








Gladstone Ports Corporation

Growth, Prosperity, Community

Port of Gladstone

Western Basin Dredging and Disposal Project

Environmental Impact Statement Addendum

WorleyParsons

resources & energy

Executive Summary

This addendum report has been prepared as additional information for the Environmental Impact Statement (EIS) for the Port of Gladstone Western Basin Dredging and Disposal Project (the Project) in accordance with the Terms of Reference (ToR) for the Project issued by the Coordinator-General. It was prepared to assess the potential impacts of the dredging component (berth pockets, Marine Offload Facility (MOF), access channel and swing basins) of a proposed LNG facility to be located near Laird Point on Curtis Island. The purpose of this addendum is to address the cumulative impact assessment resulting from this incremental change to proposed dredging and disposal for each of the two options (1b and 2a).

Option 1b involves dredging in the Targinie Channel area and covers an additional area of approximately 80 ha to a depth of RL-13.3 m lowest astronomical tide (LAT) in swing basins and approach channel and RL-9.5 m LAT in all other areas. Option 2a is proposed within an approximate 108 ha footprint, located northwest of the Stage 1A dredging works described in Section 2.1 of the EIS. Dredging is proposed to the same depths as described for Option 1b. Both areas are located within the Project Area.

The key potential impacts for the additional dredging of Option 1b or 2a include:

- Increased dredging with the estimated quantity of dredge material for Option 2a being 12.8 million m^3 and for Option 1b being 6.0 million m^3;
- Possible extension of the accumulative dredging of time up to 16 months across the duration of the Project;
- Loss of existing benthic habitat, of approximately 75 ha for dredge Option 1b to 105 ha for Option 2a, from the seabed in the additional dredged areas;
- Adverse impacts on marine water quality, by extending the period of elevated turbidity due to dredging with backhoes or cutter suction dredgers;
- Increase in sedimentation, of approximately 60,000m^3/year or 105,000 m^3/year for dredge Option 1b and Option 2a respectfully, within the Western Basin, leading to increase of annual maintenance dredging;
- Increase in capital dredge material to be placed in the Reclamation Area; and
- Access impacts for recreational and commercial fishing in the Fisherman's Landing, Passage Islands and Laird Point areas.

The majority of the management measures identified as part of the Project will also adequately address the measures required as part of the additional dredging works, within either Option 1b or Option 2a. The additional dredging may exacerbate impacts to marine water quality and hence, it is critical that dredge planning and management includes appropriate monitoring and analysis of water quality trigger values for various impact durations. Management of water quality impacts in light of the increased maintenance dredging requirements also needs to be addressed in the dredge management plan.

The coordinated approach that GPC has proposed for determining measures to offset/minimise impacts to recreational fishers due to the Project will include consideration of the additional dredging area.

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1. Introduction

This report has been provided as additional information for the Environmental Impact Statement (EIS) for the Port of Gladstone Western Basin Dredging and Disposal Project (the Project) in accordance with the Terms of Reference (ToR) for the Project issued by the Coordinator-General. It was prepared as an addendum to the main EIS report to assess the potential impacts of the dredging component (berth pockets, Marine Offload Facility (MOF) access channel and swing basins) of a proposed LNG facility to be located near Laird Point on Curtis Island. As foreshadowed in the Initial Advice Statement for the Project, further analysis of the dimensions and footprint of the dredging requirement to accommodate access for an LNG facility on Laird Point has been conducted by Australia Pacific LNG (APLNG), the proponent for the proposed Laird Point LNG facility. This resulted in an extension of the dredging requirement for Stage 2 works described in Section 2.1 of the EIS and the identification of an alternative option based around extending the dredged channel from the Stage 1A dredging area to the Laird Point area. The purpose of this addendum report was to address the cumulative impact assessment resulting from this incremental change to proposed dredging and disposal for each of the two options.

As described in Chapter 1 of the EIS, Gladstone Ports Corporation (GPC) is seeking approval to dredge the inner harbour, to create new channels swing basins and berth pockets, and dispose of the dredged material into the proposed Western Basin Reclamation Area (Reclamation Area). Dredging proposed includes that required to enable access of LNG ships to proposed LNG facilities, one of which will be located near Laird Point on Curtis Island. This LNG project will require dredging to be conducted on the western side of Curtis Island where the proposed berth pockets and MOF are to be located and in the associated channel and swing basin areas. Dredged material is to be disposed of within the Reclamation Area.

This addendum report assesses the extension of the Stage 2 dredging requirement (Option 1b additional dredge area) and the additional option for a dredged area from Stage 1A along Curtis Island (Option 2a additional dredge area). Both areas are located within the Project Area and are shown in Figure 1-1. Note that the names of the two options represent the design case evaluated by APLNG and are not related to the names of the stages of dredging set out in Table 1.3.1 of the EIS.

Option 1b involves dredging in the Targinie Channel area and covers an additional area of approximately 80 ha to a depth of RL-13.3 m lowest astronomical tide (LAT) in swing basins and approach channel and RL-9.5 m LAT in all other areas. These dredge depths consider 0.3m of over dredging. Option 2a is proposed within an approximate 108 ha footprint, located northwest of the Stage 1A dredging works described in Section 2.1 of the EIS. Dredging is proposed to the same depths as described for Option 1b.

This addendum report has been prepared in accordance with the ToR for the Project. The ToR stipulates that the EIS should clearly define the Project in the context of the proposed expansion of the Fisherman's Landing Reclamation Area (site located adjacent to the proposed Reclamation Area, undergoing a separate EIS approvals process); dredging required for the various LNG projects proposed for Port Curtis, Curtis Island and the Western Basin, including dredging for MOFs, and the draft Port of Gladstone Western Basin Master Plan (draft August, 2009). This plan identified Laird Point as one of the acceptable areas within the Curtis Island Industry Precinct of the Gladstone State Development Area for development of an LNG facility.

The ToR recognises that dredging associated with the various MOFs, specific to the various LNG projects, will be considered as part of this EIS. In addition, the ToR indicates that certain other matters specific to the individual LNG project proposals for the Western Basin, such as the disposal of dredged material associated with pipelines crossing The Narrows, should be addressed in detail by the various EISs prepared for each of the LNG projects.

To address these ToR requirements, Table 1.3 of Chapter 1 of this EIS, identifies the dredging and disposal activities for a number of other projects in the Port of Gladstone area. The Project encompasses all of the dredging works associated with the LNG industry, future GPC developments in the inner harbour in the Port, and also includes the MOFs to support the various LNG proponents on Curtis Island. GPC has sought to provide a cumulative impact assessment of all of these future activities, to enable a more comprehensive assessment than would otherwise have been performed by the various individual LNG projects.

This addendum has examined the existing conditions and proposed development, as described in Section 2.3 of the EIS, as well as the additional studies undertaken for dredge area Option 1b and dredge area Option 2a including sediment characterisation studies (Appendices A and B) (WorleyParsons, 2009a; WorleyParsons, 2009b), and hydrodynamic and sediment transport modelling (Appendix C) (WBM, 2009). A cumulative impact assessment was undertaken, which considered the dredging works proposed in Section 2.1 and dredging proposed within each of the two dredge footprint options (Option 1b and Option 2a) on the western side of Curtis Island. This assessment has been undertaken in accordance with the aims of the draft Port of Gladstone Western Basin Master Plan, which requires the development of the Western Basin to be undertaken in a co-ordinated manner, with the aim of minimising cumulative environmental impacts.

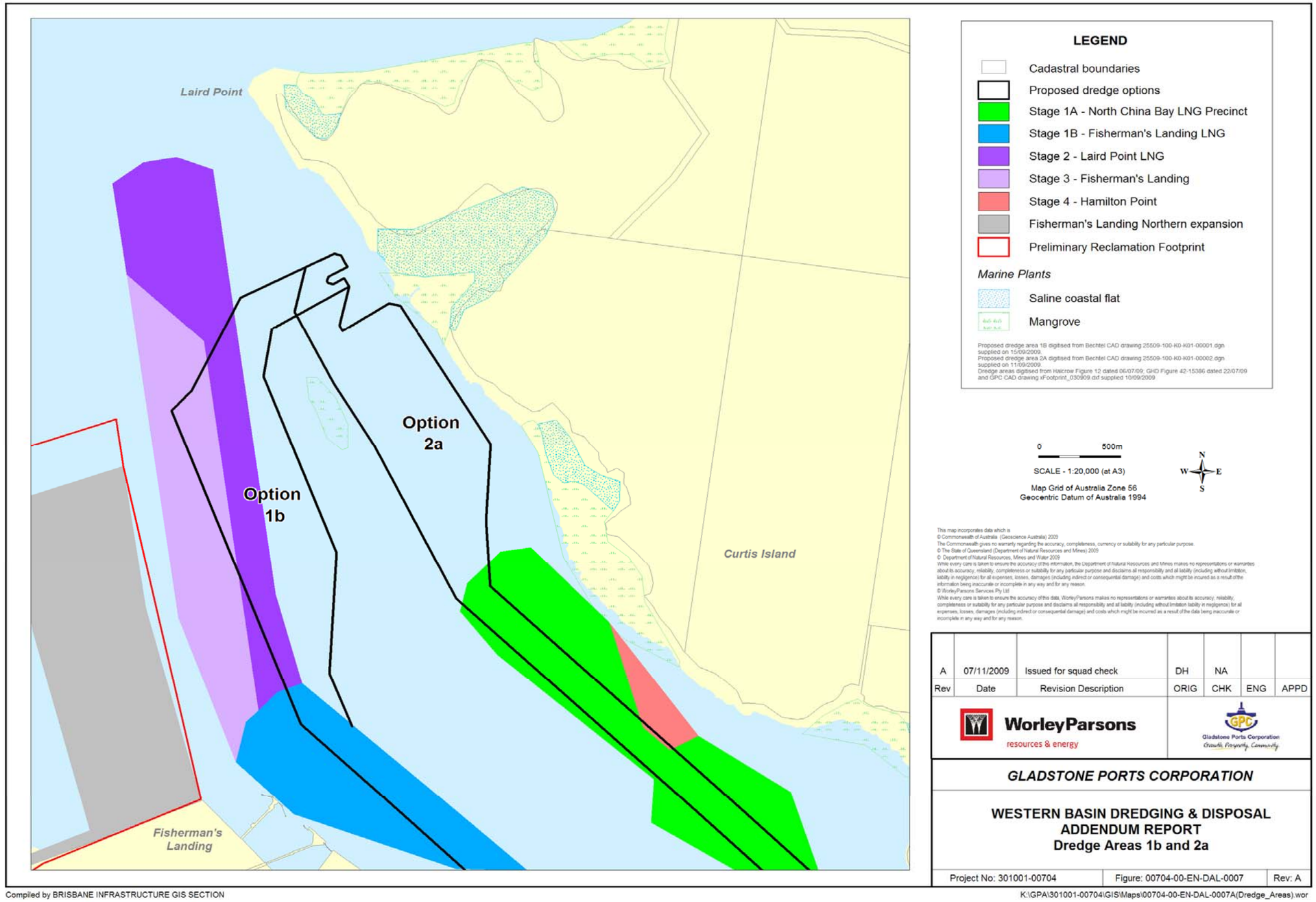

Figure 1-1 Proposed additional dredge areas (Option 1b and Option 2a) adjacent to Curtis Island

2. Project Description

The Project area considered in this addendum, encapsulates the dredge and reclamation areas described in Chapter 2 of the EIS (see Figure 2-1), as well as the dredge areas identified as Option 1b and Option 2a (see Figure 1-1), which support the proposed LNG facility near Laird Point on Curtis Island. The entire Project Area is located within the Port of Gladstone, approximately 10km northeast of Gladstone.

As mentioned in Chapter 1 of the EIS, capital dredging of the inner harbour to create new channels, swing basins and berth pockets is proposed to support the progressive development of the harbour and Port facilities. This will allow for direct access to Port facilities, as part of the expanding import and export market, and more specifically will support the development of the LNG industry within the Gladstone region. The dredging and reclamation works proposed as part of the Project includes:

- The inner harbour dredging associated with deepening and widening of existing channels and swing basins, and the creation of new channels, swing basins and berth pockets; and
- The disposal of dredged material from the above dredging works in the Reclamation Area, adjacent to the existing Fisherman's Landing Reclamation and the proposed Fisherman's Landing Northern Expansion.

2.1 Curtis Island LNG Port Infrastructure

As mentioned in Chapter 2 of the EIS, construction of the marine infrastructure to support the LNG facilities on Curtis Island will involve dredging of the approach channels, swing basins, berth pockets and MOFs. The capital dredging required for shipping access to the LNG facilities on Curtis Island and the subsequent management of the dredged material, will be provided under the approvals sought by the GPC, as part of this Project.

Dredged swing basins with sufficient depth and width to allow safe turning, while maintaining a safe under-keel clearance will be required for LNG tankers accessing LNG facilities. A dredged approach channel of 200 m width will also be required. LNG tankers will also require tugs of sufficient bollard pull to allow safe escort and swing manoeuvres. Permanent MOFs are also required to offload materials during construction and to receive construction personnel and operations personnel by ferry.

For the proposed LNG facility to be located near Laird Point, the jetty facilities will be designed to provide safe berths for the receipt and support of LNG and LPG ships, and to ensure safe transfer of cargo from the onshore storage facilities to the ships. LPG may be added to LNG to increase calorific value should the market require this. GPC, Maritime Safety Queensland (MSQ) and LNG proponents are developing shipping and safety protocols for LNG and LPG shipping and this will be addressed by the LNG facility proponents in the risk assessments for the facilities.

The MOF for the proposed LNG facility located near Laird Point is required to provide the following functions:

- Offload modules for LNG facility construction;
- Offload general construction materials from barges;
- Support to jetty construction; and

- Personnel transfer to Curtis Island.

A ramp will first be constructed at the MOF location to allow offload of equipment and materials for the construction of the MOF proper. One MOF capable of 2,500 ton loads and crane access with roll-on/roll-off ramps to unload heavy equipment, modules and materials will be provided for the proposed LNG facility located near Laird Point.

2.2 Marine Loading Facility Dredging Options

Two options (Option 1b and Option 2a) for the location of the marine facilities for the Laird Point LNG facility are being assessed to ensure that an optimal solution is implemented through consideration of potential environmental and social impacts, addressed in this report, in addition to technical and economic constraints, including the location of restriction zones and infrastructure cost. The names of the options represent the design case evaluated by APLNG, with Option 1b being the most suitable arrangement for loading facilities if shipping access was to be via the Targinie channel, and Option 2a being the most suitable arrangement for loading facilities located between Curtis and North Passage Islands if shipping access were to be provided through the Stage 1A dredge area.

The additional estimated quantity of dredge material for Option 2a is 12.8 million m^3 (0.7 million m^3 for MOF and 12.1 million m^3 for berths, swing basin and approach channel), and for Option 1b is 6.0 million m^3 (1.4 million m^3 for MOF and 4.4 million m^3 for berth and swing basin). As Option 1b overlaps the Stage 2 and Stage 3 dredge areas described in the main EIS, the volume quoted here is only that which is in the additional footprint area as illustrated on Figure 1-1. Both options are dependent on dredge material being disposed of in the Reclamation Area**.**

For Option 2a the approach to the loading berths will be past the proposed GLNG and QCLNG project loading berths along the west coast of Curtis Island. A swing basin would be dredged between the Curtis Island coast and North Passage Island. Manoeuvring studies have been completed to confirm the feasibility of this configuration. With Option 2a, an LNG ship can be berthed and loading LNG while a small vessel passes the ship. It remains outside of the proposed 250m exclusion zone around the ship and can travel northward toward the Narrows on the east side of North Passage Island.

The configuration of the MOF for Option 2a will be optimised based on the outcomes of additional manoeuvrability studies. Angling of the MOF in a southerly direction may be required to enhance safety and operability of the MOF.

For Option 1b, loading berths are located on the west side of North Passage Island. Technical and operational issues currently being evaluated for this option include:

- Potential to affect passage of small boat traffic along the Curtis Island coast on the east side of North Passage Island due to location of pipework for LNG loading;
- Potential restrictions on ship traffic past the west side of a loading LNG carrier due to exclusion zones; and
- Relative difficulty of LNG ship access due to higher currents and more turns required to approach the berth as compared to Option 2a.

2.3 Dredging and Disposal

The Project will involve dredging of 36 million m^3 of material as described in Chapter 2 of the EIS plus an additional volume for either Option 1b or Option 2a described above. A total of approximately 6.0 million m^3 of additional material is proposed to be dredged from within Option 1b, as part of capital dredging activities. Dredging of Option 2a would require approximately 12.8 million m^3 of additional capital dredging. Dredging duration is estimated to be up to 16 months for Option 2a and somewhat less than this for the additional Option 1b area.

It is considered likely that dredging in this area will be undertaken using either backhoe and/or cutter suction dredgers, consistent with the assumptions and methodology outlined in Chapter 2 of the EIS.

The disposal site for the material dredged from either Option 1b or Option 2a is within the Reclamation Area, directly north of the proposed Fisherman's Landing Reclamation Area. The Reclamation Area is conceptually designed with a total capacity of 55 million m^3 refer Chapter 2 of the EIS. This provides additional storage capacity to allow bulking and decant of capital material and future maintenance dredge material. Therefore, due to the design capacity of the reclamation area, the additional dredged material created by Option 1b or Option 2a has the potential to be accommodated.

As described in Chapter 2, the footprint of the reclamation area provides storage for approximately 29 million m^3 of dredge material when filled to RL7 LAT. The additional dredge storage will be accommodated by shaping the dredge material into a 50-70m high mound. The mound would have a 1:6 batter and be vegetated with grasses and trees as soon as practicable. Chapter 2 of the EIS provides a conceptual design of the reclamation area.

3. Environmental Values and Impacts

The environmental impact assessment methodology applied for the Project is described in Chapter 3 of the EIS. The impact assessment undertaken for this addendum report used the same methodology. Reporting of environmental values, potential impacts and mitigation strategies is generally by exception, with the focus of discussion in the sub-sections below being any changes attributable to the additional dredging for Option 1b or Option 2a.

3.1 Climate and Climate Change

Chapter 4 of the EIS provides a description of the climate in the Project Area and an assessment of the Project's vulnerabilities to climate change, addressing Section 3.1 *Climate and Climate Change* of the ToR for the Project. Potential impacts identified and assessed are summarised in Table 4-7 of the EIS. Those that have not been assessed as being 'Minor/No effect' (refer to Table 4-7 of the EIS) are only relevant to the reclamation component of the Project i.e. the Reclamation Area. As the additional works described in this addendum report are associated with the dredging component of the Project only, it is considered that there would be no additional impacts relating to climate change requiring mitigation measures, other than described in Section 4.2 of the EIS.

For impacts and mitigation measures relating to greenhouse gas emissions refer to Section 3.6.2.

3.2 Land

The potential impacts of the Project on land use, geology, soils and land contamination and the associated mitigation measures for these impacts are described in Chapter 5 of the EIS. Based on the assessment undertaken for the additional dredging associated with Option 1b or Option 2a, it is concluded that these dredging activities described do not introduce any different potential impacts than those described in Chapter 5 of the EIS.

The potential for acid sulphate soils (ASSs) in the additional dredged areas is described in Section 3.3.2 of this addendum. The mitigation measures described in Chapter 5 for managing ASS during dredging will also apply to dredging works associated with Option 1b or Option 2a.

3.3 Coastal Environment

This section addresses marine water quality, sediment quality and coastal processes relevant to the additional dredge areas. Specific sediment quality studies were undertaken for the proposed dredging areas associated with both Option 1b or Option 2a. Numerical modelling additional to that provided in Appendix J of the EIS was undertaken to inform the assessment of potential impacts of dredging on water quality and coastal processes.

3.3.1 Water Quality

Water quality in the study area within and surrounding Option 1a and Option 2b has been investigated by considering the environmental values in and around Port Curtis, the applicable water quality guidelines and the existing water quality conditions described in Chapter 7 of the EIS. Prior to identifying the key environmental values of the study area, the type of ecosystem was characterised in Chapter 7 of the EIS, in accordance with the Queensland Water Quality Guidelines (QWQG, 2006), as inshore marine waters (enclosed coastal), located within the Central Coast Region.

Environmental Values

A summary of water quality environmental values as determined from information contained in the Queensland Water Quality Guidelines (QWQG, 2006), State Coastal Management Plan (EPA/QPWS, 2002), Curtis Coast Regional Coastal Management Plan (EPA/QPWS, 2003), Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000) and from existing data are presented in Table 7-1 of the EIS.

Existing Water Quality Conditions

The water quality monitoring program described in Chapter 7 of the EIS provided data from the Project Area including in the vicinity of the Option 1b or Option 2a areas (refer to Figure 7-1 in the EIS). Baseline water quality in the Project Area is summarised in Section 7.1 of the EIS. An analysis of the water quality data with reference to the Option 1b and Option 2a areas has shown the following:

- The pH within the Project Area is in the range of pH 7 to pH 8.5, and generally around pH 8, which is indicative of inshore marine waters and would also be applicable to water quality conditions surrounding Options 1a and 2b;
- Fixed site turbidity monitoring undertaken during baseline studies for the EIS reported median turbidity in deep waters during the dry season ranging from 3 to 9 Nephelometric Turbidity Units (NTU) and 95th percentiles from 11 to 35 NTU. These values would also be applicable to turbidity levels likely to be encountered within and surrounding Options 1b and Option 2a;
- Copper and nickel have elevated concentrations in The Narrows, located directly north of Option 1b and Option 2a and elevated concentrations of lead and zinc are present in Port Curtis. Nickel was also reported above ANZECC/ARMCANZ (2000) trigger values in the shipping channel near South Passage Island, adjacent to Fisherman's Landing, southwest of Options 1b and 2a and in many of the surrounding estuaries based on historic data (see Table 7–4, Chapter 7 of the EIS);
- Fitzroy River contains elevated concentrations of nickel, and to a lesser extent copper, which may be influencing observed metal concentrations reported in The Narrows and also further south, within the vicinity of Option 1b and Option 2a;
- The relationship between turbidity and TSS was examined in the water column using the available data from baseline monitoring and prior turbidity programs (see Chapter 7). The relationship between turbidity and TSS was close to 1:1 for turbidity up to 7 NTU and then closer to 1:2 with turbidity >10 NTU. This turbidity/ TSS relationship was also used as part of the this assessment to evaluate potential impacts on marine communities surrounding Option 1b and Option 2a; and
- Concentrations of metals and ammonia in elutriate samples isolated from sediments samples collected within the Project Area (refer to Section 7.1 of the EIS), are likely to be representative of concentrations found in sediments located in proposed dredge areas Option 1b and Option 2a.

For the purposes of describing water quality in the vicinity of Options 1b and 2a, in accordance with (QWQG, 2006), the study area can be described as “slightly to moderately” disturbed. ANZECC/ARMCANZ (2000) guidelines for toxicants in aquatic ecosystems commonly apply a 95 percent protection level to ecosystems that are classified as “slightly to moderately” disturbed.

Impacts and Mitigation Measures

For the purposes of assessing the impact of the additional dredge activities on water quality, it has been assumed that dredging is planned and scheduled such that the overall dredging operations in the Project Area are aligned with the scenarios previously modelled and reported in Chapter 7 of the EIS. Modelling outputs for investigating the spatial representation of the dredge plumes under the different dredging scenarios, suggest that dredge plumes generated by a cutter suction dredge operating in the Option 1b or Option 2a areas will be localised to a relatively small area surrounding the dredge. Refer to the results for Scenario 2 particularly, which modelled a cutter suction dredger in the Stage 2 dredge area, in close proximity to the entrance to The Narrows.

Mitigation measures nominated in Chapter 7 of the EIS are appropriate for the additional Option 1b or Option 2a dredging activities. Mitigation includes:

- Detailed calculations prior to each dredging program to ensure nominated turbidity objective can be obtained;
- Development of a dredge management plan which will include appropriate trigger values and daily monitoring of sites adjacent to the dredge and Reclamation Area decant; and
- Ammonia monitoring in the vicinity of dredging operations.

Trigger values for turbidity and TSS will consider the changes in incident light levels on the seabed during dredging and the duration of the impact.

3.3.2 Sediment Quality

Marine sediment quality was examined in Chapter 7 of the EIS and sediments characterised in accordance with the National Assessment Guidelines for Dredging (NAGD) (Commonwealth of Australia, 2009) and the Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland (Queensland Environmental Project Agency [EPA], 1998). Previous sediment investigation results from studies undertaken in and around Port Curtis were examined, and the following contaminants of concern were identified as occurring at concentrations above NODG screening levels:

- Metals and metalloids;
- Polycyclic aromatic hydrocarbons (PAHs); and
- Organotin compounds (TBT, DBT, and MBT).

Acid sulphate soils (ASS) were also identified as of concern, given that ASS has been detected during prior sediment investigations and it is proposed to dispose of dredge material within the Reclamation Area.

The sediment sampling and analysis plan (SAP) to characterise sediments within the areas to be dredged as part of the Project, is described in Chapter 7 and Appendix L of the EIS. A draft of this SAP, proposed by GPC in July 2009 and commented on by the Department of the Environment, Water, Heritage and the Arts (DEWHA) and DERM in September 2009, was adopted for sediment sampling and analysis specific to the Option 1b and Option 2a areas. The SAP was based on a pilot-scale study design, whereby a reduced number of sample locations (20%) were surveyed, compared to that prescribed for a full sample program.

Additional Sediment Characterisation – Option 1b

For Option 1b, sampling design was based on an early layout dredge footprint design volume of 539,000m^3. Field sampling was undertaken at a total of six randomly (i.e. minimum 20% as per pilot study described in the SAP) selected locations (refer indicative Figure 3-1) and samples were tested for the contaminant substances and physical characteristics listed in Table 3-1. In addition, ASS testing was undertaken at a total of 21 sampling locations using a combination of field ASS testing and laboratory testing. Following sampling, slight modification was made to the dredge footprint which resulted in a few locations being marginally outside the new bounds. However, these are still considered relevant for this assessment, especially given the previously undisturbed nature of the seabed in this area. The full report on sediment characterisation is provided in Appendix A and the methodology and findings are summarised below.

Table 3-1 Contaminants and physical characteristics tested

Particle size distribution (PSD)	Total Petroleum Hydrocarbons (TPH)
Moisture content	Organophosphorus Pesticides (OPP)
Total Organic Carbon (TOC)	Organochlorine Pesticides (OCP)
Metals (Al, Sb, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, V, Zn)	Polychlorinated Biphenyls (PCB)
Organotins (TBT)	Polycyclic Aromatic Hydrocarbons (PAH)
Benzene, Toluene, Ethylbenzene and Xylene (BTEX)	

Golder Associates Pty Ltd (Golder) were sub-contracted to undertake the in-field sampling and analysis and reporting for ASS. Golder engaged GeoCoastal, to undertake the overwater vibrocoring and Shine Drilling, Australian Barge Hire and Drillsure to undertake the drilling. Sampling was undertaken between 25 August and 26 August 2009 using split spoon sampling techniques and 21 September and 22 September 2009 using vacuum-vibrocoring techniques.

A continuous sediment core was recovered using vacuum-vibrocoring techniques, which enabled the recovery of all sedimentary material, including unconsolidated sediments such as flowing sands. This method prevented cross contamination or vertical mixing of samples and enabled the collection of a high volume of sample for multi-parameter analyses and sub-sampling. When refusal occurred using the vibrocore, split spoon sampling drilling techniques were used to recover sample to the required dredge depth. Each borehole location was located using a differential GPS (accurate to ± 3-5m).

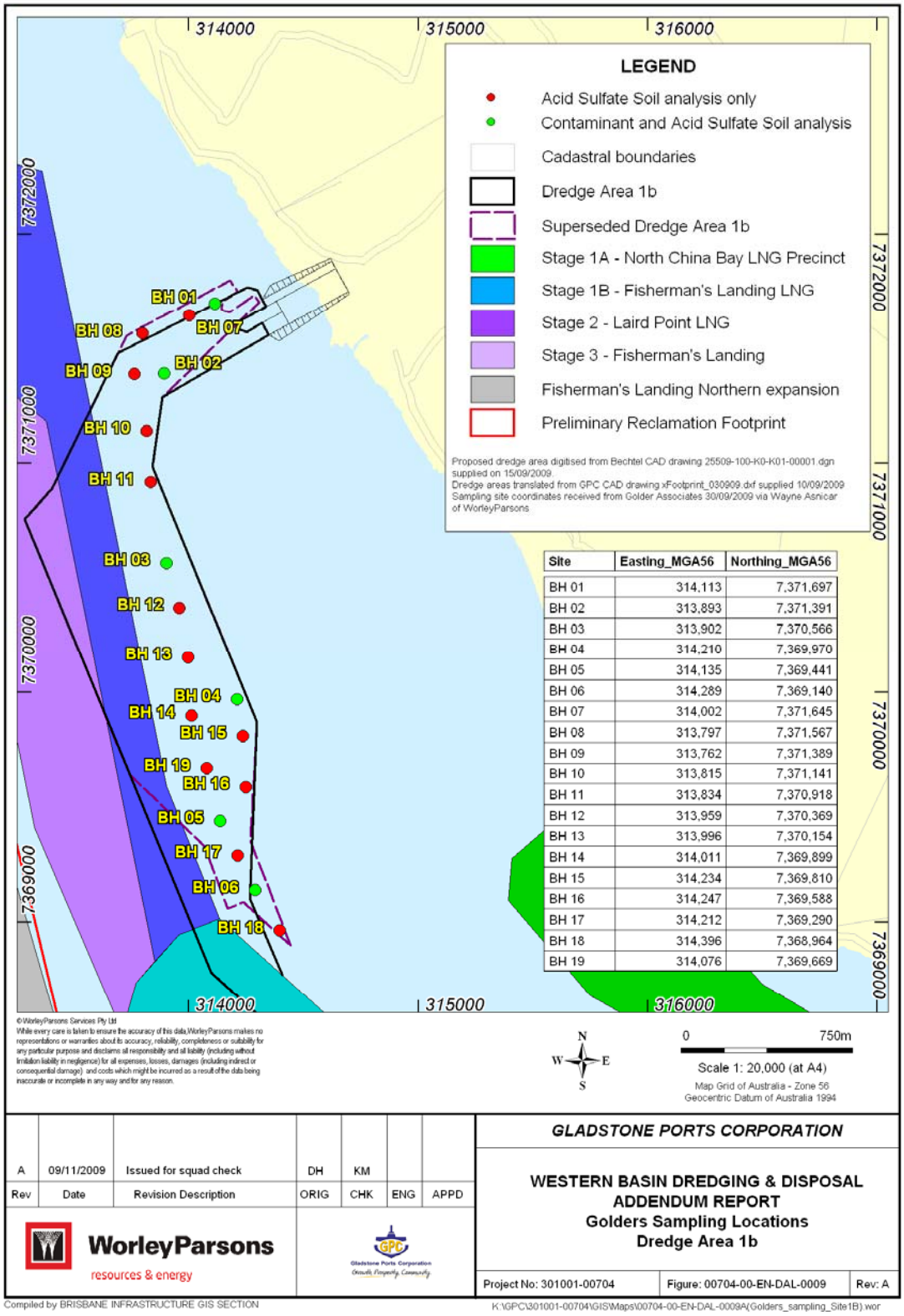

Figure 3-1 Location of sampling sites – Option 1b

For contaminant testing within each borehole, two sub-samples were collected from the top 1m of the core at 0.5m intervals. Below 1m sediment depth, sub-samples were collected and composited at approximately 1m intervals from 1.0 – 5.0m and from below 5.0m (where sample was recovered). Samples collected below vibrocore refusal (drilling techniques) were taken at 1m intervals, from approximately 450mm cores.

ASS samples were initially screened at approximately 0.5m vertical intervals (in accordance with QASSIT methodology) in at least 25% of the locations sampled (i.e. five locations). Less intensive analysis was conducted on the remaining cores, at a rate of 1 test per 1-2m of core (depending on results of in-situ sampling). Screening was undertaken by Golder using the pH_F (field pH) and pH_{FOX} (ph following peroxide oxidation) method of analysis. A representative number of samples selected from the screened samples were sent to the primary laboratory and subjected to the full SPOCAS or S_{CR} test suites.

Primary sediment analysis was completed by a NATA accredited laboratory, Australian Laboratory Services (ALS). A secondary laboratory (Advanced Analytical Australia, AAA) was used as part of quality assurance procedures. Sediment contaminant concentrations were assessed against: the National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia, 2009); and EILs and Health Investigations Levels for residential land use (HIL-A) in the Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland (EPA, 1998).

Chemical analyses conducted on sediments sampled within capital dredging area Option 1b revealed concentrations generally below NAGD Screening Levels, with the exception of arsenic (two samples), mercury (two samples), copper (one sample), lead (one sample), and nickel (one sample) in sediments below 1m depth. Arsenic, nickel and copper were reported in previous studies at naturally high concentrations in the region as discussed in Chapter 7 of the EIS. Given that all contaminants exceeding NAGD Screening Levels occurred in sediments below 1m depth, it is likely that these results are indicative of natural levels.

In comparison with EPA (1998) guidelines, two arsenic, one copper and seven manganese concentrations were reported above the EILs. Two of the manganese EIL exceedances occurred in the surface sediments, with the remaining five occurring in sediments below 1m. The likely reason for the elevated arsenic and copper concentrations is discussed above. Manganese has also been previously recorded above the EIL in the Port of Gladstone and was considered to be at naturally occurring concentrations (refer to Chapter 7 and Appendix L of the EIS).

Survey results for organic contaminant substances in the APLNG dredge area Option 1b are summarised below:

- TPH fraction C6-C9 was below the detection limit in all samples;
- TPH fraction C10-C14 was above the detection limit in one sample only, in sediments below 1m;
- TPH fractions C15-C28 and C29-C36 were above detection limits in the majority of samples throughout the sediment horizons;
- All PAHs, except one, were below detection limits across all sample locations and sediment horizons. Phenanthrene was detected in one sample from surface sediments; and
- BTEX, TBT, OCP, OPP and PCBs were below respective detection limits in all samples.

The 95% UCL of the mean for all contaminants tested in dredge area Option 1b were below the respective NAGD Screening Levels. The 95% UCL of the mean for manganese exceeded the DEH (1998) EIL for sediments below 1m. All other contaminants were below the EIL guideline at the 95% UCL of the mean. Power analysis conducted on sample results within dredge area Option 1b, confirmed that statistically valid comparisons could be made against the NAGD Screening Levels, even at the pilot level of sampling undertaken.

Results of the ASS testing indicated that all Holocene sediment samples had an absence of actual acidity (i.e. not Actual ASS [AASS]). It was also indicated that the Holocene sediments within the northern and southern most extents of the study area have moderate to high levels of oxidisable sulphur, meaning that these Holocene sediments are Potential ASS (PASS). In these areas Acid Neutralising Capacity (ANC) was not sufficient to neutralise this acidity. As such, these areas would require treatment with good quality agricultural lime at a rate of up to 140kg of lime/m^3. Based on the quantity of sediments to be dredged and the level of acidity, the treatment category, according to QASSIT guidelines and State Planning Policy 2/02 is considered 'extra high'.

Based on the analyses undertaken for dredge area Option 1b, it is considered that the capital material to be dredged is suitable for unconfined placement on land, subject to acid sulphate soils management requirements.

Additional Sediment Characterisation – Option 2a

For Option 2a sampling design was based on an early layout dredge footprint design of approximately 91ha and volume of approximately 9,651,000m^3. Field sampling for contaminant substances was undertaken from a total of eight (i.e. minimum 20% as per pilot study, described in the SAP) randomly located sampling sites (refer Figure 3-2) and tested for the contaminants listed in Table 3-1. In addition, ASS testing was undertaken from a total of 34 sampling locations using a combination of field ASS testing and laboratory testing. The full report on sediment characterisation is provided in Appendix B and the methodology and findings are summarised below.

Golder was sub-contracted to undertake the in-field sampling and analysis and reporting for acid sulphate soils assessment. Golder engaged GeoCoastal to undertake the overwater vibrocoring and Shine Drilling, Australian Barge Hire and Drillsure to undertake the drilling. Sampling was undertaken between 29 July and 5 August 2009 using a combination of vacuum vibrocoring techniques and 23 August and 27 August 2009 using drilling techniques.

The methodology employed for the collection of samples and analysis for dredge area Option 2a was consistent for the collection of samples and analysis for dredge area Option 1b.

Chemical analyses of sediments within capital dredging area Option 2a identified that contaminant substances, if present, are generally below NAGD Screening Levels. The exception to this was the presence of arsenic in three samples (one within the surface 1m of sediment and two below 1m), mercury in one sample (below 1m), and zinc in two samples (below 1m). Arsenic has been identified as occurring naturally within sediments in the Port of Gladstone (refer to Chapter 7 and Appendix L of the EIS). Given that the exceedance of mercury occurred in sediments below 1m and have been reported independently in nearby sediment surveys (URS, 2009), it is possible that these results are also an indication of natural levels of mercury within the sediments. Zinc exceedances occurred below 6m sediment depth and hence may be a reflection of natural levels, but are significantly higher than other sample concentrations from similar depths for this sampling regime.

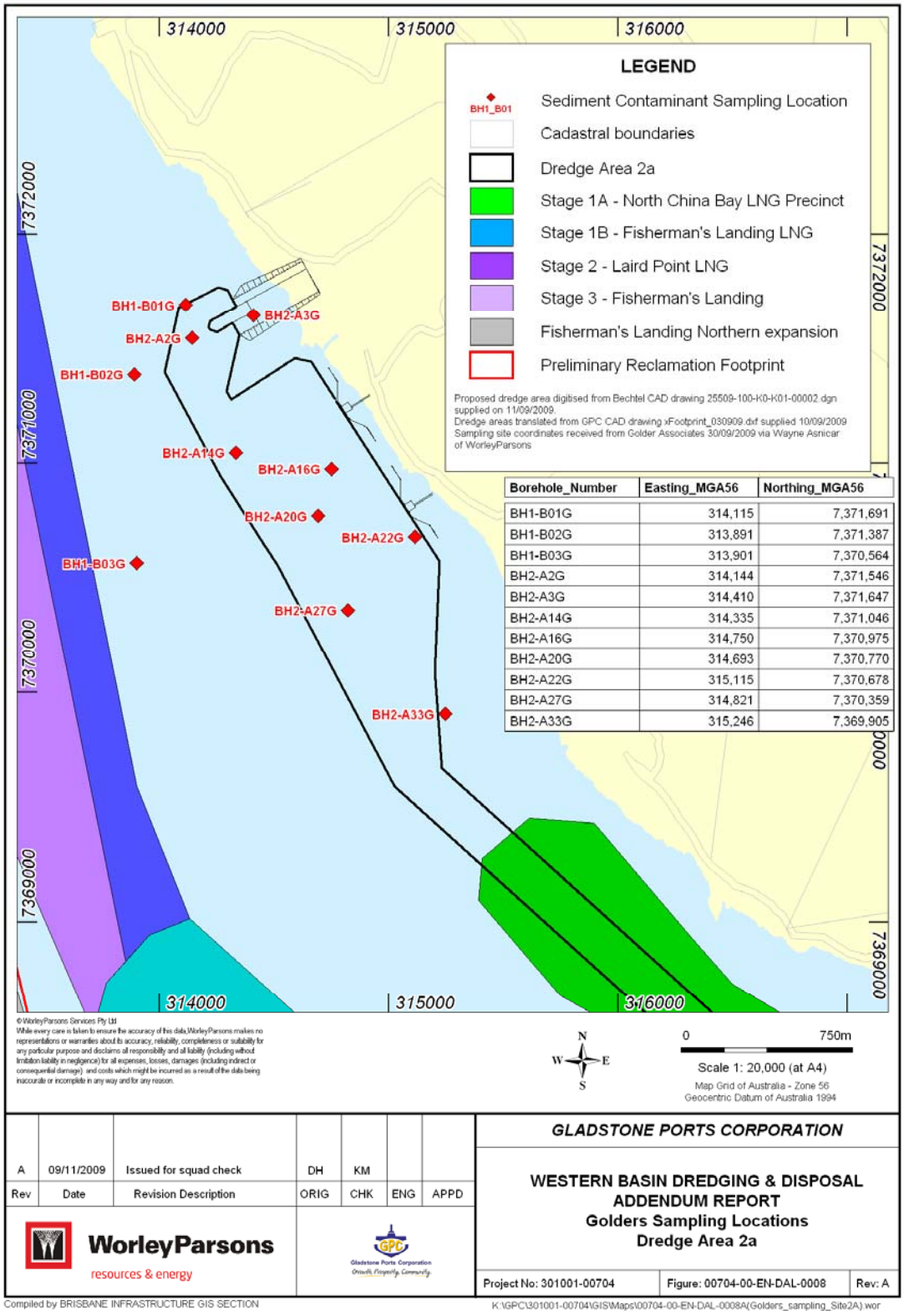

Figure 3-2 Location of sampling sites – Option 2a

In comparison with EPA (1998) guidelines three arsenic, one manganese and two zinc samples exceeded respective EILs. Arsenic and zinc are discussed above. Manganese has been recorded above the EIL in the Port of Gladstone and is considered to be at naturally occurring levels (refer to Chapter 7 and Appendix L of the EIS).

A summary of the remainder of the contaminant substance results includes:

- Total Petroleum Hydrocarbon fractions C6-C9 and C10-C14 were not detected in any sample;
- Fractions C15-C28 and C29-C36 were detected in the majority of samples from all sediment horizons;
- Generally, the majority of PAHs were not detected in any sample. A total of nine PAHs were recorded above detection limits, the majority of these only occurring in sediments below 1m in one location; and
- BTEX, Tributyltin, Organochlorine Pesticides, Organophosphorus Pesticides and Polychlorinated Biphenyls (PCBs) were not detected in any sample.

Following the completion of the sampling and analysis, the Option 2a dredge footprint was 'shifted' westward by approximately 120m and expanded from 91ha to 108ha due to rectification of discrepancies in the dredge options data and the displaced design, and layout efficiency modifications. Consequently, several sampled boreholes became located outside the amended dredge footprint but still provide useful information on the sediment characteristics of the immediate dredge area at near Laird Point and are considered relevant for this assessment. Remaining within the amended dredge area were six borehole locations tested for contaminants, and 25 borehole locations tested for ASS.

Based on statistical analysis of the six sites remaining within the amended Option 2a dredge footprint, the 95% upper confidence level of the means for all contaminants tested in dredge area Option 2a were below respective NAGD Screening Levels as well as EIL levels. Despite undertaking only a pilot level of sampling, statistical power was sufficiently high to make a valid comparison against NAGD Screening Levels for all contaminants except arsenic. However, while power was marginally low for arsenic comparison against NAGD Screening Level of 20 mg/kg (power = 0.68 versus recommended 0.8), it was sufficient for comparison against the locally derived Port Curtis Integrated Monitoring Program's (PCIMP) trigger value for arsenic of 24.3 mg/kg, which reflects naturally elevated background concentrations.

Holocene sediments within the dredge footprint are ASS bearing. There is a 'zone of infiltration' on the boundary of the Holocene and Pleistocene sediments in which ASS may also occur. These sediments are shallow, occurring at depth between 0.2m and 4.1m sediment depth, with an average depth of 1.8m. The Holocene sediment layer appears to be limited in extent to north eastern portion of the dredge footprint. Holocene sediments within the footprint contain negligible actual acidity (i.e. no actual ASS). However, the majority of the dredge area has moderate to very high potential acidity (potential acid sulphate soils, PASS). PASS was detected at all depths throughout the Holocene layer and in some instances up to 1.2m into the underlying Pleistocene sediments (zone infiltration). Acid neutralising capacity (ANC) is generally insufficient to neutralise the potential acidity generated. Therefore, treatment of the soils with good quality agricultural lime will be required to mitigate acid generation. Liming rates range from 20kg lime/m^3 in the central portion of the dredge area to 150-200 kg lime/m^3 in areas closest to Curtis Island. Based on the quantity to be dredged and the level of acidity, the treatment category, according to QASSIT guidelines and State Planning Policy 2/02 is considered 'extra high'. Note that by moving the footprint further west (from the location originally proposed), some areas of high PASS have been avoided.

Based on these analyses it is considered that capital dredging material within dredge area Option 2a is suitable for placement on land subject to acid sulphate soils management requirements.

Impacts and Mitigation Measures

As dredged material from both the Option 1b and Option 2a areas has been found to be suitable for placement on land, mitigation measures proposed in Chapter 7 and Chapter 5 (ASS) of the EIS are also considered appropriate for the dredge material in the Option 1b and Option 2a locations.

3.3.3 Coastal Processes

Chapters 6 and 7 and Appendix J of the EIS describe the modelling undertaken for specific dredging and reclamation scenarios in relation to hydrodynamics, flushing, wave, suspended sediment, and siltation processes in Port Curtis. This modelling, which quantifies key physical processes acting within the Project Area, informs the assessment of environmental impacts. Model scenarios were developed based on geographic locations and the type of work proposed at each location. The scenarios are described in Section 6.8 of the EIS. Of most relevance to the assessment of cumulative impacts associated with dredging Options 1b and 2a, are the Base Case and Scenario 3 simulations.

Numerical modelling of additional scenarios was undertaken by BMT WBM Pty Ltd (refer to Appendix C) for this addendum report. The modelling was an extension of the above mentioned modelling to assess the impact of the additional Option 2a and Option 1b dredge areas.

The components of the additional dredging included as part of the assessment are as follows:

Option 1b:

- Incremental change to the berth and swing basin to the west of North Passage Island at -13m LAT; and
- MOF and associated approach dredging at -8m LAT.

Option 2a:

- Berth and Swing Basin to the east of North Passage Island at -13m LAT; and
- MOF and associated approach dredging at -8m LAT.

The additional options have been included and referenced as extensions of Scenario 3 as described in Section 6.8 of the EIS. The two additional Scenarios are Scenario 3-1b and Scenario 3-2a representing dredge Option 1b and Option 2a respectively.

The additional two scenarios have been assessed with respect to:

- Tidal hydraulics; and
- Sediment transport.

No additional runs were completed for either flushing or dredge plumes, on the basis that:

- The small impacts associated with hydrodynamics would mean a negligible difference would be evident with respect to flushing; and

- It was assumed that dredging for Option 1b and Option 2a would occur in conjunction with Stage 2 dredging, and given that use of a cutter suction dredger is proposed (rather than a trailer suction hopper dredge), would generate lesser impacts than those demonstrated in Model Scenarios 1a and 1b (refer Chapter 7 and Appendix J of the EIS for details).

Tidal Hydraulics Potential Impacts

Potential Impacts were assessed with reference to time series results from model predictions of water level and current speed at 30 locations throughout the model, 28 of which correspond to the locations used in the initial modelling (Appendix J of the EIS) and 2 of which were added to assist with assessment of the impacts of additional dredge areas Option 1b and Option 2a..

The interpretation of the model predictions relevant to the incremental change to dredging modelling indicates the following:

- Current velocities tend to decrease in dredged areas where depths are greater in addition to those areas adjacent to dredging as flow is directed towards the more efficient dredged flow paths;
- Increases in velocity typically occur in the un-dredged upstream and downstream approaches to the Option 1b or Option 2a dredged areas where flows accelerate on entering and exit;
- The additional dredging has negligible impact on the high tide levels throughout the area and the results for the additional dredging areas are essentially the same as reported in the modelling reported in Appendix J of the EIS;
- In Scenario 3-1b, the reduction in flow to the west of North Passage Island (due to the increase in flow to the east as a result of the dredging) further reduces the velocities through the Laird Point Swing Basin and approach channel. Relative to the Base Case, the decreases in velocity predicted along the eastern wall of the reclamation are up to 0.7m/s (ebb) while the predicted decreases in the Laird Point Swing Basin and the channel leading to it are up to 0.1m/s (flood);
- In Option 2a dredging area, velocities decreased by up to 0.4m/s (flood) and 0.5m/s (ebb). Velocities in the MOF approach channel also generally decrease although some increases do occur on the ebb tide in the main flow path as a result of the increased flow through the area;
- Increases in velocity relative to the Base Case of 0.35m/s flood and 0.7m/s ebb occur on the shoals upstream of North Passage Island as a result of increased flows across the shoals to/from the Curtis Island channel; and
- Relative to Scenario 3, the changes are smaller (refer to Figures 2-8, 2-11, 2-14 and 2-17 in Appendix C). Figure 3-3 shows the changes to velocity for Option 2a at peak flood tide relative to the Base Case, and Figure 3-4 shows the changes relative to Scenario 3.

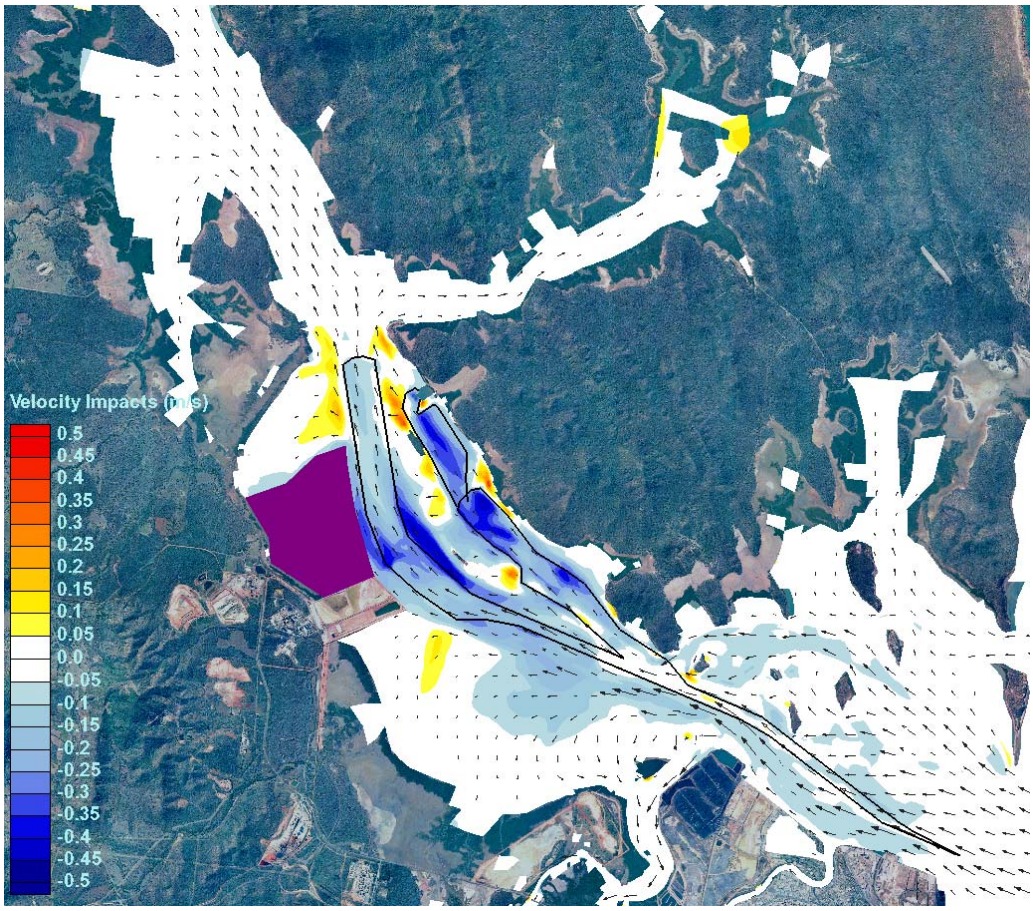

Figure 3-3 Scenario 3-2a peak flood tide velocity differences relative to the Base Case

Note: Source Figure 2-13, Appendix C

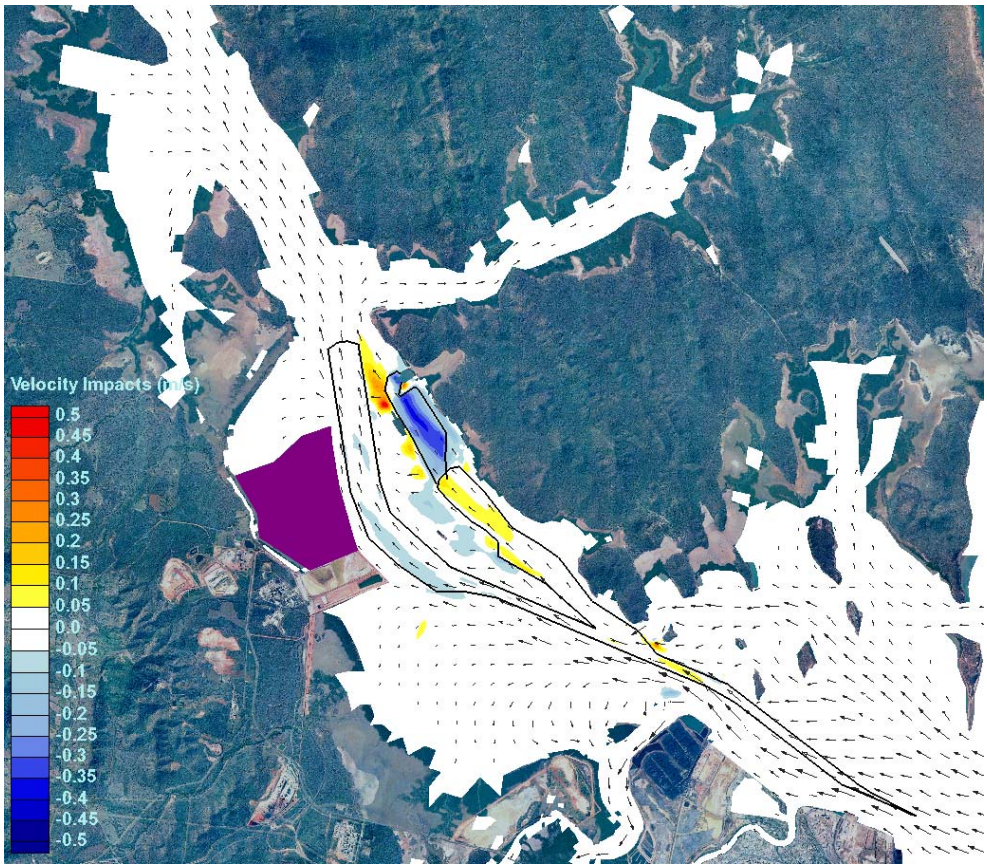

Figure 3-4 Scenario 3-2a peak flood tide velocity differences relative to Scenario 3

Note: Source Figure 2-14, Appendix C

Sediment Transport and Siltation Potential Impacts

Assessments of sand transport potential and tidal current generated bed shear stresses were undertaken in relation to morphological changes induced by the proposed reclamation and dredging scenarios. In summary:

- Potential sand transport is confined to the channels, where current speeds are sufficient to mobilise coarse sand sediments. Further general trends are described in Chapter 7 of the EIS;
- For Scenario 3-1b, the net sand transport potential in the dredged area itself decreases due to the reduction in velocities. There are small zones of increased sand transport potential on the shoals to the north-west of the BG swing basin and the shoals between the MOF dredging and the Laird Point Swing Basin upstream of North Passage Island due to increased velocities in these areas;
- For Scenario 3-2a, the small existing sand transport potential through the basin area is reduced to negligible levels although there is a slight increase through part of the MOF area which is not dredged as deep. There is a zone of increased sand transport potential across the shoals between the MOF approach channel and the Laird Point Swing Basin upstream of North Passage Island due to increased velocities in this area;

- An estimated 11,000m^3/year sand-size sediment transport potential (5,500-22,000 error bounds) is predicted for Option 1b additional dredging area. This includes the MOF approach channel with additional sedimentation due to the relative hot spot on the adjacent shoal;
- For the Option 2a dredging area, the predicted coarse material sedimentation is 24,000m^3/year (12,000-48,000 error bounds) due to the relative hot spots upstream of the MOF approach channel. At the hot spot locations, sand transported into the dredged area is expected to be deposited near the bottom of the batter;
- The Curtis Island channel upstream of South Passage Island and China Bay is predicted to experience net deposition of fine cohesive sediments;
- In Scenario 3-1b the additional dredging adjacent to the Laird Point Swing Basin including the MOF approach channel is expected to accumulate net siltation of 48,000m^3/year;
- An additional 81,000m^3/year of siltation is predicted for the quiescent areas of the APLNG Option 2a area; and
- Total additional sedimentation is estimated at approximately 60,000 m^3/year or 105,000 m^3/year for Option 1b and Option 2a respectfully.

Mitigation Strategies

Overall maintenance dredging requirements will arise from a combination of sand-sized material transported into the dredged areas where the tidal currents are sufficiently energetic and the bed material is sufficiently mobile, and silt-sized material deposited in sufficiently quiescent parts of the dredged areas. Monitoring of deposition rates and preparation of an appropriate maintenance dredging plan (refer to Section 7.3 of the EIS) that is based on increased maintenance dredging requirements from the additional dredged areas will assist in managing impacts to Port operations.

3.4 Water Resources

The introduction of additional dredged material of similar quality would not introduce any significantly different water quality (surface water and groundwater) parameters to the Reclamation Area. Therefore, it is not expected that any noticeable change in water quality from that discussed in Chapter 8 of the EIS will result from the addition of material from Option 1b or Option 2a to the Reclamation Area. Similarly, the additional dredged material is not expected to alter the stormwater runoff from the site significantly due to the Reclamation Area footprint not being changed by the Option 1b or Option 2a requirement.

Based on the assessment undertaken for this addendum, it is considered that there would be no additional impacts to ground or surface waters requiring mitigation measures, other than described in Chapter 8 of the EIS.

3.5 Nature Conservation

The Project is located within or adjacent to several marine resource management areas including the Great Barrier Reef World Heritage Area (refer to Chapter 9 of the EIS), which supports habitat for listed and threatened species as well as soft sediment benthic communities, seagrass beds and coral reefs. The primary environmental features of interest in the vicinity of the proposed Option 1b and Option 2a dredge areas are the mangroves and saltmarsh areas on Curtis Island and the seagrass habitat that occurs in several sites within the Western Basin and south of Fisherman's Landing.

3.5.1 Marine Flora and Fauna

Section 9.3 of the EIS describes marine flora and fauna in the Project Area including megafauna, benthic communities, commercial and recreational fisheries and invasive marine pests. The study area for the marine flora and fauna desktop and field surveys documented in Section 9.3 includes the Option 1b and Option 2a locations.

The intertidal zone adjacent to Option 1b and Option 2a is characterised by mangroves, open mudflat and saltmarsh, providing habitat for a diversity of species including shorebirds, reptiles, mammals and benthic invertebrates. The saltmarsh and mangrove habitat, adjacent to the proposed dredging areas, and that becomes inundated at high tide, provide important habitat to many fish species.

The Narrows and the Passage Islands survey sites (refer Figure 9-26 of the EIS) were all found to support a mixture of sediment types across the survey sites (refer Figure 9-27 of the EIS). Benthic marine communities within and adjacent to Options 1b and 2a are comprised of marine flora and fauna that live in or in close association with the benthic substrate. Subtidal habitats adjacent to the south-west corner of Curtis Island vary according to substrate type, currents and prevailing environmental conditions. It was confirmed that benthic macroinvertebrate communities across the Project Area were characterised by moderate species richness and abundance with molluscs and crustaceans being the dominant taxa. Composition at Western Basin, Fisherman's Landing and the reference areas were fairly similar but differed to those from the Narrows and Passage Islands where a greater diversity and different types of assemblage was observed.

The field surveys undertaken for the EIS confirmed the presence of seagrass at 33 of the 94 sites in the study area. A total of four species were sampled including *Z. capricornii*, *Halodule uninervis*, *Halophila spinulosa* and *H. ovalis*. *Z. capricornii* was the most widespread species, whilst *H. uninervis* was uncommon. Seagrasses to the west of Curtis Island are patchy except for immediately around North Passage Island, which supports mainly filamentous green algae but where *Halophila ovalis* and *H spinulosa* occur sporadically (refer Figure 9-30 of the EIS). Figure 9-22 of the EIS illustrates seagrasses adjacent to North Passage Island in 2002 and no seagrasses in subsequent years (namely 2004, 2005, 2006, 2007, and 2008). WorleyParsons conducted video survey, in May 2009, from Subtidal sites adjacent to Laird Point with no seagrasses encountered. Therefore, the proposed additional dredging locations for Option 1b or Option 2a are unlikely to contain any seagrass.

Matters of National Environmental Significance

Section 9.4 of the EIS discusses Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). World heritage properties, national heritage places, listed threatened species and communities and listed migratory species are described for the Project Area which includes the Option 1b or Option 2a locations. The primary impacts affecting MNES resulting from the additional dredging is removal of additional benthic habitat, decline in marine water quality, and impacts to marine megafauna from water quality impacts and vessel operations. Additional dredging increases the potential impact. Mitigation measures proposed in Section 9.4 of the EIS are also appropriate for the additional dredging.

3.5.2 Impacts and Mitigation

The potential impacts and mitigation measures associated with the Project for marine flora and fauna are addressed in Section 9.3.2 of the EIS. The additional dredging required for Option 1b and Option 2a may extend the total dredging time for the combined dredging works, but may also occur concurrently

with dredging activities described in Chapter 2 of the EIS. Direct impacts associated with the additional dredging for either Option 1b or Option 2a include loss of existing benthic habitat from the seabed, between Curtis Island and the Western Basin over the dredge Option 1b or Option 2a footprints. It is estimated that the loss of benthic habitat would be in the order of 75 ha for dredge Options 1b to 105 ha for dredge Option 2a. The removal of the existing soft sediment habitat will be partially offset by the re-establishment of benthic communities on the seabed, through recolonisation of the newly exposed sediments. These communities will be subject to routine maintenance dredging, so that navigable depths are maintained, resulting in the establishment of species that are tolerant to regular disturbance. The community composition is likely to be similar to that recorded in the existing channels during the EIS field surveys.

Dredging of Option 1b or Option 2a will also result in adverse impacts on water quality, by extending the period of elevated turbidity and increasing rates of sedimentation. Plume modelling undertaken to date suggests that plume intensity from the additional dredging will not be significantly different to that initially proposed, however the plumes may spread further northward into the Narrows and Graham Creek given the location of the Option 2a area in particular. Species most vulnerable to the increased extent and duration of elevated turbidity levels and TSS concentrations that will occur are seagrasses. The total area of seagrass potentially affected by turbidity plumes is unlikely to be different to that estimated in Section 9.3.2 of the EIS. This is because the additional dredge areas fall within the maximum predicted plume extent and dredging methodology proposed will include backhoes and/or cutter suction dredgers. The existing areas of seagrass that have been identified as vulnerable to impact are at greater risk due to the extended exposure to turbid plumes generated from cutter suction dredgers. However, these turbid plumes are significantly lower in concentration than those associated with trailer suction hopper dredgers.

Potential impacts to other species remain unchanged from the EIS. The proposed water quality monitoring described in Chapter 7 of the EIS should be adopted within the dredge management plan and implemented to minimise indirect impacts to the seagrass meadows present within the Project Area, including surrounding Option 1b and Option 2a.

Direct impacts to EPBC listed species beyond the extent described in the Chapter 9 of the EIS are unlikely, as long as the appropriate environmental management mitigation measures are followed, where applicable. Indirect impacts to the habitats of listed species, such as the Wiggins Island seagrass beds are also unlikely beyond the extent described in Chapter 9 of the EIS. Future impacts on seagrass meadows and the dependant species which utilise these habitats should again be controlled by adopting the appropriate water quality monitoring measures, including those described within Chapter 7 and Chapter 9.

3.6 Air Quality, Noise, Vibration and Greenhouse Gas Emissions

Chapter 10 of the EIS presents a description of the process for the identification and management of air quality, noise, vibration and greenhouse gas emissions associated with the Project. It was prepared in accordance with Section 3.6 *Air quality, noise and vibration* of the ToR for the Project.

3.6.1 Air Quality Potential Impacts and Mitigation Measures

As outlined in Section 10.1 of the EIS, the likelihood of significant air emissions from either construction or operation of the Project is low as the major construction activities are to be undertaken at a maximum

height of RL 7 (construction of the bund wall for the Reclamation Area), but will mostly be completed below the high water mark (dredging). The additional dredging associated with this addendum will be consistent with all dredging proposed for the Project and therefore, it is considered that there would be no additional impacts requiring mitigation measures, other than described in Chapter 10 of the EIS.

3.6.2 Greenhouse Gas Emissions and Abatement

Section 10.2 of the EIS outlines that the greenhouse gas (GHG) assessment was completed to provide a qualitative investigation of potential GHG emissions associated with the Project. The additional dredging required is up to approximately 25% greater of the overall dredging required for the Project. Therefore, to provide an estimate of the GHG emissions 15% and 25% was added to the dredging component for Options 1b and 2a respectfully. The results are presented in Table 3-2. This increased the Project's GHG emissions from 291,000 tCO_2-e (refer Table 3, Appendix T) to 334,650 tCO_2-e and 363,750 tCO_2-e for dredging of Options 1b and 2a respectfully. This equates to an additional increase of approximately 13% or 24% of GHG emissions (300,500 tCO_2-e to 344,150 tCO_2-e and 373,250 tCO_2-e for Option 1b and 2a respectfully).

Table 3-2 Estimate of GHG emissions from main sources during construction phase

GHG emission source	Approximate estimate of GHG emissions (Option 1b)	Approximate estimate of GHG emissions (Option 2a)
Transport of materials (revetment)	2,500 tCO_2-e	2,500 tCO_2-e
Embodied emissions of geotextile	300 tCO_2-e	300 tCO_2-e
On site machinery (at Reclamation Area)	6,700 tCO_2-e	6,700 tCO_2-e
Dredging	334,650 tCO_2-e	363,750 tCO_2-e
Total	344,150 tCO_2-e	373,250 tCO_2-e

Based on the assessment undertaken for this addendum, it is considered that the mitigation measures described in Chapter 10.2 of the EIS would be adequate to address the incremental increase in GHG emissions.

3.6.3 Noise Impacts and Mitigation Measures

Based on Section 10.3 of the EIS and the additional dredging locations for Option 1 b and Option 2a, the sensitive receptors would not be impacted by the additional dredging areas.

The noise modelling considered noise sources from the following activities:

- Construction of the Reclamation Area. This will not alter as a result of the additional dredge areas; therefore, it is considered that there would be no additional impact requiring mitigation measures;
- Various dredging activities: This is consistent with the additional dredge areas; therefore, it is considered that there would be no additional impact requiring mitigation measures;
- Pile driving for the beacons and channel markers to be installed: The additional dredging areas may result in additional pile driving for beacons and channel markers; however, it is considered that the

impacts will be consistent with those described in the main EIS and would not be an additional impact to sensitive receptors.

3.7 Transport

Chapter 11 of the EIS describes the likely traffic and transport infrastructure impacts from the Project and addresses Section 3.2.6 *Transport* of the ToR for the Project. The additional dredging workforce figures and haulage routes will be consistent with the figures and routes outlined in Sections 11.1 and 11.2 of the EIS.

It is expected that the total peak workforce of 225 people when four dredgers will be in operation, described in Chapter 2 of the EIS, would not increase due to the additional dredging requirements for Option 1b of Option 2a. Therefore, it is considered that construction traffic volumes would not increase. It is also considered that the haul routes and haulage traffic would not increase due to the additional dredging requirements as the Reclamation Area's footprint and location remain unchanged.

Based on the assessment undertaken for this addendum, it is considered that there would be no additional impacts requiring mitigation measures, other than described in Chapter 11 of the EIS.

3.8 Cultural Heritage

Chapter 12 of the EIS describes the process for identification and management of indigenous and non-indigenous cultural heritage associated with the Project. It has been prepared in accordance with Section 3.8 Cultural Heritage of the ToR.

3.8.1 Indigenous Cultural Heritage

The additional dredge areas for Option 1b or Option 2a lie outside the external boundaries of the Port Curtis Coral Coast (PCCC) native title claim area (namely the marine area comprising the water of Gladstone Harbour) and is not subject to a current native title claim or Aboriginal Cultural Heritage Body and was not subject to a native title claim at the time of or since the introduction of the *Aboriginal Cultural Heritage Act 2003* (the Act). Accordingly, pursuant to Section 96 of the Act, in order to identify the Aboriginal Parties for areas not located within the external boundaries of the PCCC native title claim, public notification in the form of a newspaper advertisement was required. Respondents who provide a formal response to the written and/or advertised notice within the time required under the notice must be endorsed by the sponsor as an aboriginal party to the Cultural Heritage Management Plan (CHMP).

Formal notification for the Gladstone Harbour area occurred on 10 August 2009 and the assigned period for formal responses to the public notification has closed. A number of formal responses were received by the Project within the required timeframes, and these respondents have subsequently been endorsed by the Project as Aboriginal parties for the purpose of developing a CHMP for the Project. These respondents were the applicants for the PCCC native title claimant group and other traditional owners. As there were a number of respondents in addition to the applicants for the PCCC native title claimant group and as there have not been formal meetings between the Project and all of the individual endorsed parties, it has not yet been determined whether the development of one or two CHMPs will be required for the Project. Either way, the Project is committed to working with all of the endorsed parties for the Project and it is expected that the development of a CHMP(s) for the Project will be completed pursuant to Part 7 of the Act by early 2010.

The CHMP will involve the assessment of potential Project impacts on Aboriginal cultural heritage. Protection, management and mitigation measures will be discussed by the parties following the completion of the assessment program and then developed into a specific Management Plan required under the processes outlined in the CHMP.

The Option 1b or Option 2a areas will be included as part of the Project in the development of the CHMP.

3.8.2 Non-indigenous Cultural Heritage

A review of the contextual and thematic historical research and searches of all relevant registers and databases indicates that no known historical heritage sites or places are located within or in close proximity to the additional Option 1b or Option 2a dredge areas.

It is considered that there would be no additional impacts on non-indigenous cultural heritage requiring mitigation measures, other than described in Section 12.2 of the EIS.

3.9 Social

Chapter 13 of the EIS provides an overview of the Social Impact Assessment (SIA) that has been undertaken to identify the potential impacts of the Project on the surrounding social environment. Chapter 13 directly addresses Section 4.1 of the ToR for the Project.

Early and accurate information about the additional dredge areas will be distributed to those impacted by or have an interest in the activities. In keeping with the key stakeholders that were consulted for the development of the EIS, project updates will be provided to key stakeholders who include:

- Recreational and commercial fishers;
- Environmental organisations;
- Indigenous groups;
- Local and state governments; and
- Business groups.

In addition, GPC will continue to strengthen its close working relationships with LNG proponents and other organisations that are associated with the Project.

Impacts to the recreational and commercial fishers may include reduced access to Port Curtis. Figure 13-8 of the EIS shows community site usage in the vicinity of Laird Point and North Passage Island. The area near Laird Point and into Graham Creek is used by the community for fishing and mud crabbing. The impacts potentially include reduced access during the dredging of Option 2a and when ships are at berth (depending on exclusion zones). In the case of Option 1b, access may potentially be reduced during dredging or due to the jetty structure and LNG loading pipeline from the proposed Laird Point LNG facility to the berth. Exclusion zones during loading may also potentially impede access. As discussed in Chapter 19, GPC may consider measures that offset/minimise impacts to recreational fishers as a result of the Project. This would require a coordinated approach involving local recreational fishers, representative bodies and relevant State Government agencies.

The recreational and commercial fishers will be provided with additional dredging area details, including timing, and opportunities to offer feedback to GPC management.

It is unlikely that the additional dredging will place any significant pressure on the housing market, given the current oversupply and limited number of employees associated with the overall Project. Gladstone is expected to continue its strong population growth that is characterised by high labour force participation and low unemployment. Although the Project is not expected to limit the availability of social services, affordable housing or create income inequality, these key social concerns will be monitored to ensure perceptions remain aligned with reality.

Overall, it is considered that there would be no significant additional impacts on the social environment requiring mitigation measures, other than described in Section 13.2 of the EIS.

3.10 Landscape and Visual Character

As described in Chapter 2 of the EIS, the Project will involve dredging of a total of 36 million m^3 from the Western Basin. A total of approximately 6.0 million m^3 of additional material is proposed to be dredged from within Option 1b, as part of capital dredging activities. Dredging of Option 2a would require approximately 12.8 million m^3 of capital dredging.

The Reclamation Area is conceptually designed with a total capacity of 55 million m^3. This provides additional storage capacity to allow bulking and decant of capital material and future maintenance dredge material.

Due to the design capacity of the Reclamation Area, the additional dredged material created by Options 1b or Option 2a has the potential to be accommodated.

As described in Chapter 2, the footprint of the Reclamation Area provides storage for approximately 29 million m^3 of dredge material when filled to RL7 LAT. The additional dredge storage will be accommodated by shaping the dredge material into a 50-70m high mound. The mound would have a 1:6 batter and be vegetated with grasses and trees as soon as practicable. Chapter 2 of the EIS provides a conceptual design of the Reclamation Area. However, detailed design will be undertaken to confirm capacity potential.

Chapter 14 and Appendix X of the EIS provide a detailed Landscape and Visual Character Assessment particularly addressing the potential impact the Reclamation Area will have on surrounding sensitive receptors.

As the maximum capacity of the Reclamation Area has the potential to include the additional dredge material, assessment and proposed mitigation measures stated in Chapter 14 remain valid.

3.11 Economic Impact

Chapter 15 of the EIS provides an economic assessment in accordance with Section 5.1 of the ToR.

Continued growth in the construction industry is expected within the Gladstone region and the scope of the project supports such an approach. This project has been developed with reference to the diverse range of existing and proposed industries within the Port of Gladstone's Western Basin. In addition to the seven proposed LNG proponents and existing industries, it is possible that an industry of greater or lesser size could develop in the area.

The intention to expand the Port of Gladstone, including the additional dredging areas, will reinforce its position as the region's most significant piece of infrastructure, thereby strengthening direct benefits

within local and state economies. This situation is not changed by the inclusion of the additional dredge areas for Option 1b or Option 2a.

3.12 Health and Safety

Based on the assessment undertaken for this addendum, it is considered that there would be no additional impacts requiring mitigation measures, other than described in Chapter 16 of the EIS. Dredging activities for the Option 1b or Option 2a areas will be managed by GPC as for other dredging described in Chapter 2 of the EIS.

3.13 Hazard and Risk

Chapter 17 of the EIS provides a qualitative risk assessment of potential hazards and risks associated with the Project and identifies actions for mitigating or reducing the hazards and risks. Based on the assessment undertaken for this addendum, it is considered that there would be no additional impacts requiring mitigation measures, other than described in Chapter 17 of the EIS. The risk profile of some of the risks may change as a result of the additional dredging. These aspects have previously been discussed in this addendum report. GPC will continue the assessment of hazards and risks throughout the Project life to refine and update the outcomes of risk process.

4. Environmental Management Plan

The Environmental Management Plan developed for the Project outlines Gladstone Ports Corporation's environmental management commitments for the construction and operational phases of the Project. The Environmental Management Plan summarises the potential impacts from construction of the bund wall, filling of the bund and dredging activities and the relevant management mitigation measures to be implemented to manage each of the respective impacts.

To manage the cumulative impacts from dredging associated with the Project and either Option 1b or Option 2a, a dredge development plan will be developed. As discussed in Section 3, the dredge management plan will include daily monitoring of sensitive sites most likely to be affected by the dredge and appropriate trigger values that have been derived in consideration of changes in incident light levels on the seabed during dredging and the duration of the associated impact. It is recommended that additional monitoring sites be located in The Narrows and Graham Creek to monitor the dredging impacts associated with backhoe and/or cutter suction dredging for dredging Options 1b or 2a.

Maintenance dredging requirements will increase as a result of the additional Option 1b or Option 2a areas. Monitoring of deposition rates and preparation of an appropriate maintenance dredging plan that is based on increased maintenance dredging requirements from the additional dredged areas is required.

5. Conclusions

The potential impacts for the additional dredging of Option 1b or 2a include:

- Increased dredging with the estimated quantity of dredge material for Option 2a being 12.8 million m^3 (0.7 million m^3 for MOF and 12.1 million m^3 for berths, swing basin and approach channel) and for Option 1b being 6.0 million m^3 (1.4 million m^3 for MOF and 4.4 million m^3 for berth and swing basin);
- Possible extension of the accumulative dredging of time up to 16 months across the duration of the Project;
- Loss of existing benthic habitat, of approximately 75 ha for dredge Option 1b to 105 ha for Option 2a, from the seabed in the additional dredged areas;
- Adverse impacts on marine water quality, by extending the period of elevated turbidity due to dredging with backhoes or cutter suction dredgers;
- Increase in sedimentation, of approximately 60,000m^3/year or 105,000 m^3/year for dredge Option 1b and Option 2a respectfully, within the Western Basin, leading to increase of annual maintenance dredging;
- Increase in capital dredge material to be placed in the Reclamation Area;
- Increase in GHG emissions of approximately 13% or 24% for dredge Option 1b and 2a respectfully; and
- Access impacts for recreational and commercial fishing in the Fisherman's Landing, Passage Islands and Laird Point areas.

Considering the environmental values, the existing environmental conditions and the impacts identified in the body of the EIS, the majority of the management measures identified as part of the Project will also adequately address the measures required as part of the additional dredging works, within either Option 1b or Option 2a. The additional dredging may increase impacts to marine water quality and hence, it is important that dredge planning and management includes appropriate monitoring and comparison against water quality trigger values for impact identification.

The coordinated approach that GPC has proposed for determining measures to offset/minimise impacts due to the Project will include consideration of the additional dredging area.

6. References

ANZECC/ARMCANZ (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand), (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 1. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. Canberra, ACT, Australia.

Apte, S., Anderson, L., Andrewartha, J., Angel, B, Shearer. D., Simpson, S., Stauber, J & Vincente-Beckett, V 2006, Contaminant pathways in Port Curtis, Technical Report no. 73, Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management, Indooroopilly, Qld. (As viewed on 12/6/2007). http:// www.coastal.crc.org.au/ pdf/ TechnicalReports/73_PC_contaminants.pdf.

Apte, S., Duivenvoorden, L., Johnson, R., Jones, M.-A., Revill, A., Simpson, S., Stauber, J. & Vicente-Beckett, V. (2005) Contaminants in Port Curtis: Screening level risk assessment. Technical Report No. 25, CRC for Coastal Zone, Estuary and Waterway Management, Brisbane, 146 pages.

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging, Commonwealth of Australia, Canberra, 2009.

DEH (1998). Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland. Queensland Government Department of Environment, Brisbane.

EPA/QPWS (2002). State Coastal Management Plan – Queensland's Coastal Policy. Environmental Protection Agency. http:// www.derm.qld.gov.au/ environmental_management/ coast_and_oceans/ coastal_management/ state_coastal_management_plan.

EPA/QPWS (2003). Curtis Coast Regional Coastal Management Plan. Environmental Protection Agency. http://www.derm.qld.gov.au/register/p00528bm.pdf

EPA (2006). Queensland Water Quality Guidelines 2006 – Minor Updated March 2007. Queensland Government Environmental Protection. (http:// www.epa.qld.gov.au/ publications/ p01818.html).

EPP (Water) 2009. Environmental Protection (Water) Policy 2009. Subordinate Legislation 2009 No. 178. http://www.legislation.qld.gov.au/LEGISLTN/SLS/2009/09SL178.pdf.

Jones, M-A., Stauber, J., Apte, S., Simpson, S., Vincente-Beckett, V., Johnson, R. & Duivenvoorden, L. 2005. A risk assessment approach to contaminants in Port Curtis, Queensland, Australia. Marine Pollution Bulletin 51, 448 458.

Rasheed, M.A., Thomas, R., Roelofs, A.J., Neil, K.M. and Kerville, S.P. (2003) Port Curtis and Rodds Bay seagrass and Benthic Macro-invertebrate Community Baseline Survey, November/December 2002. Department of Primary Industries and Fisheries Information Series QI03058.

URS (2009). Marine Sediment Investigation. Environmental Investigations of Proposed Capital Dredging at China Bay and Pipeline Crossing at the Narrows, Gladstone. Prepared by URS for Santos Ltd, January, 2009.