Water quality impacts during construction (sediment plume) • Potential impacts to beach frontage due to morphological impacts post development • Positive impact to the business owners during operation with increased visitors in the area. • Increased land traffic during operation • Increased marine traffic during construction and operations • Increased risk of navigation accidents during construction and operations
Business and commercial interests	0 - 1.5 km	• Air quality decrease during construction. • Noise increase during construction. • Positive impact to the business owners in the area during operation with the increased visitors to the area. • Increased land traffic during construction and operations

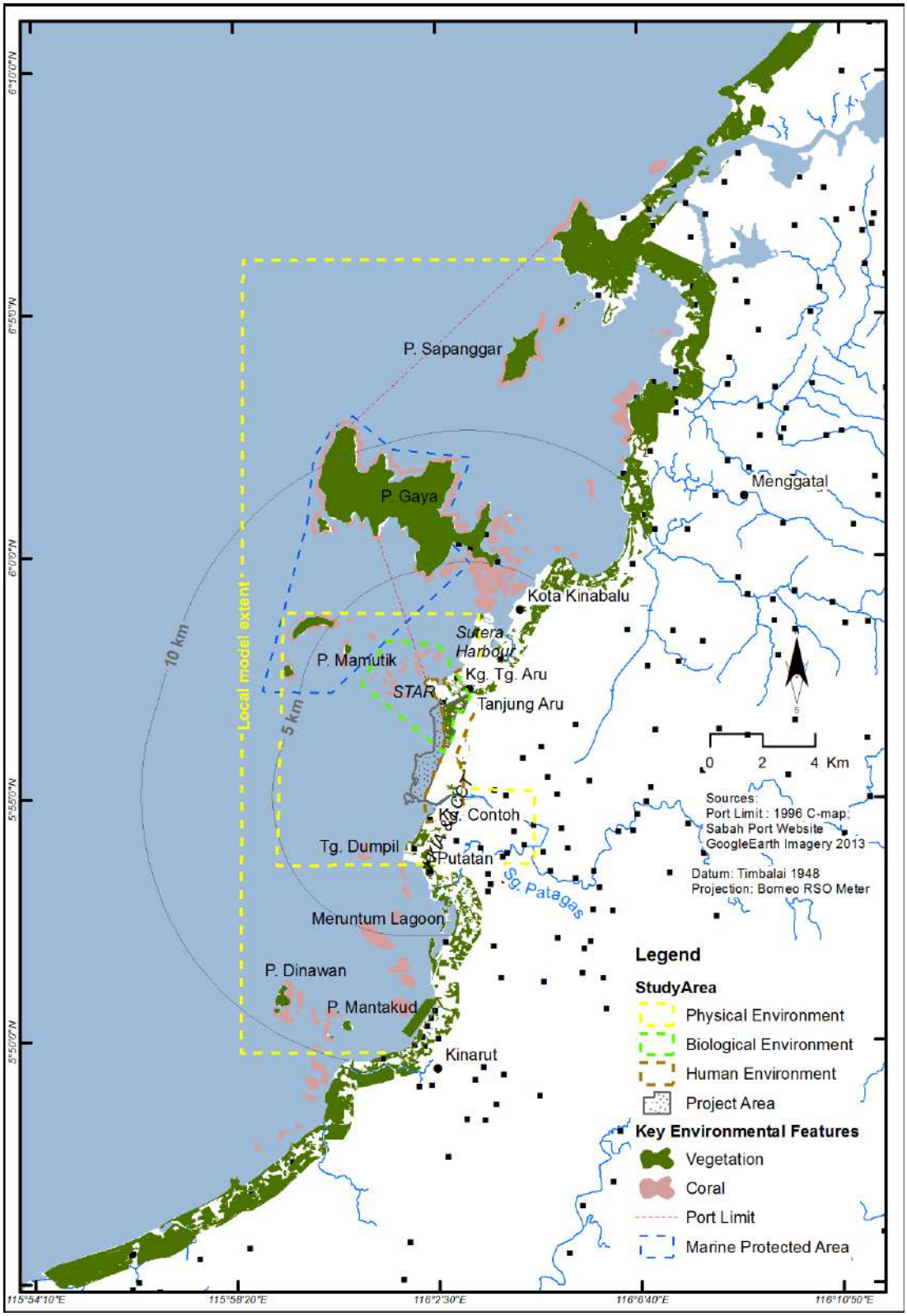

Figure 5.1 Geographic area of the SEIA study, overall and for individual components.

Table 5.2 Special Environmental Impact Assessment (SEIA) spatial boundaries.

Component	Study Coverage	Coverage Purpose
Physical	North of P. Sapangar to south of P. Mantakud in Kinarut and extending beyond the TARP.	Metocean and water quality conditions (local model boundary) and impact assessment.
	Area from north of Sutera Harbour to south of Tg. Dumpil, extending further off shore to the marine protected area of P. Manukan, P. Sulug and P. Mamutik.	Environmental baseline sampling focus area (on water quality, sediment analysis, noise and dust nuisance).
Biological	Land area covering vegetation on the northwest of KKIA & LCCT	Terrestrial flora and terrestrial fauna.
	Waters covering north of STAR to south of Sg. Patagas	Marine habitats focus area (coral reefs). It is noted that primary surveys of reefs and other habitats are not proposed in the TARP area. This is because the border of the TARP is considered the sensitive receptor, and any impacts to the waters of the TARP will be considered a significant impact that should be mitigated.
Human	Land area from coastline along proposed site inland to the KKIA airport runway boundary; and from Kg. Contoh in the south to Kg. Tg. Aru in the north.	Socio economic baseline study extent - the airport runway forms a boundary or buffer from the project site to other potential sensitive receptors. Impacts to residents in the hinterland areas are hence not anticipated.

5.1.3 Supporting Studies

On-going studies that will be referenced and incorporated in the SEIA include:

- Hydraulic study including masterplan layout development
- Traffic Impact Assessment
- Soil Investigation Report (Geotechnical and geohydrology)
- Marine Traffic Risk Assessment (MTRA)
- Landscape study
- Engineering and Environmental Validation study

5.1.4 Consultations

List of authorities to be consulted in the SEIA study may include:

- Land and Survey Department
- Department of Irrigation and Drainage (DID) Sabah
- Town and Regional Planning Department
- Dewan Bandaraya Kota Kinabalu
- Department of Fisheries (DOF), Sabah
- Sabah Parks
- Forestry Department, Sabah
- Ports and Harbour Department
- Malaysian Airports Berhad
- Civil Aviation Department
- Public Works Department

- Marine Department
- Sabah Electricity Sdn Bhd
- Water Department

Other stakeholders include NGOs such as SEPA and special interest groups (e.g. Sabah Surfing Association, Kinabalu Avian Club) will be consulted.

5.2 Baseline Data Collection

5.2.1 Bathymetric Survey, River Survey and Coastal Profiling

A total of forty seven (47) hydrographic profiles will be surveyed perpendicular to the general shoreline and nearshore bed contours including an offshore hydrographic survey of the shallow reef area between the Tg. Aru headland and Pulau Mamutik with a survey of the Sg Patagas river. The area of bathymetric survey to be executed as part of the SEIA is shown in Figure 5.2.

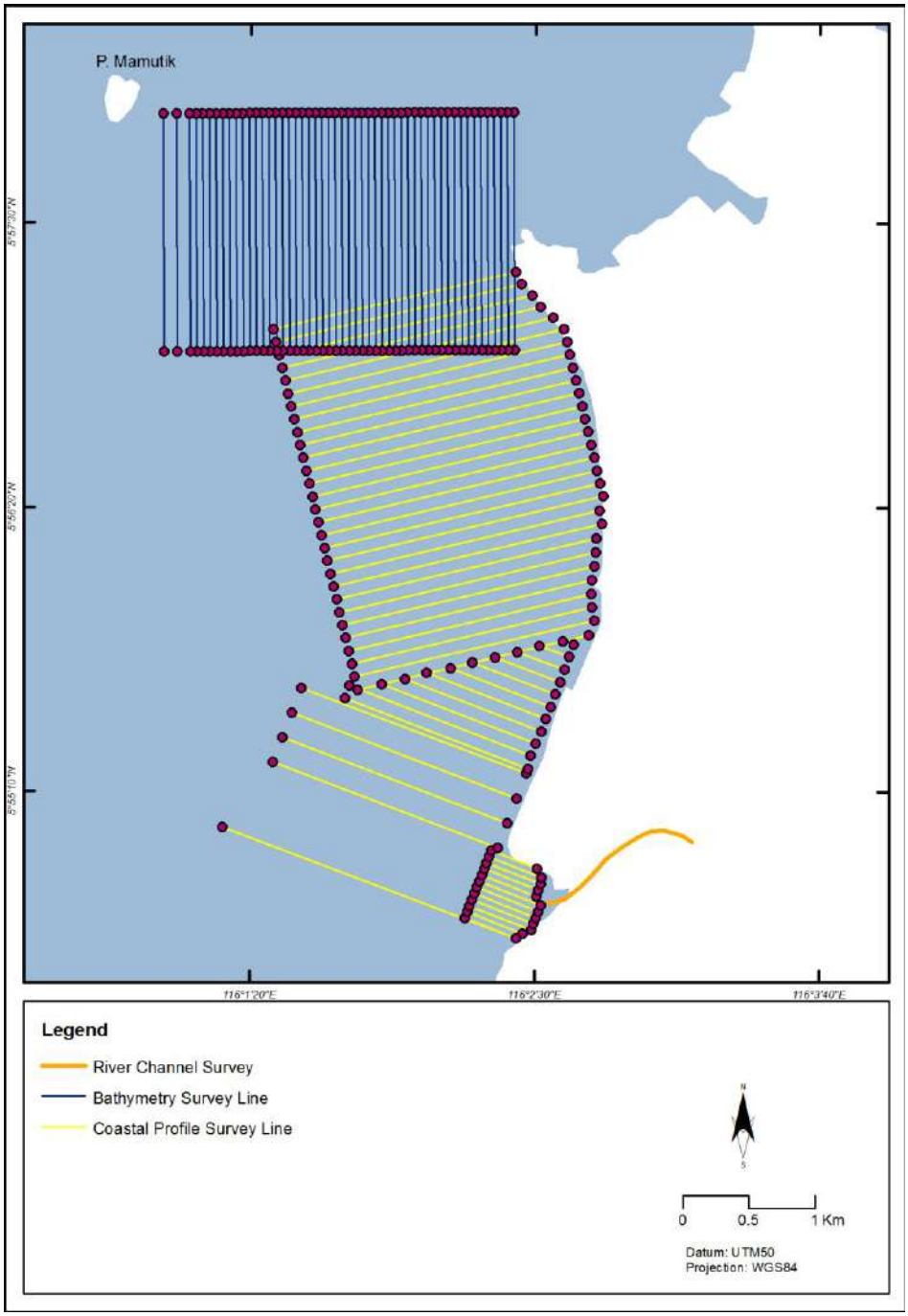

Figure 5.2 Approximate coverage of bathymetric survey

5.2.2 Current and Wave Measurement

Current and wave measurement of speed, height and direction will be measured at two (2) distinct locations of different depths, in the order of 17m and 9m as presented in Figure 5.3 and Table 5.3. The inshore ADCP may more accurately determine the currents near shore as the offshore islands and shallow coral reefs within the study area disturb the waves and currents.

The period of measurement will span over fourteen (14) days covering a spring and neap tidal cycle. Current measurements will be carried out using Acoustic Doppler Current Profiler (ADCP) units that measures the variation of current speed and direction over the water column. The number of bins (measurements through the vertical water column) will be

maximized and measured at a resolution of 0.35m to 1.0m spacing (depending on the ADCP specifications).

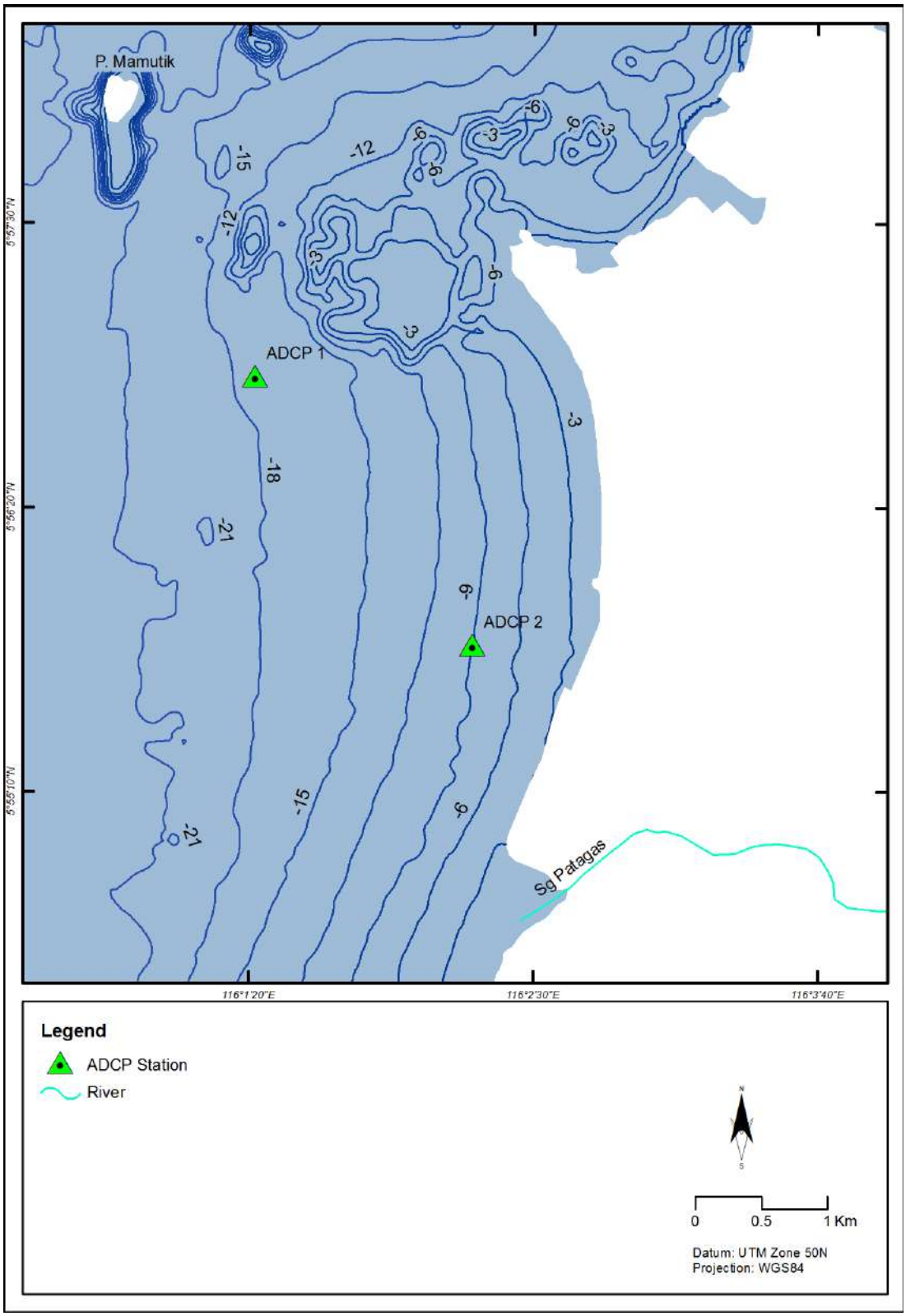

Figure 5.3 Locations of the proposed current and wave measurements, ADCP1 and ADCP2.

Table 5.3 Geographical coordinates for deployment of ADCP 1 and ADCP 2 (in UTM Zone 50N).

ADCP No.	UTM 50		Geographical WGS 84		Approximate Depth (mCD)
	Easting (m)	Northing (m)	Longitude	Latitude	
ADCP 1	391827.93	657530.32	116.0226°E	5.9479°N	17
ADCP 2	393472.19	655504.5	116.0376°E	5.9295°N	9

5.2.3 Hydrology / Drainage

Survey of the drainage network in the project area and surrounding areas will be carried out in order to assess potential impacts on existing streams and drainage outfalls. Topography including existing ground levels within the project site and surrounding areas as well as in relation to KKIA will be described and the surface hydrology such as natural streams and storm drains will be mapped.

Discussions will also be held with the Department of Irrigation and Drainage (DID) to obtain information on historical records of flood events for the project site, including height of flood and frequency upstream of Sg. Patagas.

5.2.4 Ambient Air Quality

A baseline ambient air quality survey will be conducted to establish the existing ambient air quality in the closest community area to the proposed site at four (4) locations (Figure 5.4).

Parameters for 24 hours air quality sampling are Total Suspended Particulates and PM_{10}.

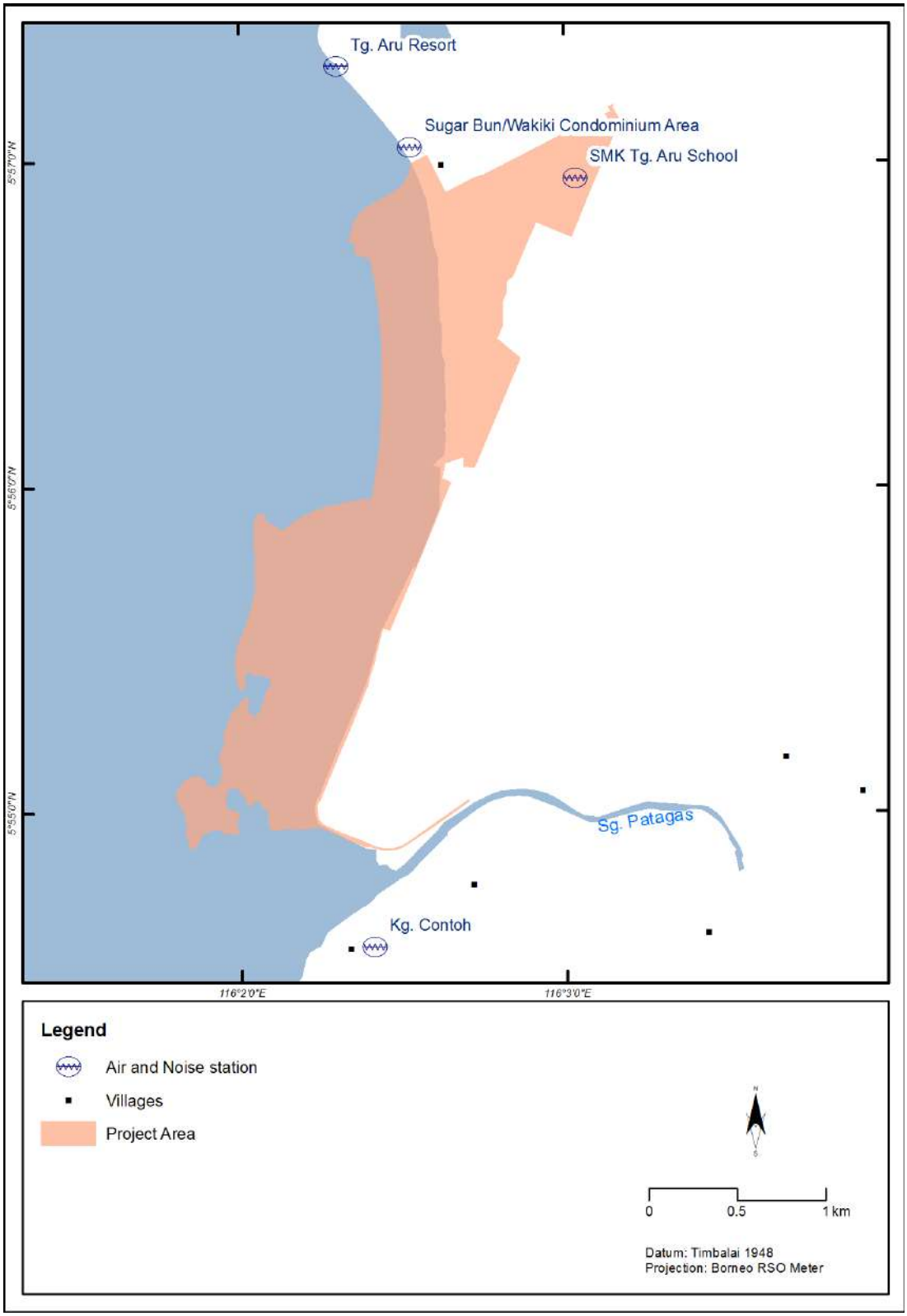

Figure 5.4 Location of air and noise sampling stations.

5.2.5 Ambient Noise Level

A baseline noise survey will be conducted to gauge the baseline ambient noise levels at the nearest sensitive receptors. Measurements will be carried out at four (4) locations (Figure 5.4). Measurements will be carried out continuously for 24 hours.

A weighted noise levels (LA) will be measured using a Precision Sound Level Meter; the following parameters would be measured:

- Equivalent Continuous Sound Level (LAeq);
- Statistical Indices (LA10, LA50 and LA90); and
- Maximum and minimum noise levels (LAmax and LAmin).

During the noise survey, the dominant noise sources affecting the measurements will be identified and recorded.

5.2.6 Water Quality

A specific water-sampling program within the project area is required to establish baseline conditions for suspended sediments and other pollution concentrations, such that the impact assessment regarding suspended sediment plumes and wastewater from the construction can be based upon relative changes rather than absolute values.

5.2.6.1 Marine and River Water Quality

Samples will be collected at sixteen (16) marine and two (2) river water sampling stations with consideration of the tidal period to cover the nearshore waters adjacent to the project site as well as at sensitive receptors further afield, e.g. STAR and offshore waters near TARP as shown in Figure 4.3.

Proposed water quality parameters to be analysed are:

- E-coli
- Enterococci
- DO
- BOD
- Ammonium
- Total Nitrogen
- Chlorophyll-a.
- Nitrate
- Total suspended solids
- pH
- Oil and grease
- Salinity
- Temperature

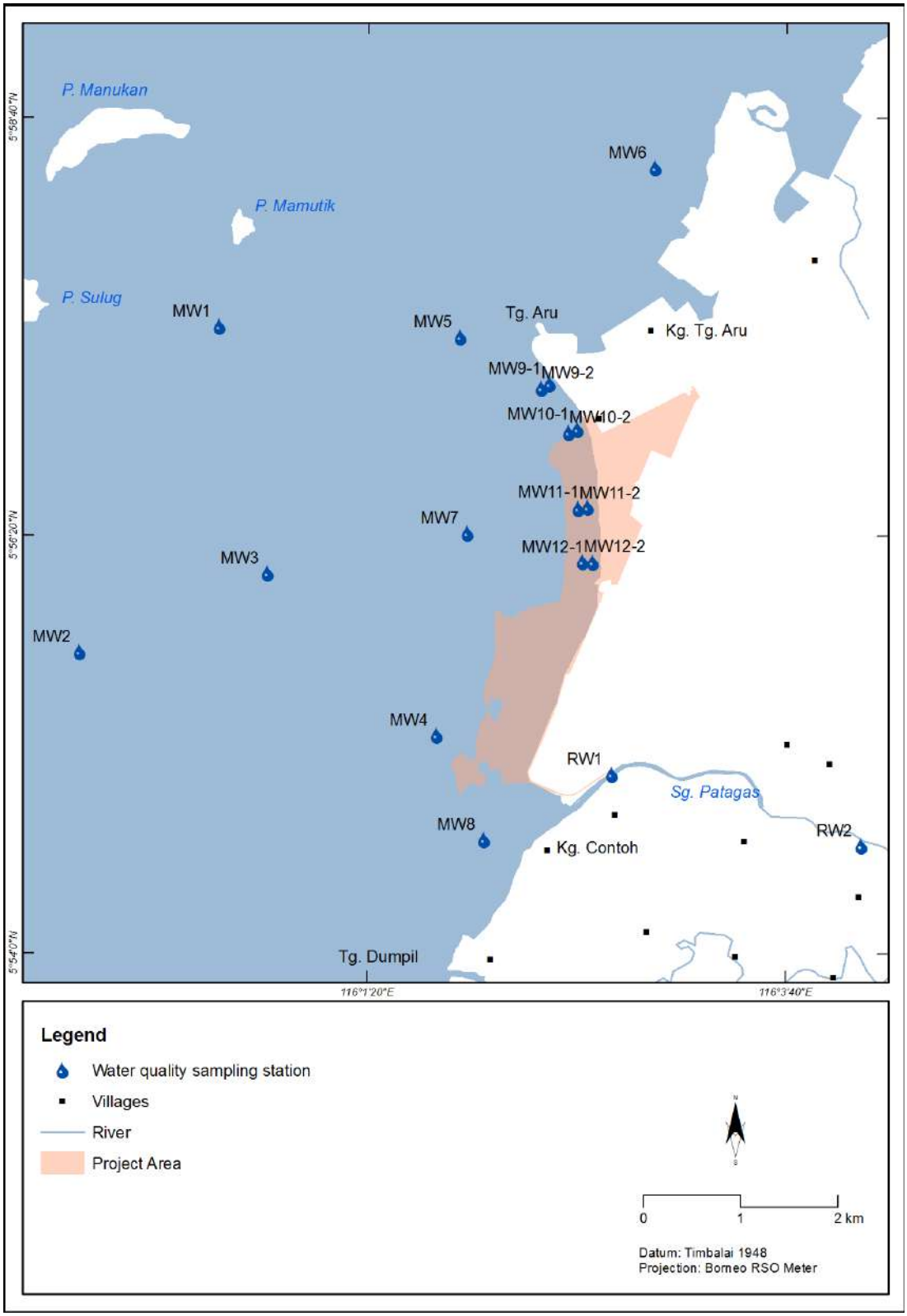

Figure 5.5 Locations of water quality sampling stations.

5.2.6.2 Drain Water Quality

There are eight (8) drains found in the project area (Figure 5.6). Water sampling will be carried out to assess the pollution loads from these drains.

Water quality samples to be collected at the drains along Tg. Aru beach on five occasions considering the tide and other factors affecting the load. Samples are to be analysed for the following parameters:

- E-coli
- DO
- BOD
- Ammonium
- Total Nitrogen
- Chlorophyll-a.
- Nitrate
- pH
- Oil and grease
- Salinity
- Temperature

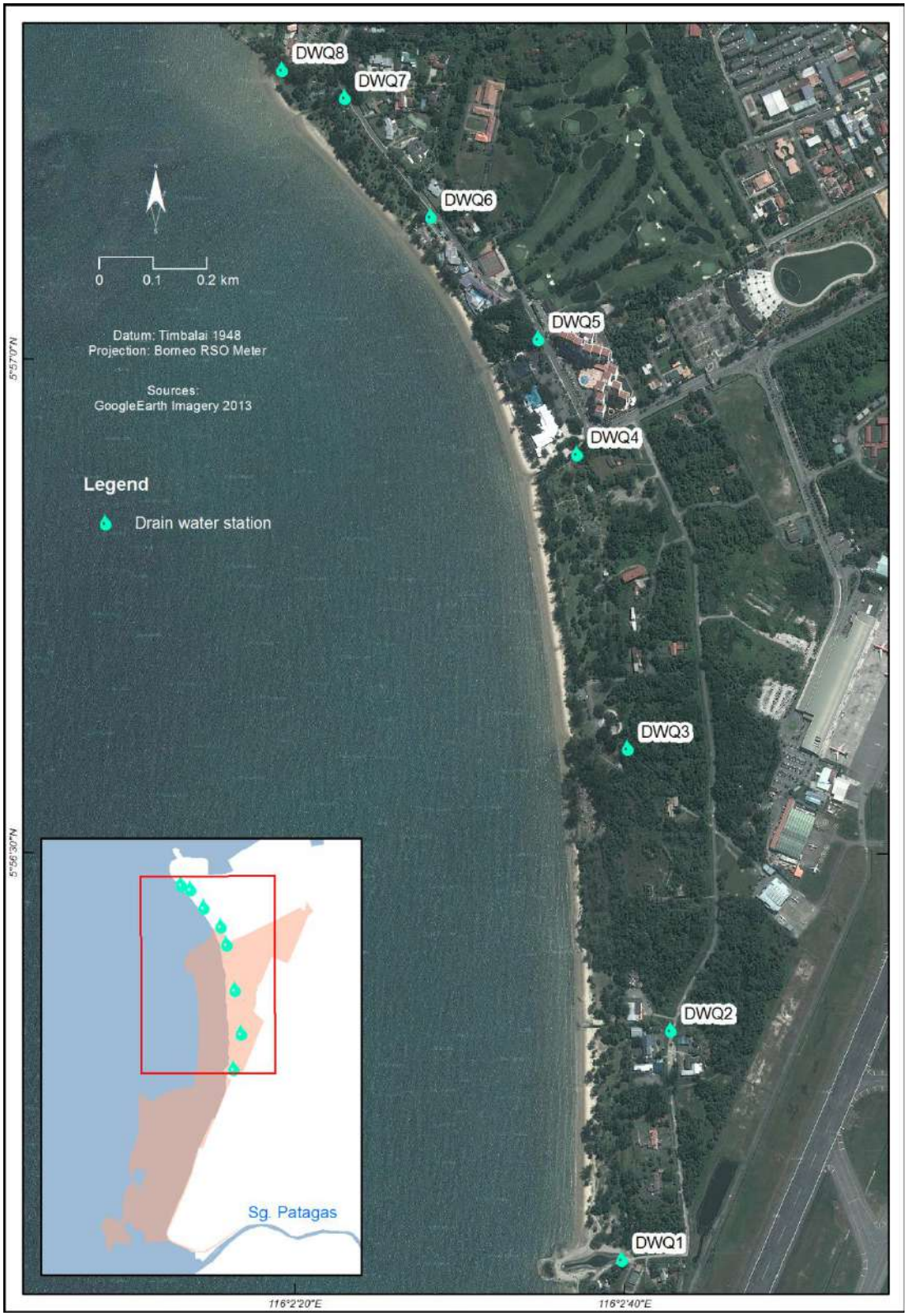

Figure 5.6 Location of water sampling stations at drains found along the project area.

5.2.7 Sediments

Approximately 30 samples of surface seabed sediments, taken across ten (10) coastal profiles, will be collected at the Project site. An additional 10 samples will be collected at the fully exposed mobile sand banks sitting off Tg. Aru. Samples will be assessed for sediment grain size.

Sediments within the areas to be excavated for the channels will be assessed for grain size, organic composition and potential contaminants. A total of five (5) locations with two samples per station will be collected for the following parameter analysis:

- Grain size
- Chemical analysis of: organic matter, oil and grease, nutrients and selected heavy metals.

5.2.8 Terrestrial Ecology

The vegetation in the area is primarily scrub or secondary vegetation. The vegetation units will be mapped and the community types will be described according to community structure (canopy height, closure), floristics (dominant species). In addition, mapping of old-growth and key-stone species supporting bird habitat will be carried out.

An assessment of the habitat value for terrestrial fauna will be carried out based on the findings of the terrestrial vegetation survey and habitat types identified, and comparisons with wildlife surveys or studies in similar habitats. This will be supplemented by observations of terrestrial fauna in particular birds.

5.2.9 Coral Reefs

The nearest reef areas to the project site are off Tg. Aru, around 1 km from the project site. There is limited information on the status of these reefs; these will be investigated to determine the presence and distribution of live coral cover.

Coral reefs within the TARP will not be surveyed; for the purposes of this impact assessment all reef areas will be considered sensitive receptors regardless of live coral cover.

Semi quantitative techniques using underwater video camera / snorkelling will be undertaken, with SCUBA dive surveys if any areas of high coral cover are determined.

Methods

(i) Reef Mapping and Reconnaissance

Mapping and verification of corals within and around project area will be carried out using an underwater towed video camera supplemented by spot dives where necessary. The tow camera will be used in a modified manta-tow method to obtain semi-quantitative estimates of live hard coral cover.

Live coral lifeforms will also be recorded; and the genus of coral species where possible. It is noted however, that species identification from video camera footage is relatively difficult; hence it will not be possible to produce a full species/ genera list from this survey. The key outcome of the survey will be to provide information on the percentage cover of the substrate by live hard and soft coral, predominant life forms (i.e. branching, tabulate, massive coral), and the presence of other key benthic organisms, such as giant clams, crown-of-thorns starfish, etc.

(ii) Quantitative survey

If significant live corals are found in the vicinity of the site, line intercept transects (LITs) will be used, where site conditions permit, to assess sessile benthic communities of coral reefs by characterising them into lifeform categories. Species composition of lifeforms encountered by the LIT will be recorded to at least the lowest taxonomic level possible in the field.

5.2.10 Land Use

Detailed land use map within project site; mapping of sensitive receptors within 5 km radius based on satellite imagery and ground truthing will be carried out. Following are method proposed for land use verification:

- Analysis of high resolution satellite image of the area
- Ground surveys
- Land use maps from Town Planning Department and other studies/ reports.

5.2.11 Socio Economy

5.2.11.1 Socioeconomic Surveys

A socio-economic survey will be carried out within a 5 km radius of the boundary of the proposed project site. Profiling of residents and business owners around the project area, as well as visitors /recreational users of the project site will be carried out.

The socio-economic survey will be carried out to gather the following information:

- For residents: socio-economic information such as educational achievement, employment, household income, quality of life, economic status, etc.
- Perception towards the proposed project whether they agree or disagree with the proposed development, perceived benefits and disbenefits from the project, and impacts to their environment and livelihood including heritage value. Respondents will be briefed on the project and potential impacts, including the access restrictions during construction, prior to obtaining their feedback.

The target group will include the following:

- Residents;
- Business operators
- School authority
- Visitors / recreational users

A questionnaire survey and consultation session will be conducted with target samples for each respondent profile as the following:

Table 5.4 Surveys and consultation activities for the SEIA.

Respondent profile	Target samples	Method
Residents	A sample size of 10% of the households focusing on the area northeast of the project site (Waikiki, residences along Jalan Aru, around Pekan Tg. Aru and Kg. Tanjung Aru) and south of the project site (Kg. Contoh).	Questionnaire
	Waikiki Residents.	Focus Group Discussion

Respondent profile	Target samples	Method
Business operators	Survey targeting hotels, restaurants and businesses in the Tg. Aru area.	Questionnaire
School authority / Government Centre	Survey targeting school management, parent and teachers in the Tg. Aru area as well as Seri Mengasih Centre	Consultation
Airport Authorities	Department of Civil Aviation (DCA), Malaysia Airport Berhad (MAB)	Consultation
Visitors / recreational users	Survey of beach and park users, covering 1st – 3rd beaches and up to STAR, as well as Prince Philip Park and Perdana Park; will be conducted for a period of two weeks (10 weekdays and 4 weekends)	Questionnaire

5.2.11.2 Public Meeting

One public meeting will be carried out to deliberate SEIA findings at the end of study - to provide information on the impacts, proposed mitigation and monitoring – and to obtain feedback on these findings.

5.2.11.3 Recreational Use

Visitor counts and record of activities will be conducted at three (3) locations along the beach and one location within the public park to record visitor densities and activities. Counts will be carried out over two one-hour periods (morning and evening) on two separate weekday and weekends taking into account the holiday season and long weekends.

5.3 Hydraulic Study

Numerical modelling of waves, currents and sediment transport on pre and post bathymetrical conditions at the site will be carried out to assess the impact of the development. Assessment of impacts will focus on the following:

- Hydraulic impact – i.e. changes to current, water levels and waves due to the project and potential impacts of this to e.g. marine traffic, flushing and navigation as discussed in Section 5.3.1
- Sediment plume impacts from dredging and reclamation works to assess sediment plume excursions, excess concentrations and siltation rates from the site and the potential impacts on the marine environment and other receptors (see Section 5.3.1 and Section 5.3.2).
- Morphological impacts – i.e. changes to the morphology in the area, inclusive of potential changes to coastline stability (see Section 5.3.4).
- Water quality impacts considering the changes in tidal flushing due to the project (see Section 5.3.3)

5.3.1 Hydraulic Modelling

Two-dimensional (2D) current fields will be used for the assessment of extreme water levels and currents, flushing capacity (water quality) and the potential impact on hydraulic regime and plume excursions from dredging/excavation works and plume excursions from Sg. Patagas. The modelling will certainly investigate the before project and post project scenarios.

The hydraulic model coverage and resolution varies as the studies become more detailed and consist of a:

- Regional Model
- Local Model
- Study Specific Models

5.3.1.1 Regional Model

The regional model covers a wide area and it is necessary in order to capture the complex current fields caused by the interaction of wind and tidal waves in the South China Sea. Figure 5.7 shows the extent of the model coverage and the boundaries at the sea interfaces. The regional model uses an unstructured flexible mesh with progressive increasing spatial resolution towards shorelines and over offshore shoals impeding the current patterns. The unstructured mesh is based on bathymetrical data extracted from sea charts and data from dedicated bathymetric survey (adjusted to mean sea level).

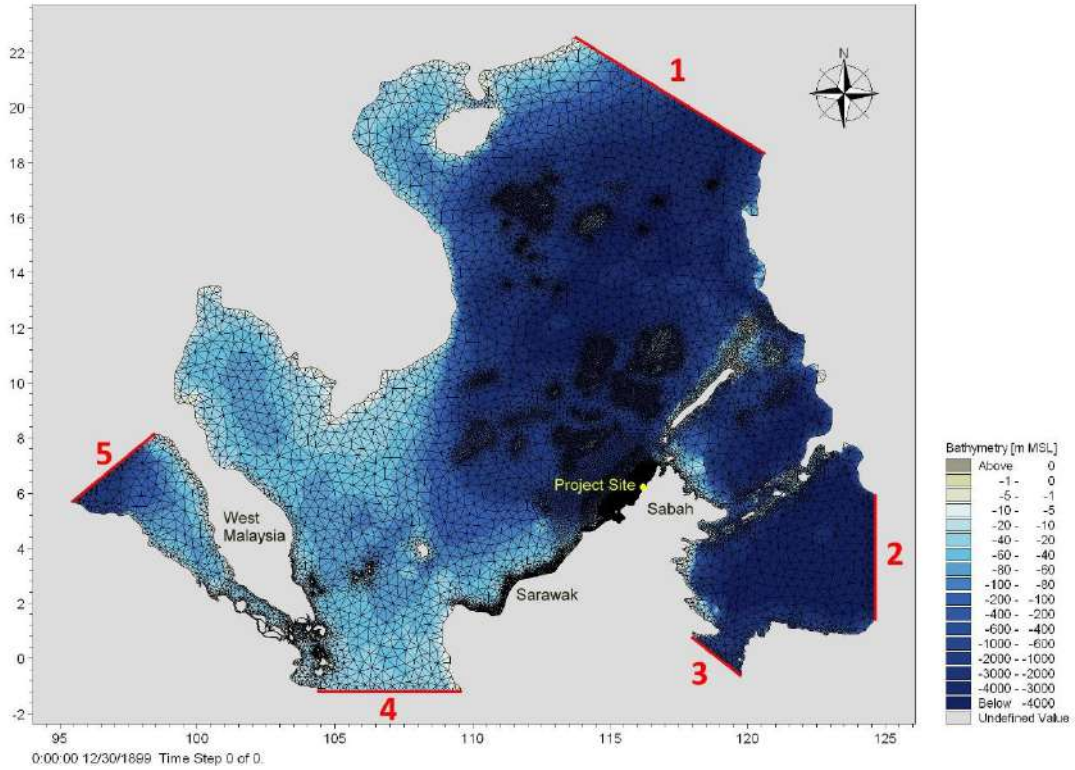

Figure 5.7 Coverage and open boundaries for the South China Sea hydrodynamic model.

Data input into this model includes the wind and pressure fields covering the entire South China Sea obtained from the Global Forecast System (GFS) and tidal data obtained from the KMS global tide model. A typical example during the north east monsoon is shown in Figure 5.8.

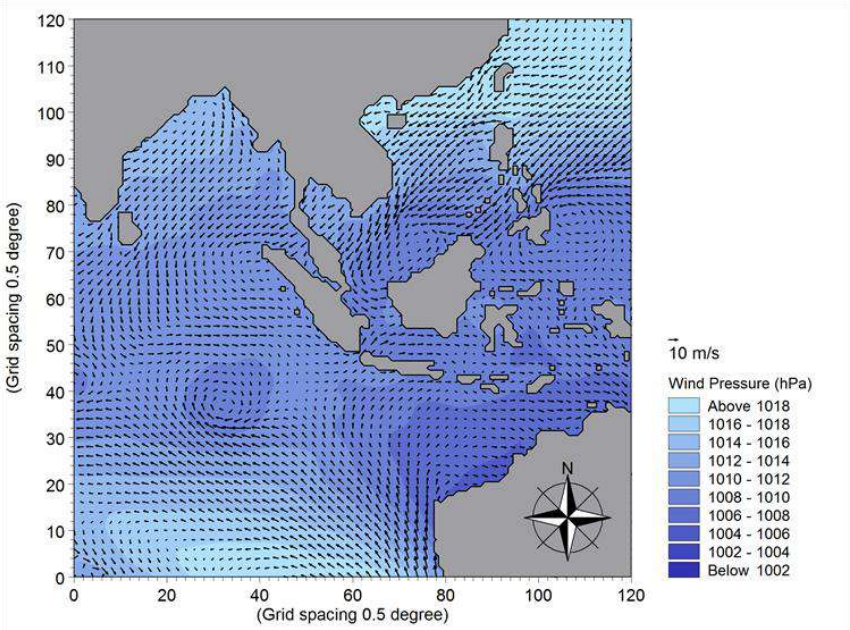

Figure 5.8 Overview of 2D wind and pressure fields from GFS showing the typical NE monsoon

5.3.1.2 Local Model

The local model focuses more on the project area but still takes account of a considerable distance offshore and both south and north of the project area. The model coverage and unstructured mesh are shown in Figure 5.9. It uses an unstructured flexible mesh with progressive increasing spatial resolution towards the shoreline with increased resolution around the islands, shoals, reefs and banks that retards the currents.

The local model for the present study has a very high spatial resolution from Tanjung Aru to Tanjung Dumpil to allow for the prediction of wave induced currents within the surf zone, being a requirement for the realistic sediment transport modelling.

The model is used to simulate the tides and tidal currents as well as seasonal effects (wind and pressure driven currents during the monsoon seasons and cyclonic events).

The local models are calibrated using field measurements of waves, currents, water levels, winds, salinity, temperature, turbidity and water quality undertaken as part of this project during an extensive survey campaign.

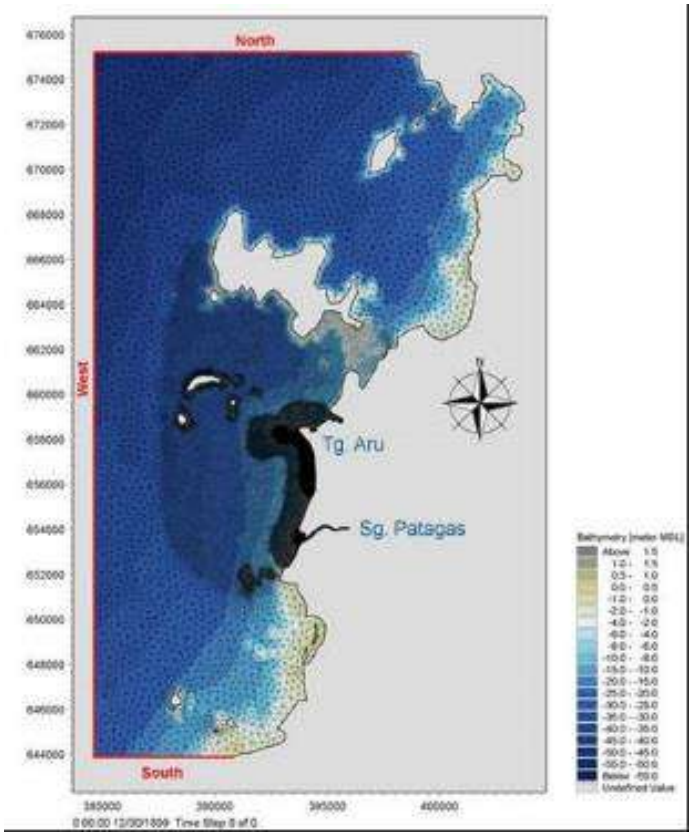

Figure 5.9 Local hydrodynamic model area.

5.3.1.3 Study Specific Models

For specific detailed studies at the project site such as for waves, currents, beach stability and sediment transport, river plume, water quality, sediment plume from the reclamation etc specific models extracted from the local model have been run where it is zoomed in on the areas of interest. For example the model area used for the detailed sediment modelling is shown in Figure 5.10.

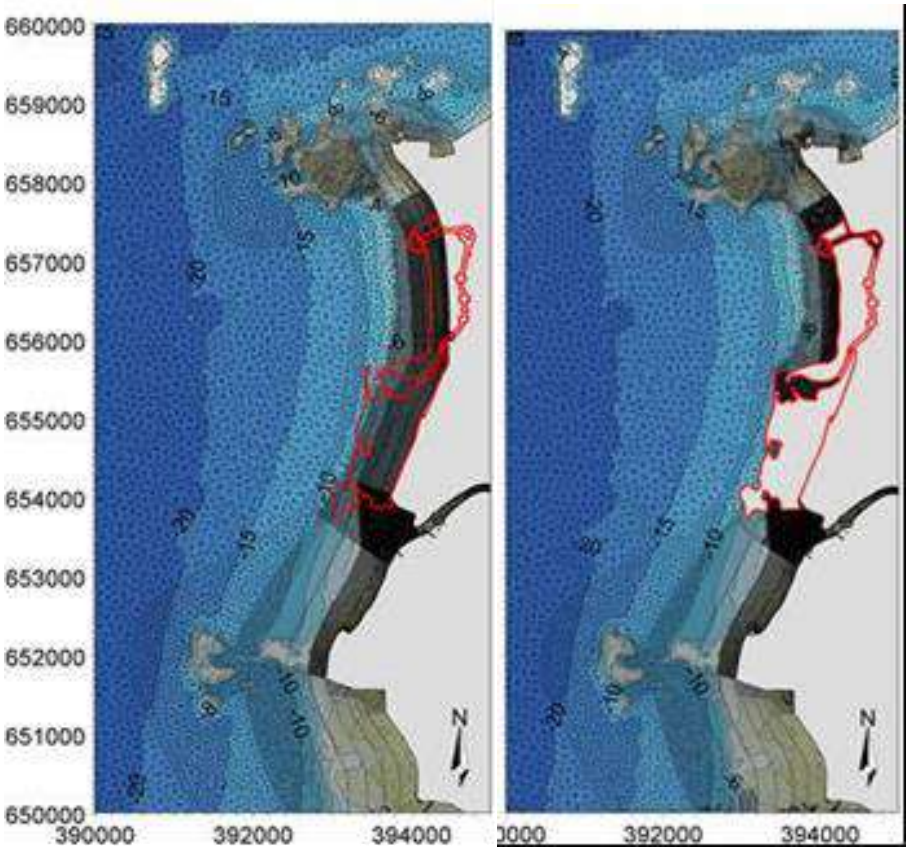

Figure 5.10 Model area for detailed sediment modelling; existing condition (left) and with Project (right). Unstructured mesh used for the Tg Aru fine local hydrodynamic model that extend past Lok Kawi

Other examples showing the extent of the model areas used for other studies such as the wave modelling and the current modelling at the project site are shown in Figure 5.11 and Figure 5.12. They also cover a wide area west, north and south of the project site.

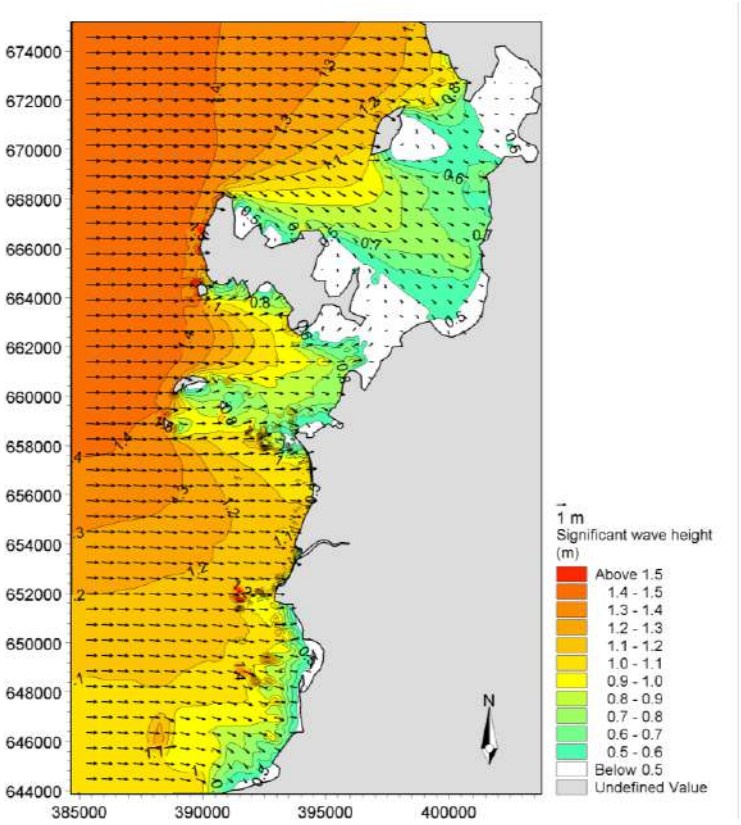

Figure 5.11 Typical example of the wave conditions during SW monsoon period

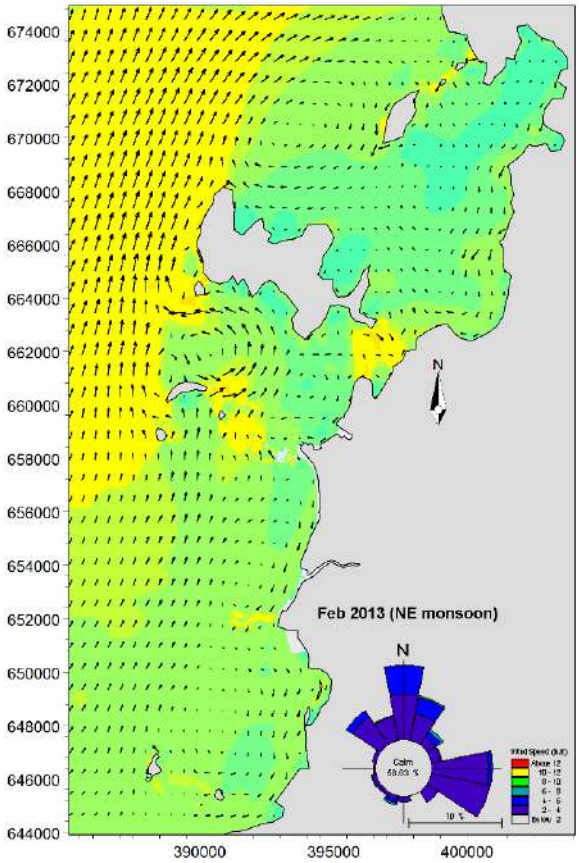

Figure 5.12 Typical example of the net current during the NE monsoon

For specific model results at certain areas these can be extracted and visualised for detailed assessment of the pre and post development changes. For example the pre and post development wave and current patterns are assessed along 1st Beach, the new beach and the beaches to the south of the project site in front of Kampung Contoh. This is used to assess whether the Project will result in changes of currents or waves that could result in erosion or accretion of sediments or the potential for trapping of debris and rubbish in these areas.

5.3.2 Sediment Plume Modelling

Reclamation and dredging/excavation works generally leads to generation of sediment plumes due to the spill of finer sediments and it is a general requirement by authorities that the possible excursion of sediment plumes is assessed.

The possible excursion of sediment plumes will be assessed by use of a calibrated and verified hydrodynamic model coupled with a sediment transport model. Based on expected construction methods and available characteristics of fill material, the likely excursion and suspended sediment concentrations will be modelled, allowing for an assessment of possible impacts to marine sensitive receptors in the vicinity of the site.

Different seasonal meteorological conditions will be considered for the assessment.

5.3.3 Water Quality Modelling

The study will focus on modelling the seasonal water quality in and around the development study site and the canal system with specific focus given to biological oxygen demand, dissolved oxygen, bacteria i.e. *E. coli*, intestinal enterococci and eutrophication/nutrients (ammonium and nitrate). Additional emphasis will be given to the seasonal influence of potential pollution sources such as Sg. Patagas and the impacts this river will have on water quality at the study site.

In addition, the results of the water quality modelling of nutrients will be assessed in relation to the subsequent impact on the frequency of algae bloom occurrences.

5.3.4 Beach Modelling

Given that the development scheme includes a stretch of beach in front of the development, the stability and mobility of the beach as well the long term quality of the beach will be assessed using DHIs LITPACK model which comprises sediment transport models for littoral zones in combination with sediment samples taken in and around the site.

The sediment samples will be used to derive sediment size (distribution curves) and will be extracted:

1 At the project site along existing beach as well as

2. On the fully exposed mobile sand banks sitting off Tg. Aru.

The established LITDRIFT model will be used as part of the SEIA as well to determine coastal impacts.

5.3.5 Coastal Impacts and Sedimentation

Marine structures, in particular reclamation, will generally have an impact on the adjacent coastline due to changes in current conditions and wave exposure. Based on numerical modelling of typical seasonal current and wave conditions, the impacts to the coastal

morphology will be qualitatively assessed with indication of areas that may be subject to erosion or accretion (sedimentation) due to the Project.

5.3.6 Ground water levels & saline intrusion

The project incorporates a canal usable for small vessels that extends between the Fisherman's Wharf and the Marina as shown in Figure 5.13. The approximate size of the canal is in the order of 42 m wide with the bed level at -3 m CD. During the maximum and minimum astronomical tides there will be a minimum water depth of 3 m (LAT) and a maximum water depth of 5.4 m (HAT). The average water depth at mean sea level (MSL) will be 4.23 m.

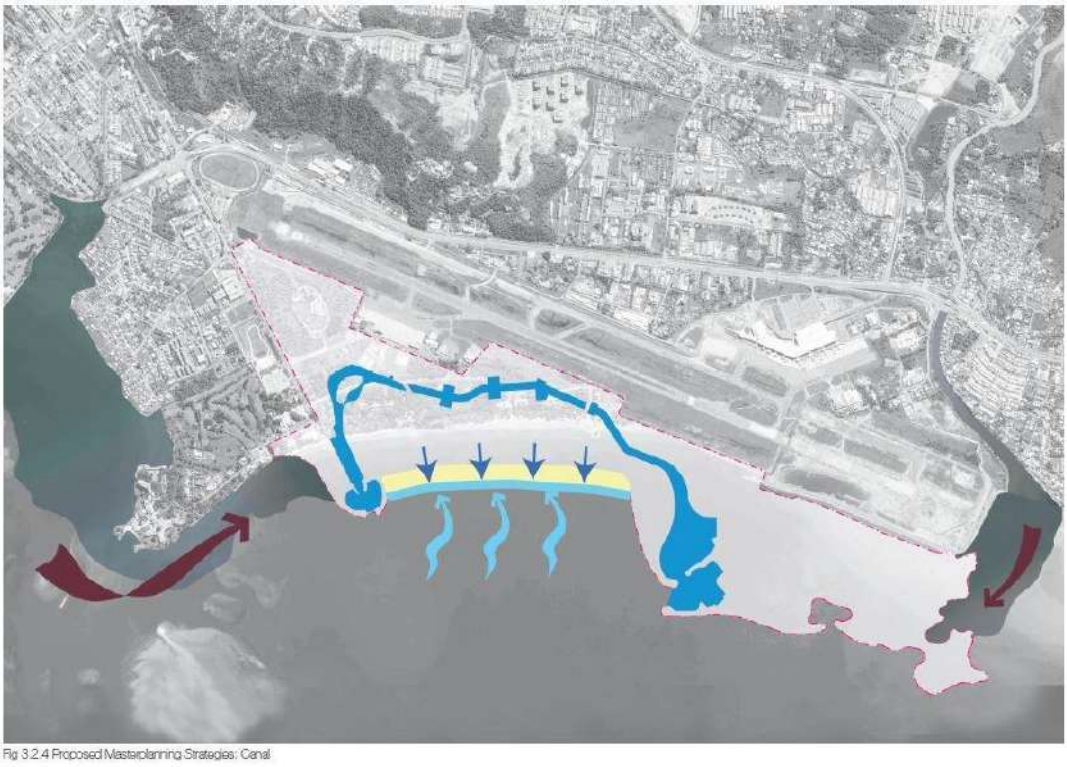

Figure 5.13 Masterplan showing the proposed canal with the existing frontage in the background

It can be seen from the figure that the canal extends inside the existing land area by about 350 m in the north and reduce to between 150 m and 200 m along most of the middle and south section. The canal and water way forming the Fisherman's Wharf, the Marina and including a long section of approach canal to the Marina is formed in the reclamation area that is already within the sea.

The initial assumption is that as the channel is not very far inland from the existing beach line, and it lies well within the area of the development it would not be expected to have significant impacts outside the project boundary. The area also experiences very high rainfall and it is not considered that there would be significant changes to groundwater levels and/or saline intrusion which would affect properties or other infrastructure outside the project boundary.

However, to ensure that the new canal system will not affect the existing water table or the salinity an outline study will be conducted to assess the potential affects. Further to this outline study, Piezometers or other ground water level measurement device are to be installed within some of the boreholes during the site investigation together with a measure of the rainfall over a period of time. This investigation will assist in obtaining more data should a more comprehensive modelling approach be required.

5.3.7 Hydrological assessment

The reclamation footprint may affect the existing hydrology and drainage system within the areas surrounding the Project site. To assess this, a hydrological study will be carried out which involves catchment delineation for the project and surrounding areas, calculation of catchment runoff for the affected drains and determining the required drainage specifications to cater for this runoff.

The project drainage will be designed in compliance with the Manual Saliran Mesra Alam (MSMA) urban storm water management manual for Malaysia and any discharges will comply with the relevant Malaysian water quality standards.

5.4 Impact Assessment

The impact assessments for the various sectors will be based on GIS mapping of the environmental sensitive receptors in the potential impact area, combined with an assessment of potential impacts from the project development, for example sediment plumes during construction, or morphological impacts post-construction. This will be compared to published data on tolerance limits and quality standards, including any standards or limits outlined in the Green Globe/LEED and Blue Flag Marina and Beaches standards that may be relevant.

The various sectors that will be included in the analysis include:

- Water quality
- Noise and dust
- Terrestrial flora and fauna
- Coral reefs and marine park
- Marine megafauna
- Impacts on fisheries and nearshore navigation
- Impacts of transportation of sand
- Impact to nearby airport
- Aesthetic and cultural impacts
- Impacts to human health and well being

For the TARP, water quality impacts will be evaluated against Class 1 Malaysia Marine Water Quality Criteria and Standards. For example, suspended sediment plume excursion will be evaluated against the Class 1 standard for *Preservation, Marine Protected Areas or Marine Parks* which is 25 mg/l or ≤ 10% increase in seasonal average, whichever is lower, at the border of the TARP. As long as this is met, no impacts to the coral reefs or other primary producer habitats within the TARP boundaries would be expected. A literature review will also be carried out to determine the threshold limits for corals, and this will be applied to the TARP **border**.

5.4.1 Impact Matrix

The Rapid Impact Assessment Matrix (RIAM) is proposed as a summary for the impact assessment, which is structured based on the importance, magnitude (severity), permanence, reversibility and cumulativity for each potential environmental impact. These five criteria are grouped into two categories as detailed below:

Group A Criteria
There are two criteria within Group A:

A1: **Importance** of the condition, which is assessed against the spatial boundaries, or human interests it will affect (Table 5.5); and

A2: **Magnitude**, which is defined as a measure of the scale or severity of benefits/dis-benefit of an impact (Table 5.6). This is generally predicted through modelling or expert judgement and also takes into account the sensitivity of the particular receptors of the impact.

Table 5.5 Importance of the condition – scoring, generic and project-specific definitions.

Score	Definition	Project-Specific Description
4	Important to State/ national/international interests	Sabah/ Malaysia/ cross border or international interests.
3	Important to district / regional interests	Tunku Abdul Rahman Park / Kota Kinabalu district / West coast region
2	Important to areas immediately outside the local condition	KK city, Kg. Tg. Aru to the north down to Tg. Dumpil in the south.
1	Important only to the local condition	Tg. Aru 2nd and 3rd Beaches down to Sg. Patagas river mouth and up to STAR
0	No importance	No importance/ not relevant

Table 5.6 Magnitude of the impact

Score	Definition
+3	Major positive benefit
+2	Significant improvement in status quo
+1	Improvement in status quo
0	No change/status quo
-1	Negative change to status quo
-2	Significant negative dis-benefit or change
-3	Major dis-benefit or change

Group B Criteria

Group B criteria are:

- **Permanence (B1)**

This defines whether a condition is temporary or permanent and should be seen only as a measure of the temporal status of the condition.

- **Reversibility (B2)**

This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence.

- **Cumulativity (B3)**

This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions.

The scale of each Group B criterion is shown in Table 5.7 below.

Table 5.7 Scale for Group B criteria.

Score	Permanence (B1)	Reversibility (B2)	Cumulativity (B3)
1	No change/Not applicable		
2	Temporary	Reversible	Non-cumulative/Single
3	Permanent	Irreversible	Cumulative/Synergistic

Score and Range System

For each potential impact/ issue, an environmental score (ES) is calculated based on the following formula:

ES = A1*A2 (B1+B2+B3)

The ES scores are then banded together into ranges as detailed in Table 5.8. The range values span from major positive impact +E to major negative impacts -E.

Table 5.8 Range bands used for RIAM

RIAM Environmental Score (ES)	Range Value (RV)	Description of RV
72 to 108	E	Major positive impact
36 to 71	D	Significant positive impact
19 to 35	C	Moderate positive impact
10 to 18	B	Minor positive impact
1 to 9	A	Slight positive impact
0	N	No change/Status quo/Not applicable
-1 to -9	-A	Slight negative impact
-10 to -18	-B	Minor negative impact
-19 to -35	-C	Moderate negative impact
-36 to -71	-D	Significant negative impact
-72 to -108	-E	Major negative impact

5.5 Identification and Assessment of Mitigation Measures

A detailed review and assessment of mitigation measures appropriate to the proposed project is required for each environmental issue identified. Mitigation measures to be considered will include those based on the Consultant's experience and those recommended in EPD publications.

Mitigation measures based on control (i.e. pollution control) will be identified based on industry best practice with respect to environmental impact and a review of relevant legislation, guidelines, assessment criteria and standards relating to environmental quality pollution issues.

Measures will be developed to ensure that the environmental commitments made during the SEIA stage, their implementation status and efficacy are made transparent to the public during project construction and operational stages.

5.6 Monitoring Programme

Environmental Management Plan (EMP) specifications will be developed as part of the SEIA study including:

1. Definition of the project's environmental quality objectives consisting of workable environmental guidelines/limits.
2. An environmental monitoring program to document compliance with the environmental guidelines/limits and to identify and resolve residual impacts should they occur.

The monitoring parameters, location and frequency will be formulated based upon the significance of the assessed impacts and the recommended mitigation measures as well as the Consultant’s experience with EMP formulation and implementation for other projects.

6 SEIA Study Team

The team members involved in the present SEIA study are listed in Table 6.1 (EPD registered) and Table 6.2 (non-registered specialists) below.

Table 6.1 SEIA study team members registered with EPD.

Name/Qualification	Area(s) of study in SEIA	EPD Registration No. / Date of Expiry	Signature
Tania Golingi BSc (Hons) Environmental Science	Ecology	S0027 30/09/2016	
Wong Lie Lie MA (Environmental and Business Management)	Mapping / GIS & Socio-economy	S0083 23/09/2015	
Dr. Claus Pedersen Hydrodynamics and Coastal Engineering (Phd)	Hydraulic Study & Coastal Engineering	S0026 30/09/2016	
Velerie Siambun BSc (Applied Biology)	Biology	S0029 30/09/2015	
Siti Nurulfirdauz Bte Hashim BSc (Environmental Science)	Water, Noise & Air Quality	S0189 16/02/2016	
Anthony Lamb M.A. (Contab) D.T.A Trinidad, Agriculture Tropical Agriculture	Flora	S0177 11/02/2015	

Table 6.2 Other experts contributing to the study.

Name/Qualification	Area(s) of Study in SEIA	Signatures
Kim Parsberg Jakobsen Civil Engineering (Phd)	Hydraulic modelling	
Richard Peckham BEng (Civil Engineering)	Coastal engineering	
Syed Mohazri Syed Hazari MSc Conservation Biology	Water quality	
Mohd. Zambri Mohd. Akhir BSc (Aquatic Biology)	Marine ecology and fisheries	
Paul Porodong Anthropology (Phd)	Socioeconomics	
Giam J. Lunkapis Anthropology (Phd)	Socioeconomics	

7 References

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