Rio Tinto Alcan

Appendix 7-C

Port Dredge Management Plan

Rio Tinto Alcan

South of Embley Project

DRAFT DREDGE MANAGEMENT PLAN – PORT

(INITIAL CAPITAL DREDGING)

February 2013

CONTENTS

FIGURES

TABLES

1 INTRODUCTION

The South of Embley (SoE) Project involves the construction and operation of a bauxite mine and associated processing and Port facilities to be located near Boyd Point on the western side of Cape York Peninsula. The SoE Project would be developed and operated by RTA Weipa Pty Ltd, which is a wholly-owned subsidiary of Rio Tinto Aluminium Limited. A detailed description of the Project is provided in the SoE Project's Queensland Environmental Impact Statement (EIS) (RTA 2011), the Supplementary Report to the Queensland EIS (RTA 2012), and the Commonwealth Environmental Impact Statement (RTA 2013).

The SoE Project requires the construction and operation of a new Port facility located between Boyd Point and Pera Head (refer **Figure 1**). The marine works will include construction of a jetty, wharf and ship loaders, requiring dredging for berth pockets and approach/departure channel. The initial capital dredge area and volumes required for the Port facility are shown on **Figure 2**.

The initial capital dredging and spoil disposal program would involve the removal and relocation of up to approximately 2.6 million cubic metres of marine sediments to a proposed new spoil ground offshore at the location indicated in **Figure 1** over a period of approximately 24 weeks.

The purpose of this Dredge Management Plan (DMP) is to provide details on the environmental management aspects of the initial capital dredging and spoil disposal activities to be undertaken as part of the this Port development. It details the environmental management and monitoring that would be implemented throughout the initial capital dredging and spoil disposal program to be undertaken by RTA for the Port as part of the SoE Project.

1.1 Commonwealth and State Approvals

The Project was declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) on 29 October 2010. This decision was revoked and substituted on 16 March 2012 and new *Tailored Guidelines for the preparation of the Draft Environmental Impact Statement* (the 'Tailored EIS Guidelines') were issued in July 2012.

The Commonwealth *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act) regulates the loading and dumping of spoil from dredging operations in Australian waters. In accordance with Section 160 of the EPBC Act, the Minister has determined that an assessment under Part 8 of the EPBC Act is required in relation to the issuing of a permit under the Sea Dumping Act. The Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) has advised that, for the purposes of efficiency, the Commonwealth EIS be scoped such that it meets the requirements of the Sea Dumping Act, such that one assessment is required.

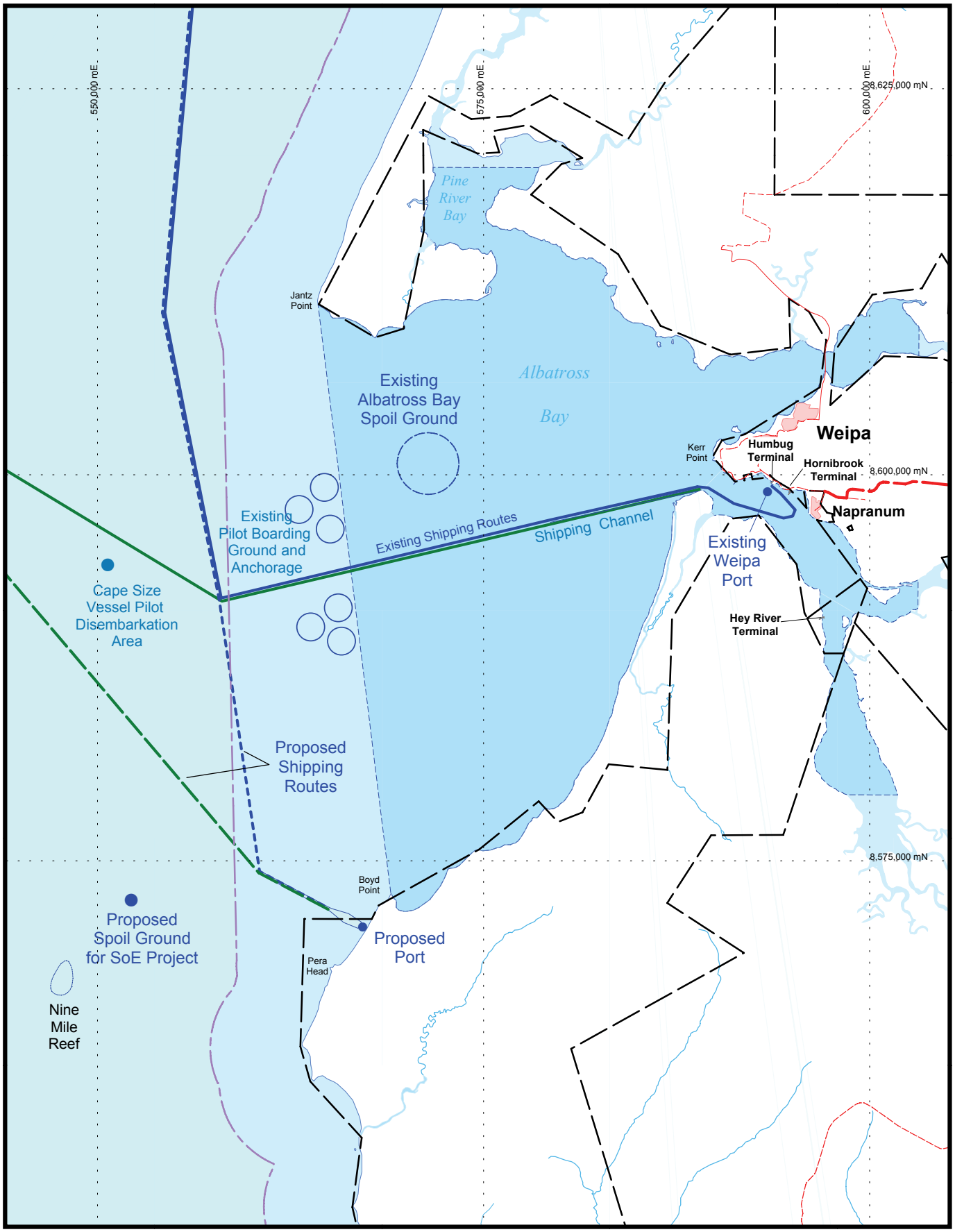
RTA submitted an application for a Sea Dumping Permit for Stage 1 of the Port facility (up to 6.5 million cubic metres) to DSEWPaC in October 2010 and amended it on 31 October 2011 for the realignment of the dredge channel. The Commonwealth EIS (RTA 2013) reflects a reduced initial capital dredge program of 2.6 million cubic metres.

Detailed sediment characterisation reports have been provided separately to DSEWPaC and the Queensland Department of Environment and Heritage Protection (EHP). Separate Sea Dumping Permit applications would be sought in the future, if required, for subsequent capital and / or maintenance dredging of the Port.

The Project has been declared a "significant project" for which an EIS was required pursuant to section 26(1)(a) of the *State Development and Public Works Organisation Act 1971* (Qld)

(SDPWO) Act. Following assessment of the information provided in the Queensland EIS and Supplementary Report and in consultation with the relevant referral agencies, the Queensland Coordinator-General released a report (the 'CG's Report') on 23 May 2012 (Queensland Government 2012). The CG's Report sets the framework within which other Queensland Government approvals are to be sought and the conditions for the prevention, minimisation and management of environmental impacts.

Development Approval is required for dredging under the *Coastal Protection and Management Act 1995* and *Sustainable Planning Act 2009* (Qld) for any section of the departure channel for the Port which is outside the mining lease and inside the coastal waters of Queensland. An Environmental Authority is also required under the *Environmental Protection Act 1994* for dredging on the mining lease. The Queensland Coordinator General stated conditions for these approvals requiring a Dredge Management Plan to be developed. This DMP supports applications for the Sea Dumping Permit and Development Approvals and will address the conditions stated by the Queensland Coordinator General.



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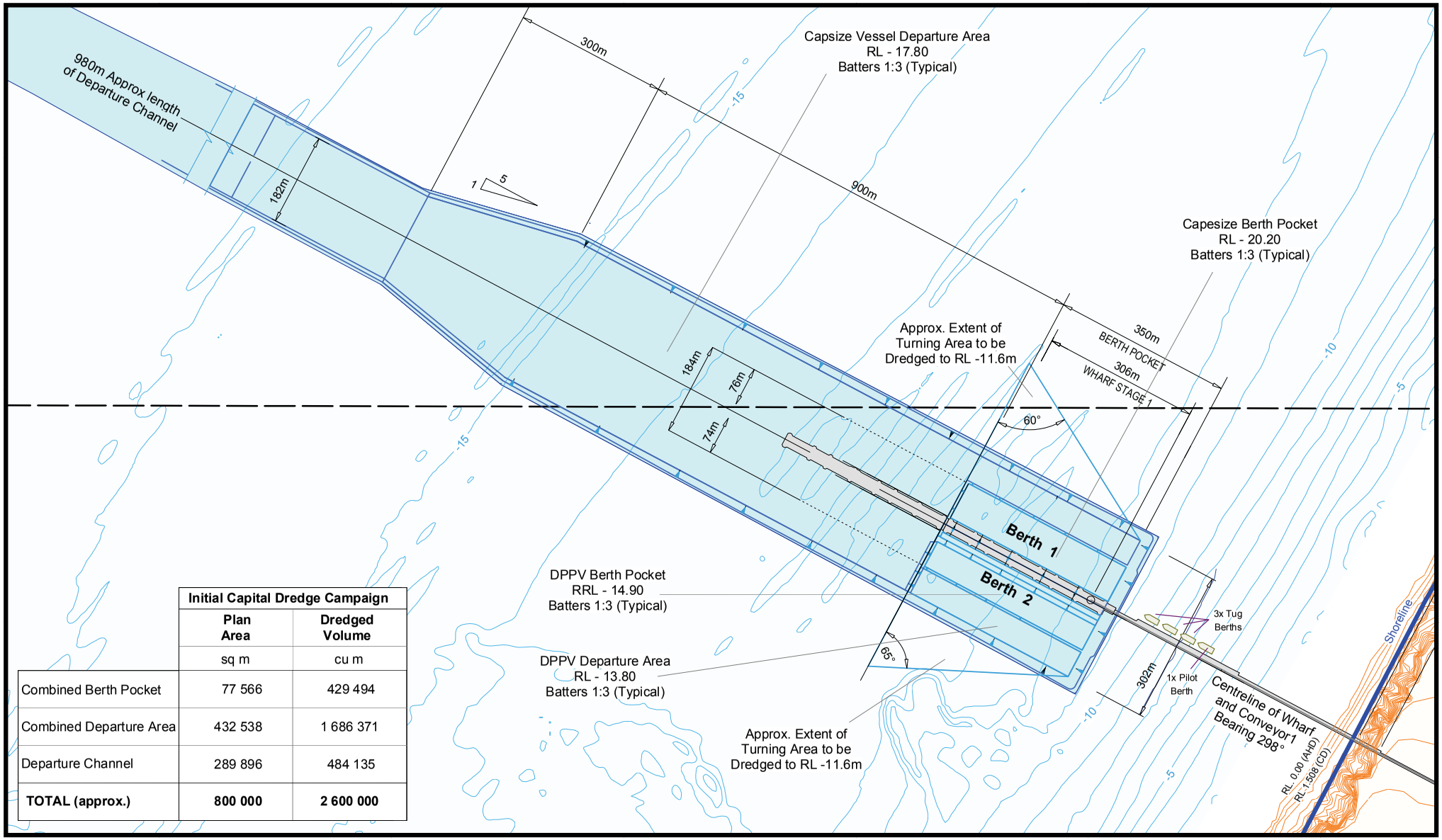
South of Embley Project

Fig. 1: Port, Spoil Ground and Mooring Locations



	Initial Capital Dredge Campaign	
	Plan Area	Dredged Volume
	sq m	cu m
Combined Berth Pocket	77 566	429 494
Combined Departure Area	432 538	1 686 371
Departure Channel	289 896	484 135
TOTAL (approx.)	**800 000**	**2 600 000**

NOTES:

Vertical Datum:
Depths are in metres and are reduced to chart datum (CD) which is approximately the level of lowest astronomical tide (LAT).
CD (LAT) is 1.508m below AHD.

N

0 100 200 300m

Data Source: 501-S0-1710-00100_00G.DXF

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South of Embley Project

Fig. 2: Port Layout (Initial Capital Dredge Campaign)

Datum/Projection: GDA94/MGA Zone 54

Date: 02/10/2012

2 DREDGING AND SPOIL DISPOSAL DESCRIPTION

2.1 Location and Proposed Volumes of Dredging and Spoil Disposal

The proposed Port site is 40km south of Weipa between Boyd Point and Pera Head on RTA mining lease ML7024. The proposed shipping channel would extend outside the mining lease into the coastal waters of Queensland (**Figure 1**). The proposed new spoil ground is approximately 17km offshore from the proposed Port near the 25m depth contour (**Figure 1**). It would cover a circular area of approximately 3km^2 within the Commonwealth marine area.

The proposed volume of material required to be removed for initial capital development of the proposed new wharf facilities, including berth pocket, swing basin and departure channel, and disposed of at the proposed new spoil ground is approximately 2.6 million cubic metres. The initial capital dredge area and volumes of the proposed Port are shown in **Figure 2**.

2.2 Dredging Methodology and Equipment

It is proposed that dredging would be conducted over a 24 week period following receipt of relevant Project approvals. The 24 weeks of dredging does not allow for any delays that may occur due to breakdowns or stand-downs which could result from adverse weather conditions

Dredging methodology will depend on equipment availability and suitability. Two methods were assessed for the Commonwealth EIS (RTA 2013) as follows:

1. CSD and TSHD - A large self-propelled Cutter Suction Dredger (CSD) would be required to dredge the hard clays and siltstones. The CSD would be solely used to break up the hard substrate, with the dredged material re-deposited directly on the sea bed behind the submerged pump of the cutter dredger. A Trailing Suction Hopper Dredger (TSHD) would be used to pick up the crushed material deposited by the CSD and load the material into its hopper. The loaded TSHD would transport dredged material to the offshore spoil ground for marine disposal. The nominal hopper capacity would be approximately 11,500m^3, with a "green valve" allowing overflow discharge during loading to occur at the keel level of the vessel.
2. CSD and SHB - An alternative dredging method with the use of the CSD loading directly into four self-propelled split hopper barges (SHBs) has also been assessed. This CSD would be of similar size to that used in the CSD and TSHD combination; however, material would be loaded directly into the SHBs during dredging. The nominal capacity of the four separate SHBs used in this arrangement would be approximately 3,700m^3, with these vessels capable of overflowing at the keel level due to the presence of the same "green valve" system present on the TSHD.

The method will be confirmed following engagement of the dredging contractor and included in the final Dredge Management Plan. Once the TSHD or SHB is filled with dredged material the vessel would then relocate the material to the proposed new spoil ground. Upon entering the designated area for disposal, the vessel would slow whilst material is being placed, however, a minimum steaming speed is required to maximise agitation within the hopper to clear the dredged material, which would not otherwise be effected if the dredge were to remain stationary.

Once the dredge has been emptied and cleared of dredged material the vessel would return to the dredge site to collect the next load.

Figure 3 shows the proposed cut levels and sediment profile. **Figure 4** shows the schedule of dredger operation times for the two methodologies. For layers 2-4 the time series has been set up such that the departure channel is dredged first before moving into the Berth Pockets and Departure Area. This allows the CSD and TSHD to alternate areas and work on different sections at the same time.

2.3 Disposal Management Measures

In order to minimise potential turbidity impacts at the proposed new spoil ground a number of practical measures to reduce loss of bulk material into the marine environment during dredging operations would be implemented:

- specifications for the TSHD used during dredging would include low wash hull-design, below keel discharge and electronic positioning systems;
- taking loaded vessels to the proposed new spoil ground and discharging material as soon as possible to minimise clays settling and adhering to the hopper lining; and,
- developing a spoil dumping plan to manage even distribution of material over the spoil ground.

The management response processes detailed in **Section 6.1** would also provide management measures to control dredge plume impacts on the receiving environment.

Figure 3: Longitudinal Sediment Profile along Dredging Footprint

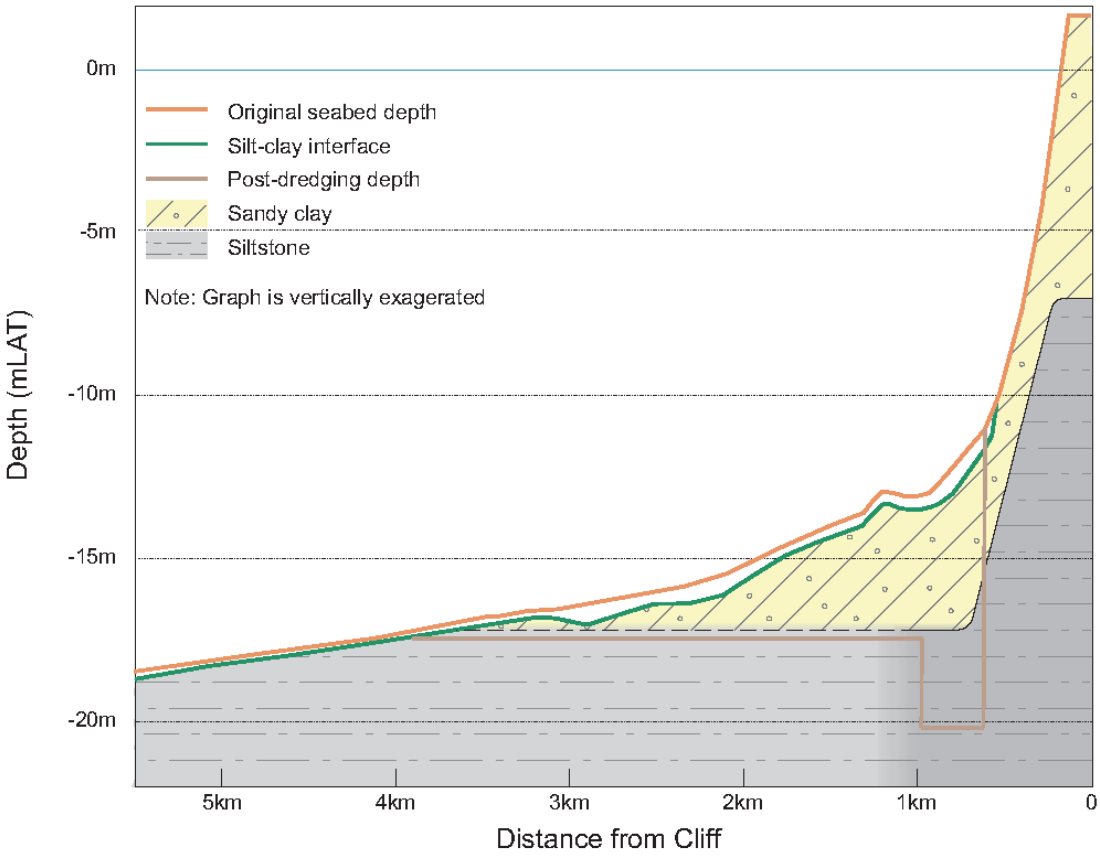
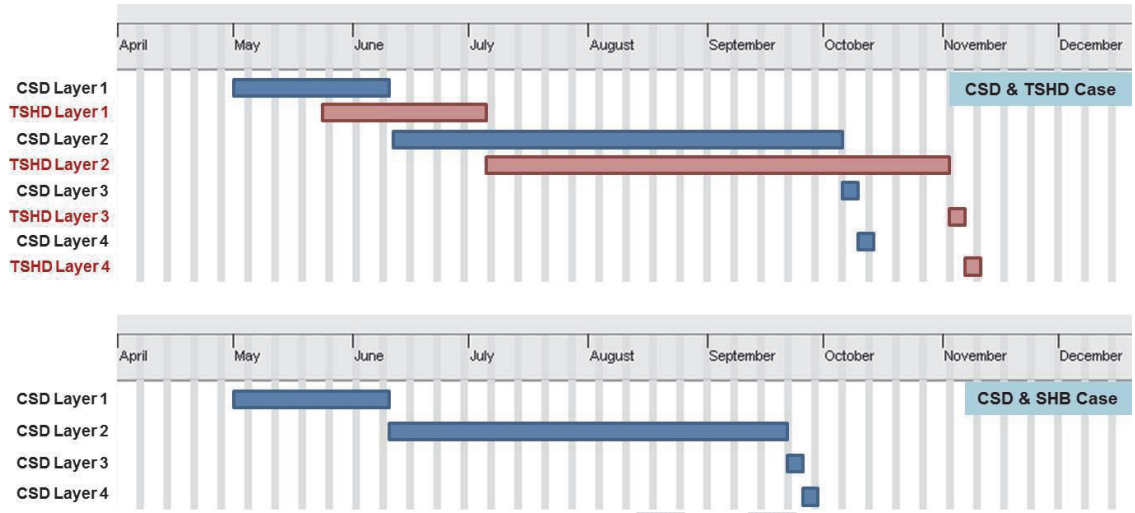


Figure 4: Modelled Dredge Time Series



3 SEDIMENT CHARACTERISATION

Sediment sampling and analyses has been completed at the Port facility location (Worley Parsons 2012). The assessment of dredged material is consistent with the assessment guidance described in National Assessment Guidelines for Dredging (NAGD) (Commonwealth of Australia 2009), Annex 2 of the London Protocol, and the Waste Specific Guidelines for Assessment of Dredged Material (IMO 2000).

RTA submitted a sampling and analysis plan (SAP) to DSEWPaC (formerly DEWHA) on the 19 September 2007 for the proposed Port. Sampling was completed in October 2007 and a sediment characterisation report was supplied to DSEWPaC in February 2008.

In 2009, RTA modified the proposed wharf design and footprint of the dredge area at the Port site to accommodate dedicated Post Panamax Vessels, generic Panamax, smaller river class vessels and tug berth facilities for two pull tugs. Following from these amendments, a supplementary SAP was submitted to DSEWPaC and approved on 27 July 2009. The supplementary SAP detailed the need for further sediment sampling required as a result of the increased dredge footprint, dredge depth and volume. Sampling was completed in June 2009.

Following further feasibility study of the Project, RTA proposed to further develop the Port to accommodate Cape size vessels, loaded to a draft of up to 18.1m (up to 6.5 million cubic metres of dredging). As a result, a SAP was prepared for the extended dredge area and submitted to DSEWPaC. This SAP was approved on 8 June 2010 and implemented on 18 June 2010.

In addition, changes have recently been made to the Project in the form of realigning the wharf structure so that it remains within the boundary of the mining lease. The realignment has resulted in the wharf being shifted two degrees south of the area originally assessed. Essentially this relocates the seaward end of the shipping channel south by approximately 250m but does not impact on the design (i.e. dredge volumes, areas, etc.). In light of these changes, in a letter dated 31 October 2011, RTA sought an exemption from DSEWPaC for further sediment sampling and this exemption was granted on 20 January 2012. The sediment characterisation report has been updated to incorporate the changes and address any comments received from DSEWPaC. It should be noted that the current proposal (an initial capital dredge campaign of 2.6 million cubic metres) is within the footprint of the approved realignment. The number of locations sampled within the dredging area was determined with regard to the volume of 'potentially contaminated' sediments (i.e. sediments that could contain contaminants above background) within the dredge footprint. For capital dredging projects this is typically based on the volume of material within the top 1m of sediment over the dredge area. Previous surveys in the area have identified that there is a thin silt surface layer of 0.1-0.5m overlying firm clays. As anthropogenic contaminants would not likely be able to penetrate the stiff underlying clays the depth of 'potentially contaminated' material has been limited conservatively to 0.5m. Given the previously proposed dredge footprint of 1,460,062m^2 for 6.5 million cubic metres, this equates to a volume of 730,031m^3 of 'potentially contaminated' material for which Table 6 of the *National Assessment Guidelines for Dredging* (NAGD; Commonwealth of Australia, 2009) requires a minimum of 17 sample locations. The sampling program has exceeded this criterion, collecting sediments at 20 locations. Sampling was also completed at the proposed new spoil ground to provide background concentrations prior to disposal activities. Seven sample locations were randomly selected in accordance with the minimum requirements of the NAGD. Samples were only collected for the surface sediments (0 - 0.1m).

According to the approved SAP, sample material for laboratory analyses was to be taken from the following horizon depths 0.0-0.5m; 0.5-1.0m; 1.0-2.0m; 2.0-3.0m, and 3.0-4.0m. Refusal of

the vibrocore on stiff substrate limited the number of horizons submitted for laboratory analyses to one, 0.0 – 0.5m. Samples within the dredge area were collected using a boat deployed vibrocorer; with an internal diameter of 50mm and an internal barrel length of 4m. At each location, one to three vibrocores were taken to obtain the necessary sample volume for chemical and physical analysis. In the event that vibrocore penetration into the sediments was limited, a stainless steel van-Veen grab sampler was deployed to collect additional surface material. Sediments within the proposed new spoil ground were collected using the van-Veen grab sampler.

Sediment samples were transported under refrigerated conditions to the primary laboratory Australia Laboratory Services (ALS) and to the secondary analytical laboratory Advanced Analytical Australia (AAA), within relevant holding times. All sediments were analysed for particle size distribution (PSD), moisture content, metals and metalloids (Ag, Al, As, Cd, Cu, Co, Cr, Fe, Mn, Pb, Hg, Ni, Sb, Se, V and Zn).

Study results showed that inshore sediments were characterised as being dominated by silt and clay fractions (84%). At a distance of approximately 4km from shore, the sediments become dominated by the sand fraction (66%). The depth of unconsolidated surface silts overlaying consolidated clays is on average 0.25m thick (range 0.05 – 0.54m).

Utilising the assessment framework provided in the NAGD (Commonwealth of Australia, 2009) the analytical results for all contaminants and their 95% UCLs of the mean were found to be below the relevant NAGD screening levels. There were no concentrations that exceeded any of the NAGD screening levels at individual sampling locations.

In addition, elutriate and dilute acid extraction (DAE) analyses were conducted in parallel with the screening level assessment for each sample collected within the Port dredge area due to previous data that identified values outside NAGD screening levels. DAE analysis shows that all metal and metalloid contaminants tested were below NAGD screening levels at each sampling location, indicating that contaminants are not readily bioavailable and are acceptable for unconfined disposal at sea.

Based on the assessment completed, dredged material is considered chemically suitable for unconfined disposal at sea.

4 EXISTING ENVIRONMENT

4.1 Past and Current Uses

The Port development site is a remote and undeveloped area and as such there are few potential contaminant sources either from shipping activity or land use. As such it would be expected that there should be no anthropogenic contaminants in the sediments to be dredged and concentrations should represent natural background levels.

The proposed new spoil ground has not been previously used for disposal of dredged spoil.

4.2 Water Quality

4.2.1 Proposed Port Area

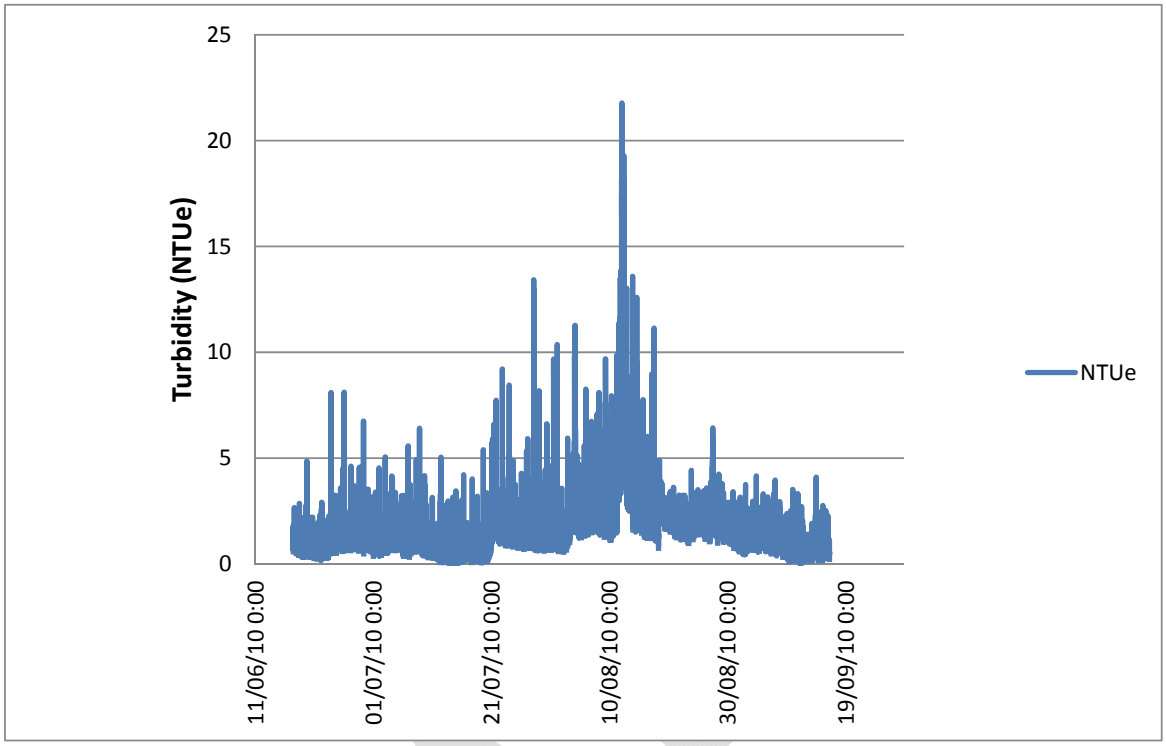
The sediment characterisation results (Worley Parsons 2012) show there would be negligible change in water quality at the proposed Port site resulting from dredging of the sediments, apart from turbidity (suspended sediments). Any potential impacts in this area would result from increased suspended sediment plumes and sedimentation.

Table 1 shows a summary of the background turbidity and TSS at sites in the proposed Port area and at the nearest reef areas, Pera Head and Boyd Point. The data shows higher turbidity and Total Suspended Solids (TSS) in the wet season compared to the dry season with maximum TSS in the wet and dry seasons of 755mg/L and 154mg/L, respectively. **Figure 5** shows the range of background turbidity in the dry season (June to September) at Pera Head as monitored in 2010.

Table 1: Summary of background water quality near the proposed Port

Location	Season	Parameter	Median	80%ile	Minimum	Maximum
Port area	Wet season	Turbidity	15	38	<0.1	503
		TSS	22.5	56	<1	755
	Dry season	Turbidity	6	11	<0.1	79
		TSS	9	16	<1	119
Pera Head	Wet season	Turbidity	2.2	23	<0.1	339
		TSS	3.3	34.4	<1	509
	Dry season	Turbidity	1.2	2.1	<0.1	22
		TSS	1.8	3.1	<1	33
Boyd Pt (Chalco data)	Wet season	Turbidity	14	39	0.2	225
		TSS	18	56	<1	338
	Dry season 2007	Turbidity	2.4	nd	<0.1	103
		TSS	3.6	nd	<1	154

Figure 5: Background Dry Season Turbidity (Pera Head)



Periods of high turbidity (and TSS) result in corresponding periods of photosynthetically active radiation (PAR) below detection limits (effectively zero). **Figure 6** shows the reef area at Pera Head during the 2007 to 2008 wet season (December to March) had elevated background turbidity and zero PAR for 27 days followed by 12 days of available light up to 100µE/cm^2 and a further period of 24 days of high turbidity and zero PAR. The reef at Boyd Point showed very high background TSS corresponding to the same periods of zero PAR (**Figure 7**).

Figure 6: Background Wet Season Turbidity and PAR (Pera Head)

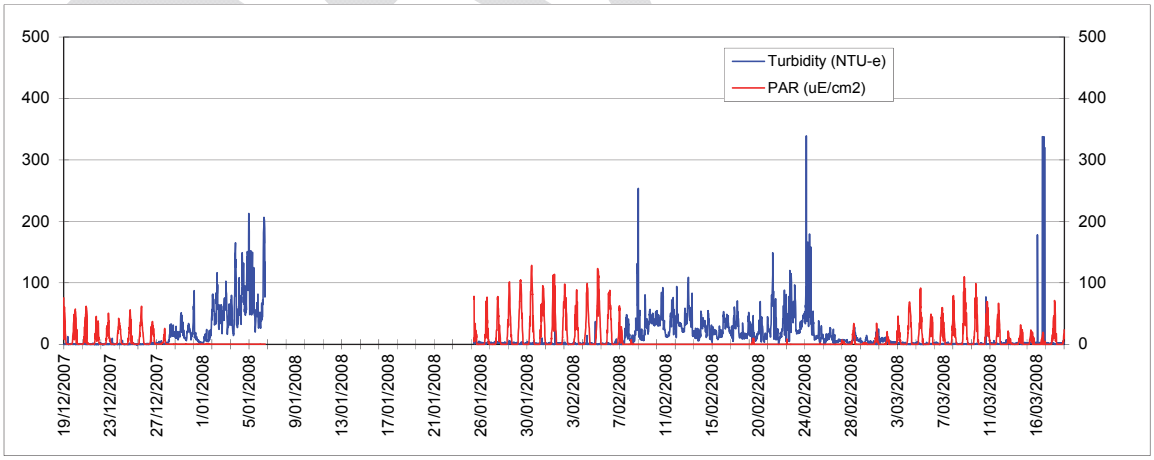
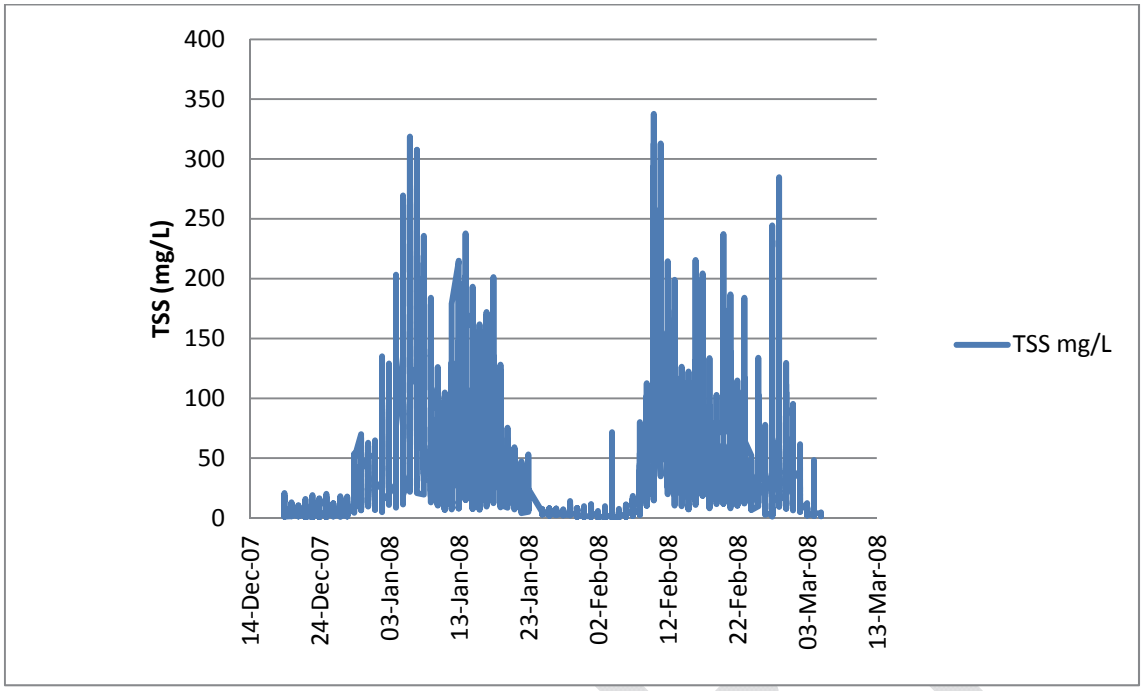


Figure 7: Background Wet Season TSS (Boyd Point) (PAR not shown)



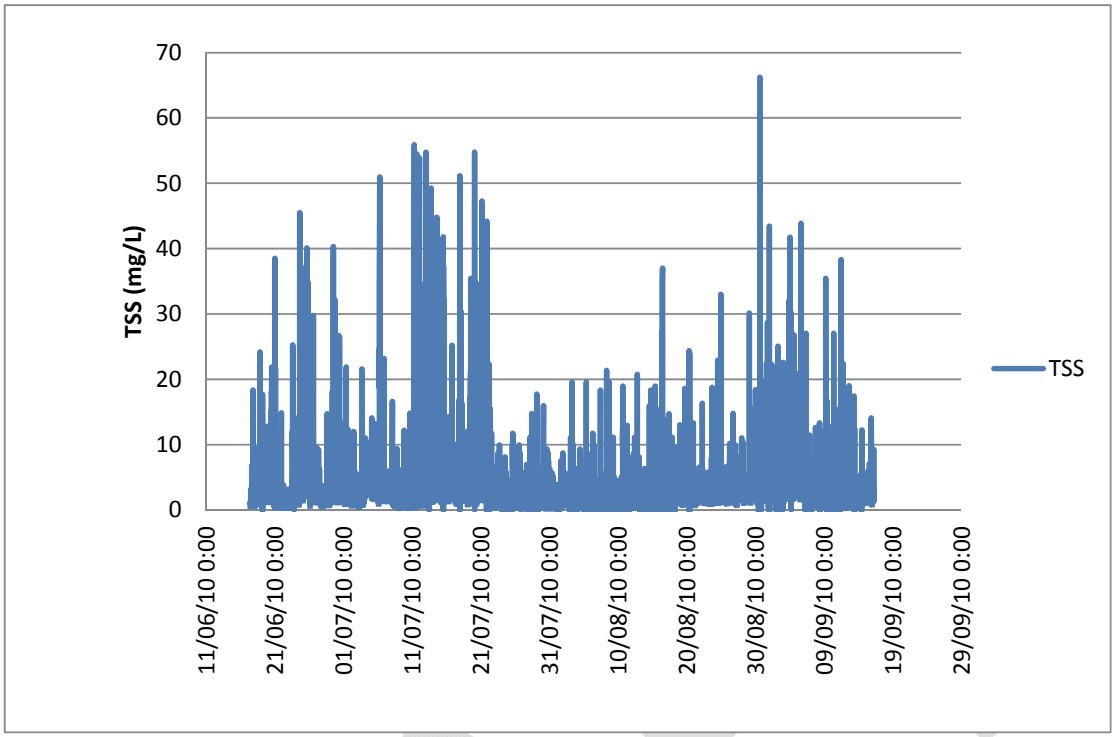
4.2.2 Proposed Spoil Ground

Baseline turbidity has been monitored in the wet and dry season at the proposed new spoil ground with TSS calculated based on a calibration coefficient where 1.5mg/L TSS equals 1 NTUe. **Table 2** shows the background turbidity and TSS is lower under dry season conditions compared to wet season conditions. **Figure 8** and **Table 2** show the background dry season TSS ranges from <1 to 66mg/L.

Table 2: Summary of background water quality at the proposed new spoil ground

Season	Parameter	Median	80%ile	Minimum	Maximum
Wet (Nov 2007- Mar 2008)	Turbidity (NTUe)	5.3	27	<0.1	149
	TSS (mg/L)	7.9	40	<1	224
Dry (Jun – Sep 2010)	Turbidity (NTUe)	1.4	2.5	<0.1	44
	TSS (mg/L)	2.1	3.7	<1	66

Figure 8: Background Dry Season TSS (Proposed Spoil Ground)



4.3 Inshore and Offshore Marine Habitats

Section 6.3 of the Queensland EIS (RTA 2011), Section 6.1 of the Supplementary Report of the Queensland EIS (RTA 2012), and Section 7.2 of the Commonwealth EIS (RTA 2013) details the key benthic marine reef habitats in the Port development and proposed new spoil ground.

Near shore fringing reef communities in the vicinity of the proposed Port area occur at Boyd Point, Pera Head and between Pera Head and Thud Point. These comprise both reefs containing hard corals and low profile reefs containing soft coral-sponge assemblages. **Figure 9** and **Table 3** show the reefal areas between Boyd Point and Pera Head. The importance of these reef systems (Boyd Point to Thud Point) in a regional context may be considered to be high as they support resources that are of conservation, cultural, commercial and recreational importance. In particular, the near shore sponge and soft coral reefs provide a food resource for a range of marine turtle species in the area.

The development footprint for the Port facility has been confirmed by field surveys with drop cameras and towed video as consisting primarily of soft sediment habitats that contain sparse epifauna typical of soft sediments, such as seapens and tube-dwelling anemones, soft-corals or sponges. These areas can also contain diverse and abundant assemblages of macrobenthic infauna. No seagrass was recorded in this area, (refer Section 7.2.7.1 in the Commonwealth EIS (RTA 2013).

The proposed new spoil ground contains unvegetated soft sediments and is not considered sensitive marine habitat.

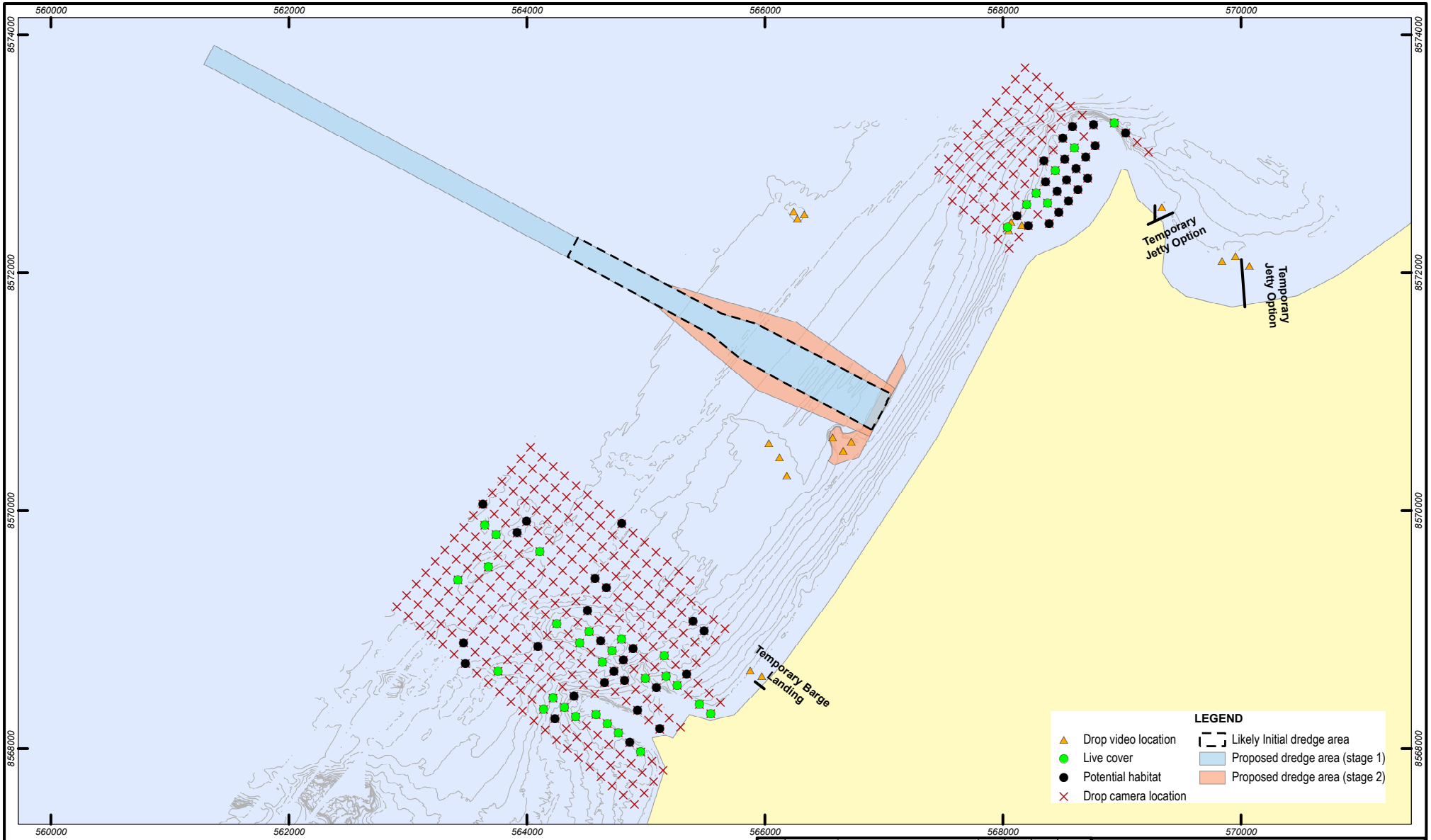
Within the vicinity of the Port and the proposed new spoil ground, Nine Mile Reef and the "Three Mile" recreational and charter fishing area are accessed frequently by recreational fishers.

Table 3: Inshore Reef Areas and Extent of Dominant Benthic Assemblages

Location	Total estimated substrate available for reefal colonisation (ha)	Estimated % Hard coral cover	Estimated Total Hard Coral (ha)	Estimated % Soft coral cover	Estimated Total Soft Coral (ha)	Estimated % Sponge cover	Estimated Total Sponges (ha)
Boyd Point	49	4.2%	2.1	2.7%	1.3	2.1%	1.0
Port area (between Boyd Point to Pera Head)[1]	23	0%	0	1.0%	0.2	1.8%	0.4
Pera Head	72	6.2%	4.5	6.3%	4.5	3.7%	2.7
South from Pera Head to Thud Point (inferred)[2]	274	6.2%	16.9	6.3%	17.2	3.7%	10.2

1 The estimate of reefal area available, and estimates of live cover for the Port area was based on a review of only six video transects (with limited resolution). Refer Section 6.1.2 of the Queensland EIS (RTA 2011) for details.

2 The estimated reefal area available for colonisation south from Pera Head to Thud Point was inferred from analysis of aerial photographs. As there is no direct data on live cover from this area, the estimates are based on the maximum percentage cover from the areas where data was available.



Source information:
Bathymetry supplied by Matrix Consulting.
Boyd Point dredging plan based on 501-S0-1710-00100_00G.DXF supplied by client 2012

While every care is taken to ensure the accuracy of this data, WorleyParsons makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.

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Kilometers

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GDA 1994 MGA Zone 54

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Rev	Date	Revision Description	DRN	CHK	ENG	APPD
0	14/03/2013	Issued for use	NEA	MM		

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SOUTH OF EMBLEY PROJECT

Figure 9: Reefal Habitat Between Boyd Point and Pera Head

Project No: 301001-01069	Figure: 01069-00-GM-DAL-0065	Rev: 0

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5 POTENTIAL IMPACTS

5.1 Turbidity Plume Generation Modelling

At the proposed Port site and the proposed new spoil ground, a turbid plume would eventuate as material is released to the water column during the dredging and disposal operation. The potential impacts of dredging and spoil disposal on water quality, through assessment of TSS concentration and sedimentation was achieved through utilisation of 3-dimensional numerical models of hydrodynamic and coastal processes (Worley Parsons 2013; in Commonwealth EIS (RTA 2013), Appendix 7-A).

The entire initial capital dredging campaign of 2.6 million cubic metres was modelled under typical tide, wind and wave conditions, all of which was realistically varied in time and space, to coincide with those most likely to be experienced during the dry and transition (spring) seasons predicted to be encompassed during the dredging operation. Dredge plume modelling during extreme weather conditions, monsoonal activity and cyclones, was not considered necessary as dredging would not be undertaken under such conditions due to safety issues.

The details of the hydrodynamic, sediment plume and sedimentation modeling are presented in Worley Parsons (2013) in the Commonwealth EIS (RTA 2013), Appendix 7-A.

5.1.1 Proposed Port Area

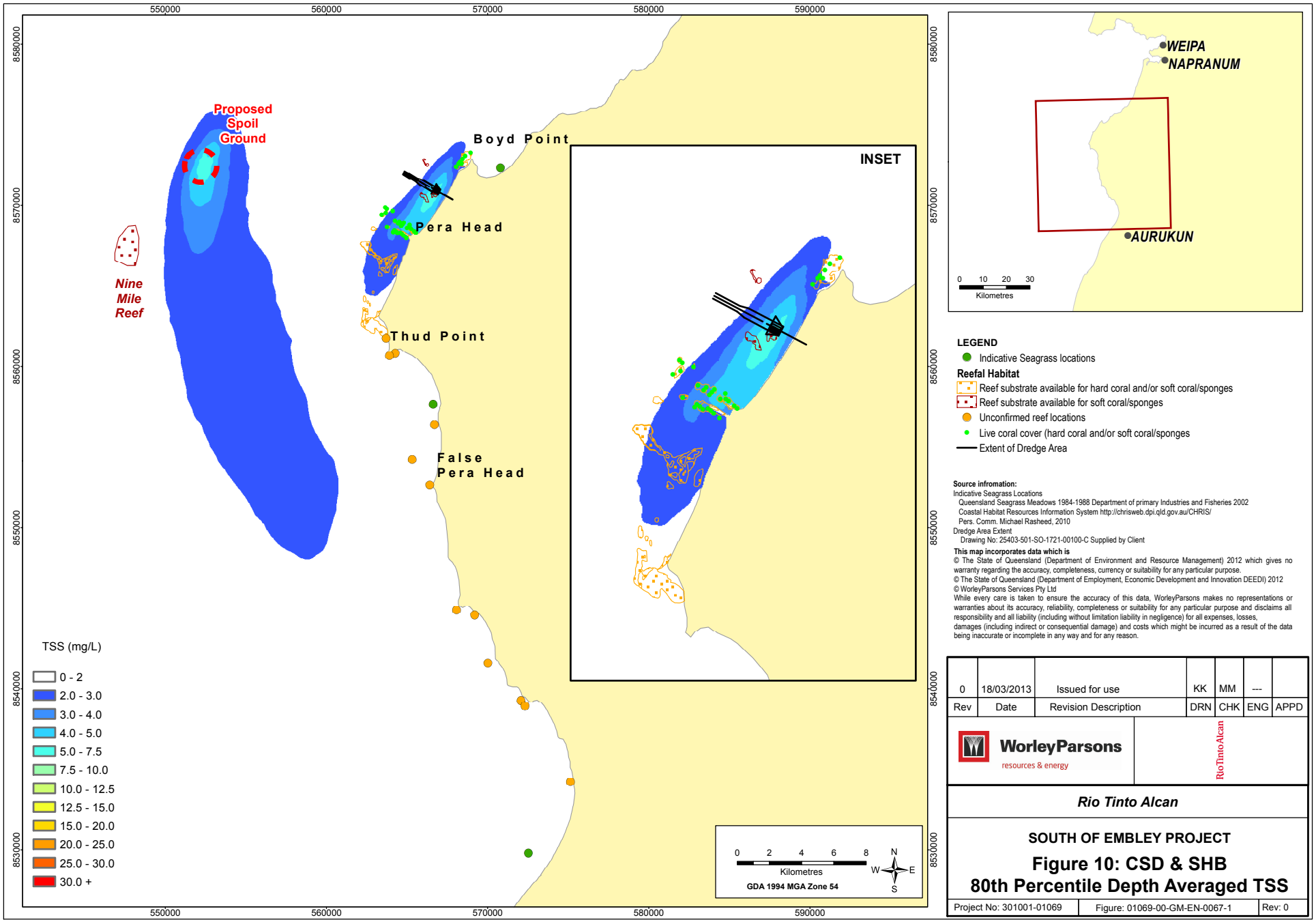
The turbid plume generated by proposed Port area initial capital dredging extends generally parallel to the coast, to beyond Pera Head and Thud Point in the south (migrating during flood tide) and to Boyd Point in the north (migrating during ebb tide).

Periods of elevated TSS concentration generally coincide with the TSHD and CSD operating in the inshore area while dredging the top layer of sediments (which have a higher content of fines). Whilst Boyd Point experiences higher instantaneous TSS levels (due to its closer proximity to the dredging operations), Pera Head is predicted to receive lower but more consistently elevated TSS levels due to the net migration south.

The modeling predicts that the 80th percentile of TSS above background at Boyd Point and Pera Head, over the entire dredge campaign, would be 2 and 3mg/L for the CSD and SHB case and 5 and 7.5mg/L for the CSD and TSHD case (**Figure 10** and **Figure 11**, respectively). These above background TSS concentrations result in incremental increases in TSS. This would result in minor impacts on water quality given that there are periods during the wet and dry seasons when background TSS is at least an order of magnitude higher than the TSS in the dredge plumes. The TSS in the dredge plumes is less significant than natural TSS resulting from storms and winds in this area.

Areas between Pera Head and Boyd Point are expected to experience the highest deposition rates under both dredging options, with rates outside of this area expected to be negligible compared to the background rates at Pera Head of 17mg/cm^2/day and 63mg/cm^2/day in the dry and wet seasons, respectively (**Figure 12** and **Figure 13**). The sedimentation is predicted to be lower under the CSD and SHB dredging option (**Figure 13**).

Model predictions near the reef areas immediately offshore from Pera Head show the median above background deposition as less than 2.0mg/cm^2/day under the CSD and TSHD case, and less than 0.8mg/cm^2/day under the CSD and SHB case. The highest deposition rates, in excess of 7.5mg/cm^2/day above background for the CSD and TSHD case, are in the immediate vicinity (within 500m) of the dredge footprint. The highest rate under the CSD and SHB case is 5.0mg/cm^2/day.



Source infromation:
Indicative Seagrass Locations
Queensland Seagrass Meadows 1984-1988 Department of primary Industries and Fisheries 2002
Coastal Habitat Resources Information System http://chrisweb.dpi.qld.gov.au/CHRIS/
Pers. Comm. Michael Rasheed, 2010
Dredge Area Extent
Drawing No: 25403-501-SO-1721-00100-C Supplied by Client

Rev	Date	Revision Description	DRN	CHK	ENG	APPD
0	18/03/2013	Issued for use	KK	MM	---	

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SOUTH OF EMBLEY PROJECT

Figure 10: CSD & SHB 80th Percentile Depth Averaged TSS

Project No: 301001-01069	Figure: 01069-00-GM-EN-0067-1	Rev: 0

Compiled by BRISBANE GIS SECTION

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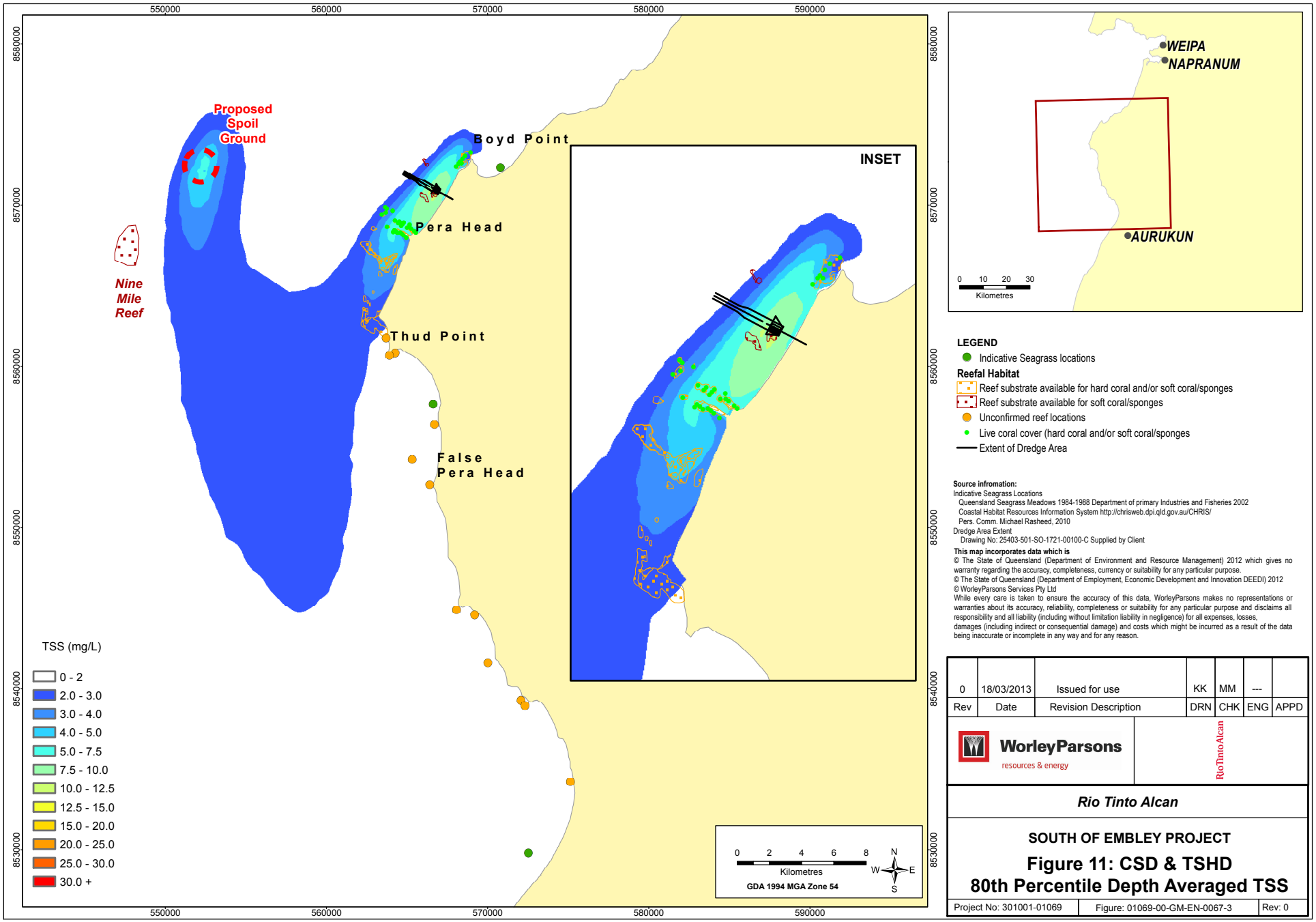

LEGEND

- Indicative Seagrass locations

Reefal Habitat

- Reef substrate available for hard coral and/or soft coral/sponges
- Reef substrate available for soft coral/sponges
- Unconfirmed reef locations
- Live coral cover (hard coral and/or soft coral/sponges
- Extent of Dredge Area

Source infromation:

Indicative Seagrass Locations
Queensland Seagrass Meadows 1984-1988 Department of primary Industries and Fisheries 2002
Coastal Habitat Resources Information System http://chrisweb.dpi.qld.gov.au/CHRIS/
Pers. Comm. Michael Rasheed, 2010
Dredge Area Extent
Drawing No: 25403-501-SO-1721-00100-C Supplied by Client

Rev	Date	Revision Description	DRN	CHK	ENG	APPD
0	18/03/2013	Issued for use	KK	MM	---	

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SOUTH OF EMBLEY PROJECT

Figure 11: CSD & TSHD 80th Percentile Depth Averaged TSS

Project No: 301001-01069	Figure: 01069-00-GM-EN-0067-3	Rev: 0

Compiled by BRISBANE GIS SECTION

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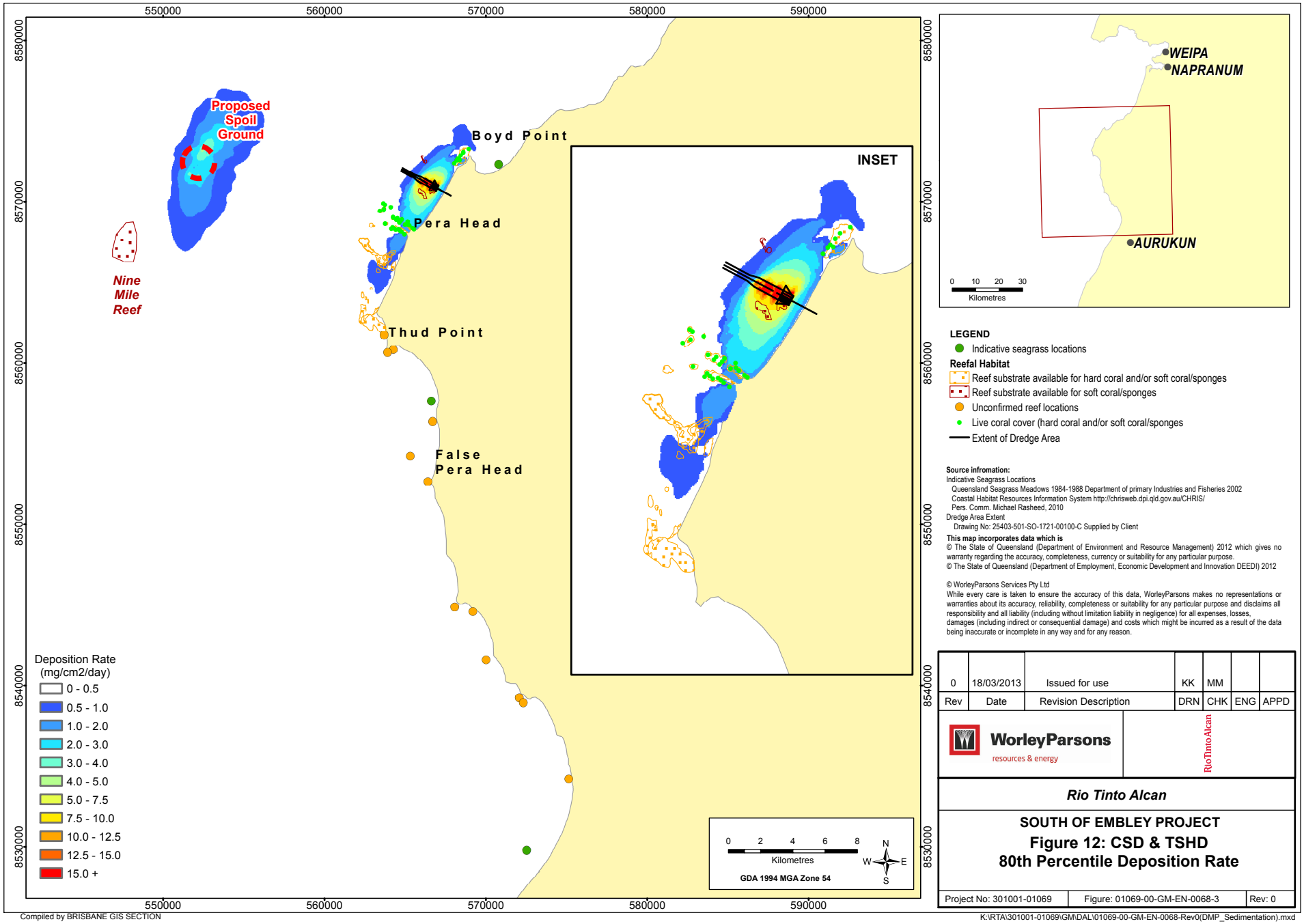

Source infromation:

Indicative Seagrass Locations
Queensland Seagrass Meadows 1984-1988 Department of primary Industries and Fisheries 2002
Coastal Habitat Resources Information System http://chrisweb.dpi.qld.gov.au/CHRIS/
Pers. Comm. Michael Rasheed, 2010

Dredge Area Extent
Drawing No: 25403-501-SO-1721-00100-C Supplied by Client

Rev	Date	Revision Description	DRN	CHK	ENG	APPD
0	18/03/2013	Issued for use	KK	MM		

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SOUTH OF EMBLEY PROJECT

Figure 12: CSD & TSHD
80th Percentile Deposition Rate

Project No: 301001-01069	Figure: 01069-00-GM-EN-0068-3	Rev: 0

Compiled by BRISBANE GIS SECTION

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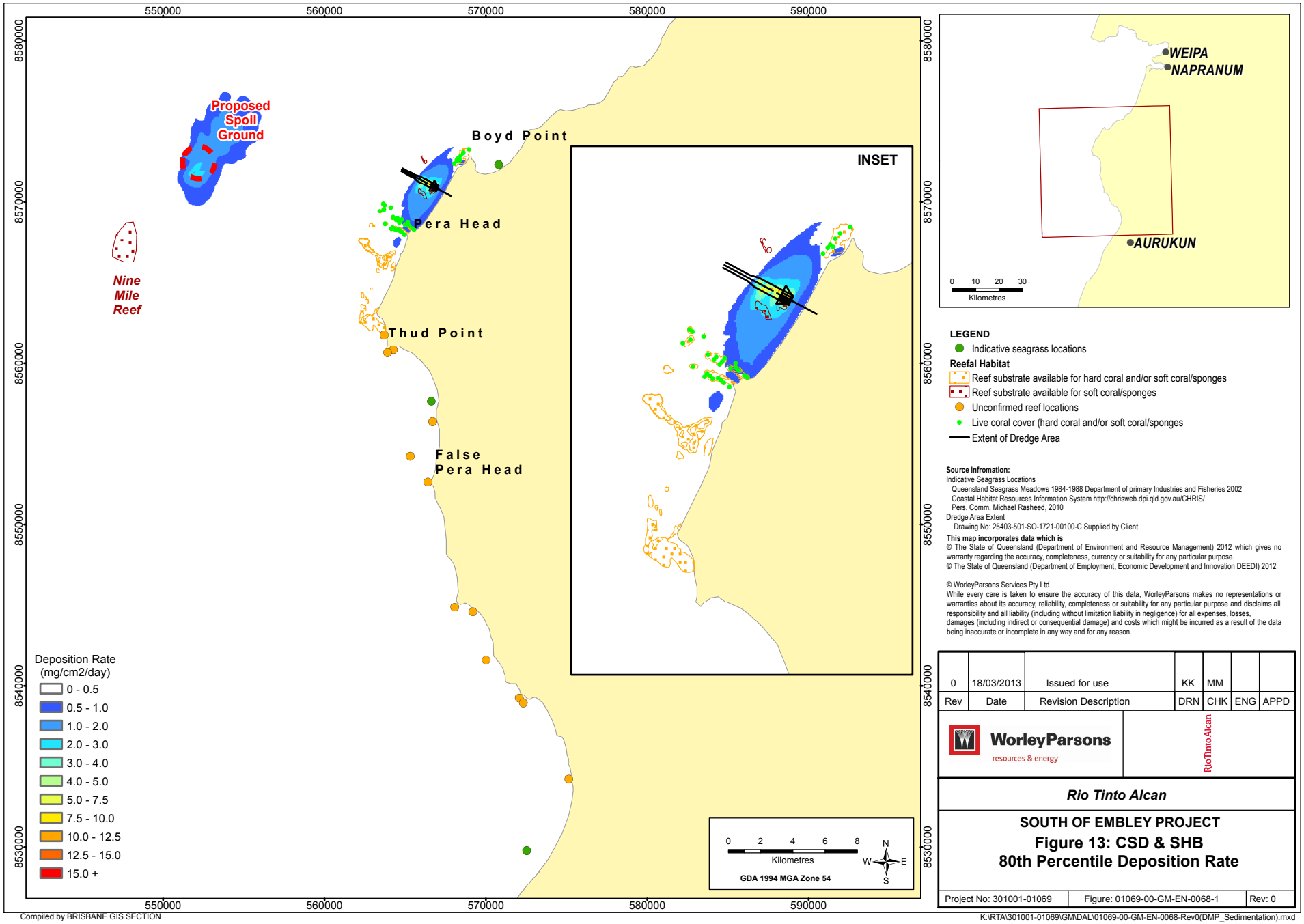

LEGEND

- Indicative seagrass locations

Reefal Habitat

- Reef substrate available for hard coral and/or soft coral/sponges
- Reef substrate available for soft coral/sponges
- Unconfirmed reef locations
- Live coral cover (hard coral and/or soft coral/sponges
- Extent of Dredge Area

Source infromation:

Indicative Seagrass Locations
Queensland Seagrass Meadows 1984-1988 Department of primary Industries and Fisheries 2002
Coastal Habitat Resources Information System http://chrisweb.dpi.qld.gov.au/CHRIS/
Pers. Comm. Michael Rasheed, 2010

Dredge Area Extent
Drawing No: 25403-501-SO-1721-00100-C Supplied by Client

Rev	Date	Revision Description	DRN	CHK	ENG	APPD
0	18/03/2013	Issued for use	KK	MM		

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SOUTH OF EMBLEY PROJECT

Figure 13: CSD & SHB
80th Percentile Deposition Rate

Project No: 301001-01069	Figure: 01069-00-GM-EN-0068-1	Rev: 0

Compiled by BRISBANE GIS SECTION

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5.1.2 Proposed New Spoil Ground

The dredge spoil disposal would result in smothering of benthic infauna within the proposed new spoil ground footprint. Deposition rates above background (0.5 to 2mg/cm^2/day) would not extend beyond 4km outside the proposed new spoil ground area for either dredging methodologies (**Figures 12** and **13**). The increase in deposition outside the proposed new spoil ground area is expected to be negligible compared to the mean background rates in the area of 47mg/cm^2/day and 31mg/cm^2/day for dry and wet season, respectively. Further management and monitoring measures for the impacts from dredge and spoil disposal activities on coral assemblages are provided in **Section 6.2.**

5.2 Marine Megafauna and Significant Species

Section 6.6 of the Queensland EIS (RTA 2011), Section 6.3 of the Supplementary Report to the EIS (RTA 2012), and Sections 4, 7 and 9 of the Commonwealth EIS (RTA 2013) provides a detailed assessment of the threatened and migratory marine species that occur or potentially occur in the Project area. Further management and monitoring measures for the impacts to marine mammals and marine turtles are provided in **Section 6.4.**

A number of threatened and migratory species are transient and/or forage and/or nest in the proposed Port area (Commonwealth EIS (RTA 2013): Section 4.4.2.3, Table 4-5 and Table 7-7 details the likelihood of threatened species occurring in the Project area and Table 4-7 details likelihood of non-avian migratory species occurring. In summary:

- Dugongs occur along the Western Cape and may traverse coastal waters in the vicinity of the proposed Port while moving between seagrass meadows, albeit there are no seagrass meadows within the proposed Port footprint (Commonwealth EIS (RTA 2013): Section 9.4.1 and Table 9-9);
- Australian Snubfin and Indo-Pacific Humpback Dolphins may occur in the vicinity of the proposed Port (Commonwealth EIS (RTA 2013): Sections 9.5.1.1 and 9.5.1.2, respectively; impacts in Section 9.6.1, Table 9-15);
- Green Turtles may forage in the proposed Port area but prefer seagrass beds; no nesting reported in the area (Commonwealth EIS (RTA 2013): Section 7.3.2.1);
- Hawksbill Turtles may feed on reef areas at Boyd Point, Pera Head and between Pera Head and Thud Point. They are also known to nest on the beach in the vicinity of the proposed Port site (Commonwealth EIS (RTA 2013): Section 7.3.2.2);
- Flatback Turtles may forage in the shallow rocky reef areas and sedimentary habitats around the proposed Port and are known to nest on the beach between Boyd Point and Pera Head (Commonwealth EIS (RTA 2013): Section 7.3.2.3);
- Olive Ridley Turtles may forage in the shallow coastal unvegetated habitats around the proposed Port area, and may nest infrequently in the area (Commonwealth EIS (RTA 2013): Section 7.3.2.5);
- Leatherback Turtles may forage in the area but are principally oceanic (Commonwealth EIS (RTA 2013): Section 7.3.2.6); and,
- Loggerhead Turtles may be transient in the area and may forage in the reef areas (Commonwealth EIS (RTA 2013): Section 7.3.2.4).

The sediment plumes and/or sedimentation from the proposed Port initial capital dredging could potentially impact these species by causing: (1) avoidance of foraging areas, (2) loss of foraging habitat or (3) reduction in marine turtle nesting.

1. *Avoidance of foraging areas*: While dolphins and marine turtles may avoid sediment plumes with abnormally high suspended sediment concentrations, the suspended sediment concentrations immediately north and south of the proposed Port initial capital dredge area are within the range of background concentrations and are at the low end of background TSS for the area. Suspended sediment concentrations up to two orders of magnitude higher than the suspended sediment generated by the dredgers occur naturally during the wet season, with lower natural levels occurring during the dry season. Sediment plumes from dredging and disposal are less significant than those generated from storms and strong winds, in which dolphins and marine turtles would normally swim. Therefore it is unlikely that the sediment plumes would cause marine turtles or dolphins to avoid foraging, or transiting the area.

   In the dredging and spoil disposal assessment of the Browse LNG Precinct by the Western Australian Government Department of State Development (DSD, 2010) it was concluded that "information regarding direct impacts of increased turbidity on turtles has not been identified from a review of published literature" and that "turtles are not anticipated to be adversely affected by localised and short term increases in turbidity, as these species are known to occur in areas of variable turbidity."

   Similarly, Dugongs are not likely to be impacted by increases in turbidity as they are well adapted to low visibility turbid environments, as demonstrated by their occurrence in turbid estuarine and coastal waters of the Gulf of Carpentaria (Bayliss and Freeland, 1989; Marsh *et al*, 2008).

2. *Loss of foraging habitat, in particular reef areas at Boyd Point, Pera Head and Thud Point*: The reef areas at Boyd Point and Pera Head have outcrops of hard substrate sparsely covered in algae, soft corals, sponges and hard corals. The estimated hard coral cover at Boyd Point and Pera Head was approximately 4% and 6%, respectively, of the estimated substrate available for reefal colonisation, 49ha and 72ha, respectively. The patchy hard coral communities are dominated by small to medium sized colonies of corals of the families Dendrophylliidae, Faviidae and Poritidae (refer Commonwealth EIS (RTA 2013): Section 7.2.3.1). The genera and species in these three families are typical of hard corals that grow in environments that experience extremes in turbidity and sedimentation (K. Anthony, pers comm; Erftemeijer *et al*., 2012).

   Corals have the ability to acclimatise to reduced light, which may result from elevated suspended solids, through changes in zooxanthellae and chlorophyll *a* concentrations (Philipp and Fabricius, 2003; Gilmour *et al*, 2006) and/or shifts to heterotrophic mode of "feeding" (Anthony and Fabricius, 2000).

   The dredging and spoil disposal assessment of the Browse LNG Precinct by the Western Australian Government Department of State Development (DSD, 2010) states "there are no clearly defined universal turbidity levels or sedimentation rates that can be used to determine whether anthropogenic pressures will stress corals beyond their threshold." However, the data and literature that is available shows that corals on nearshore coral reefs are adapted to relatively high turbidity and sedimentation rates. Larcombe *et al* (2001) reported that nearshore coral reefs can withstand turbidity and sedimentation rates within the ranges of 15 to >40mg/L and 5 to 120mg/cm^2/day, respectively. Similarly, corals on nearshore reefs at James Price Point in Western Australia are exposed to turbidity and sedimentation rates of <5 to >25NTU and 16.5 to 87.4mg/cm^2/day, respectively (DSD, 2010).

Turbinaria mesenterina is one of the more common species found on reefs near the proposed Port and its high–sediment tolerance has been investigated by Sofonia and Anthony (2008). This study showed that the coral is physiologically tolerant of very high sediment loads (up to 100mg cm^{-2}) due to an ability to rapidly clear themselves of sediment and to utilise sediment as an energy and nutrient source. The high concentrations of suspended particulate matter on near shore reefs represent a significant food source for a range of coral species contributing to significantly higher lipid stores in near shore coral species (Sofonia and Anthony, 2008).

Erftemeijer *et al*. (2012) reviewed the available published literature, including peer-reviewed scientific literature, "grey" literature in the form of environmental impact assessments, consultancy and technical reports, and additional information obtained from members of Working Group 15 of the Environmental Commission of the World Association for Waterborne Transport Infrastructure, on the sensitivity of corals to turbidity and sedimentation. This review concluded that the sensitivity of a coral reef to dredging impacts depend on its resilience and ambient conditions normally experienced. The review presents a range of data that shows corals that are naturally exposed to high and variable background conditions of turbidity and sedimentation will show higher tolerances to increases in turbidity and sedimentation caused by dredging. "Coastal turbid-zone reefs" occur in water with turbidity over 100NTU (approximately 220mg/L suspended solids) often resulting from wave-induced resuspension. Many coral species and reefs survive sedimentation rates as high as 100mg/cm^2/day for several days to weeks without any major negative effects with some nearshore reefs experiencing sedimentation rates well over 200mg/cm^2/day. Nearshore fringing reefs in the Great Barrier Reef region have long term mean sedimentation rates of 50-110mg/cm^2/day (Erftemeijer *et al*. 2012).

Corals of the Favid family, a dominant group of corals on the reefs north and south of the proposed Port, are robust and able to survive in seemingly atypical reef environments (Collins, 1994; Ferns, 1995; Scoffin *et al*, 1997).

Antwertinger (2011) investigated the effect of light and suspended particulate matter on the growth of two favid species, *Goniastrea aspera* and *Platygyra sinensis*, in a turbid, macrotidal estuary, Darwin Harbour. The fringing reefs of Darwin Harbour would be considered harsh environments for coral growth with annual average sea surface temperature of 29°C, often reaching 32°C in the wet season, and turbidities >80NTU. These fringing reefs also receive high levels of freshwater and sediment runoff during the wet season monsoon. The growth characteristics, average annual extension, average annual density and average annual calcification, of the two favid species, *G. aspera* and *P. sinensis,* were similar to those from open water reef systems with very low turbidity, including Heron Island on the Great Barrier Reef. This result showed these species are well adapted to the extreme fringing reef environment which is attributed to the fact that favids are efficient heterotrophs when light limited as a result of high turbidity (Anthony, 1999; Anthony, 2000; Anthony and Fabricius 2000).

The coral species assemblages present at the proposed Port reef areas; the ambient background conditions, spatial and temporal turbidity, TSS and sedimentation; sediment plume and sedimentation modelling and literature data, strongly suggests the predicted sediment plumes and sedimentation from both proposed dredge methodologies would have, at most, a minor impact on the reef areas at Boyd Point, Pera Head and Thud Point. It is therefore not expected that dredge plumes and sedimentation would result in the loss of foraging habitat.

The proposed Port dredge footprint would result in the loss of 0.65km^2 (initial capital dredging) and 1.94km^2 (Stage 2) of sedimentary habitat. This is unvegetated habitat and constitutes approximately 0.05% and 0.13%, respectively, of similar Western Cape York coastal sedimentary habitat and therefore would have a negligible impact on foraging by threatened or migratory species.

3. *Reduction in marine turtle nesting:* The beach area between Boyd Point and Pera Head is not considered a high density marine turtle nesting beach, with reports of 0.3 and 0.6 marine turtle tracks per kilometre per day (Section 7.3.3 of RTA 2013). If initial capital dredging spans the marine turtle nesting season it is unlikely that sediment plumes from dredging would prevent marine turtles from coming ashore to nest on the beach between Boyd Point and Pera Head.

   Altered light regimes from dredging operations would only eventuate during dredging campaigns, and so would be short term. Given the relatively low level of lighting required for dredging operations which occur offshore and the low to medium density of marine turtle nesting in the vicinity of initial capital dredging operations for the Port, the potential unmitigated impacts of lighting specifically related to the initial capital dredging activities would be negligible.

5.3 Other potential marine impacts

Fish Assemblages and Fisheries

Although fish species are able to move away from any local areas affected by a disturbance (e.g. dredging and dredge spoil deposition), physical disturbance to the dredge sites, deposition of spoil, and the re-suspension of disturbed and deposited sediment may have impacts of minor magnitude on sharks and rays, including sawfishes, and bony fishes at the proposed Port facility and the proposed new spoil ground.

The Project area is included in the area where the Northern Prawn Fishery (NPF), the Gulf of Carpentaria Commercial Inshore Finfish Fishery and the Gulf of Carpentaria Commercial Line Fishery operate. Recreational fishers and guided fishing tour operators also utilise the Project area including the "Three Mile" recreational fishing area. There would be a temporary impact on fish assemblages in the vicinity of the Port and proposed new spoil ground due to turbidity generated by initial capital dredging and disposal of sediment, however following dredging activities, the impacts are anticipated to be minor (Section 6.9.4.5 of the Queensland EIS (RTA 2011)).

Marine Pests

Marine pest species may be introduced through the following mechanisms:

- use of dredges at the Port site as a result of hull fouling; and/or,
- disposal of spoil material from initial capital dredging through pests originating in-situ or introduced by the dredger.

No pest species are known to occur within the undisturbed footprint of the proposed Port. Initial capital dredging for the proposed Port may require the services of internationally sourced dredges.

North Queensland Bulk Ports (NQBP) currently manages the Port of Weipa and carries out maintenance dredging and spoil disposal at the existing Albatross Bay spoil ground. Surveys for introduced marine pests have been undertaken since 1999 in accordance with methodologies established by the Centre for Research on Introduced Marine Pest Species (NQBP 2011). Surveys have been modified to also target the Black-striped Mussel since its detection at the

Port of Darwin in 1999 and 2000 and also the Asian Green Mussel in 2006. No introduced marine pests have been recorded to date at the Port of Weipa (NQBP 2011).

Under the DSEWPaC-approved Port of Weipa Long Term Environment Management Plan for Dredging and Dumping Activities (SKM 2009), the Port of Weipa is considered a low risk port for marine pests.

Underwater Noise

Dredging is at the lower end of the scale with regards to emitted sound pressure levels in aquatic environments (CEDA 2011 in Section 15.3.2 of RTA 2013). The main noise anticipated during dredging operations would be the noise from TSHD and CSD (CEDA, 2011).

It is unlikely that underwater noise from dredging operations would cause injury to cetaceans, based on the assessment of continuous noise impacts from Southall *et al.* (2007) (CEDA, 2011). Comparison of species hearing thresholds indicates that injury to other listed threatened estuarine and marine fauna and non-avian migratory species from dredging operations would be unlikely.

Underwater noise has the potential to impact listed threatened estuarine and marine fauna and non-avian migratory species feeding, transiting, or nesting (marine turtles) in the vicinity of initial capital dredging operations. There may be some behavioural responses for some species to avoid the area of dredging operations although this is expected only at close range to the source (Nedwell *et al.*, 2003). There is also a possibility that many species may become habituated to the noise and remain within the vicinity (Smolowitz and Weeks, 2006).

At the Port avoidance behaviour due to underwater noise from dredging could impact foraging or nesting behaviour of marine turtles in the immediate area.

6 MANAGEMENT AND MONITORING

Dredging and spoil disposal would be undertaken in accordance with the conditions of the Queensland CG's Report (and any subsequent conditions imposed through the Environmental Authority and Development Approval) and the Commonwealth Sea Dumping Permit. RTA would establish a Boyd Port Dredging Technical Advisory Group (BPDTAG) which would include representatives from EHP and DAFF (FQ) for dredging at the proposed Port. RTA must report to the BPDTAG on proposed dredging activities for the Port and implementation of the DMP(s), including monitoring results, management triggers and response actions. The group would assist in the establishment, where appropriate, of longer term management for the maintenance dredging program (which would be covered by a separate DMP).

RTA would submit plans for dredging activities, certified by a Registered Professional Engineer of Queensland, to EHP prior to commencement of dredging. Dredging activities would be confined to the removal of initial capital dredge material at the location shown on the plan(s). Prior to the commencement of initial capital dredging, hydrographic surveys of the bed levels of the area to be dredged would be completed.

Dredge spoil would not be disposed of into Queensland waters that are within the limits of the State, unless otherwise authorised. Dredge spoil material would not be disposed of into Australian waters, the sea or on land unless otherwise authorised.

Initial capital dredging activities would not start until provision has been made to lawfully place or dispose of the dredge spoil material. Evidence of applicable approvals would be made available to the regulatory authority on request.

EHP must be advised in writing at least five (5) business days prior to the date of commencement of the initial capital dredging campaign and within ten (10) days following completion of the initial capital dredging campaign.

Initial capital dredging activities would be conducted using equipment that is in survey and registered and, in relation to environmental performance, is equal to or superior to the following equipment:

- TSHD that is equipped, at a minimum, with:
    - below keel discharge of tail waters via an anti-turbidity control ("green") valve;
    - systems for determining solids to water ratio or density of dredged material;
    - electronic positioning and depth control system for defining the location and depth of dredging activities; and,
    - dragheads capable of, and where appropriate, depth control and fitted with marine wildlife protection or fauna exclusion devices (e.g. turtle deflector, deflector plates, tickler chains on dredge heads) prior to and during operation.
- CSD that is equipped, at a minimum, with:
    - electronic positioning and depth control system for defining the location and depth of dredging activities;
    - a system or process to ensure the delivery system integrity is maintained at all times;
    - systems for determining solids to water ratio or density of dredged material during operations; and,
    - cutter heads with depth control and where appropriate or required fitted with marine wildlife protection or fauna exclusion devices prior to and during operation.

- Grab Dredger that is equipped, as a minimum, with:
    - electronic positioning system for defining the location and depth of dredging activities.

RTA would:

- install all measures, plant and equipment necessary to ensure compliance with the conditions of relevant approvals;
- maintain and calibrate such measures, plant and equipment in an efficient condition and keep records of the maintenance; and,
- operate such measures, plant and equipment in an efficient manner.

All persons engaged in conducting initial capital dredging activities including but not limited to employees and contract staff would be:

- trained in the procedures and practices necessary to:
    - comply with the conditions of the relevant regulatory approvals ; and,
    - prevent environmental harm during normal operation and emergencies, or,
- under the close supervision of a trained person.

6.1 Water Quality

Background

The generation of dredge-induced turbidity plumes generally results from the suspension of fine sedimentary material during dredging and spoil disposal activities. High levels of turbidity limit the light available to light dependent communities, including coral assemblages. If increased turbidity is of sufficient intensity, duration and/or frequency, the tolerance levels of coral assemblages may be exceeded, resulting in stress and/or mortality. However, coral species at the proposed Port reef areas are predicted to show high levels of tolerance to high and variable suspended solids and sedimentation rates (refer **Section 5.2**).

In order to manage any potential impacts a water quality and coral health monitoring program would be implemented.

Management Measures

A range of measures can be implemented to manage water quality and impacts to coral assemblages.

General Management Measures

In carrying out the activity, initial capital dredging would:

- only occur from the permitted areas specified on approved plans;
- only dredge sediment suitable for unconfined ocean disposal when assessed in accordance with the National Assessment Guidelines for Dredging;
- not produce any slick or other visible evidence of oil or grease, nor contain visible floating oil, grease, scum, litter or other objectionable matter; and,
- be carried out taking all practical measures necessary to minimise the concentration of suspended solids released during the loading and pump-out of the vessel.

The following mitigation measures would be implemented to reduce the impacts on water quality related to the creation of a turbidity plume from dredging and offshore spoil disposal activities:

- mechanical devices, such as turbidity-reducing valves in the overflow on the TSHD would be used;
- hopper doors would be kept in good condition to minimise loss of sediment during transport;
- the TSHD would be equipped with below keel discharge of tail waters via an anti-turbidity control ("green") valve;
- track plots would be provided by the dredging company to demonstrate that no dredging occurs outside the designated areas;
- accurate positioning systems would be used on dredges to ensure direct impacts are restricted to the approved dredging areas;
- accurate positioning of vessels to ensure disposal of spoil is within the footprint of the proposed new spoil ground;
- safest and shortest sailing routes to and from the proposed new spoil ground would be selected to minimise the impact of propeller wash;
- current and forecasted meteorological and oceanographic information, water quality and coral health data would be considered in the daily work plan; and,
- the transportation of dredge material would be carried out such that the dredge material is kept wet at all times.

Adaptive Management Measures

The following management measures would be considered for initial capital dredge and spoil disposal operations. The measures implemented would be contingent on the level of Management Trigger exceedance and would be selected based on the outcome into the investigation of the exceedance in a process shown in **Figure 14**.

Dredge-specific Management Measures

Water quality monitoring would be undertaken using telemetered loggers measuring turbidity, and compared against turbidity trigger values for the Zones of Influence and any exceedance of the trigger values would trigger the implementation of the Water Quality Management process, including investigation into the cause and adaptive management. The Zones of Influence are the areas predicted to have sediment plumes with TSS >2mg/L above background TSS as shown in **Figures 10**, **11** and **18**.

Adaptive management measures would be implemented as required depending on the level of impact and may include:

- moving the dredge operations and vessels to other areas within the development footprint to reduce potential impacts on the affected corals;
- reducing or ceasing overflow during periods when the dredge plume is considered likely to lead to further impacts; or,
- reducing dredging activities from 24 hours a day to a period timed to reduce impacts (e.g. to 12 hours/day or night).

Spoil Ground-specific Management Measures

Optimisation of the disposal location based on meteorological and ocean conditions.

Water Quality Monitoring

Prior to the commencement of initial capital dredging and spoil disposal activities, site and season specific turbidity trigger values would be developed for the Zones of Influence based on wet and dry season baseline data. In ecosystems influenced by strong seasonal or event-scale effects (e.g. cyclones) it is necessary to monitor these seasonal influences and derive trigger

values corresponding to the key seasonal periods. In wet-dry tropical areas such as Weipa two trigger values would be derived, one for the wet season and another for the dry season (ANZECC/ARMCANZ, 2000).

Water quality monitoring would be undertaken using telemetered loggers measuring turbidity, and this data would be compared against turbidity trigger values for the Zones of Influence as detailed in **Section 6.7.1**. An exceedance of the trigger values from the telemetered loggers would trigger the implementation of the Water Quality Management process (as shown in **Figure 14**), which includes an investigation into the cause of the exceedance. A "false exceedance", as shown in **Figure 14**, is when it has been determined that data that exceeds the trigger values was erroneous due to instrument malfunction or incorrect data analysis and/or entry.

Note that during the course of initial capital dredging and spoil disposal activities, an adaptive management process would be adopted and the process for investigation of exceedances would be updated through experience and lessons learned.

6.2 Coral Health

The coral health program combines routine monitoring (**Section 6.6.2**) and reactive monitoring based on water quality triggers (**Section 6.6.1**).

Management Trigger Levels

Coral health data would be assessed against the following Management Triggers at the Influence sites:

Level 1: Detectable adverse change in health of coral assemblages.

Level 2: Detectable net mortality of coral.

Key indicators of changes in coral health would include, bleaching, mucus production and/or sediment deposition.

Coral Health Monitoring

Where the exceedance of the turbidity trigger value is determined to be likely to be attributable to dredging and/or spoil disposal activities, coral health monitoring would be carried out at identified sites and reference sites. Where available, satellite imagery would be used to understand the extent of the dredge and disposal plumes, to support decisions on the location of potential impacts, and identify the reference sites to be monitored.

The implementation of a targeted coral health monitoring effort in areas where exceedances are detected would allow for sufficient spatial resolution to characterise any changes in coral health.

Timing for the implementation of targeted coral health monitoring is shown in **Table 4**.

Figure 14: Water Quality (turbidity) Management Process

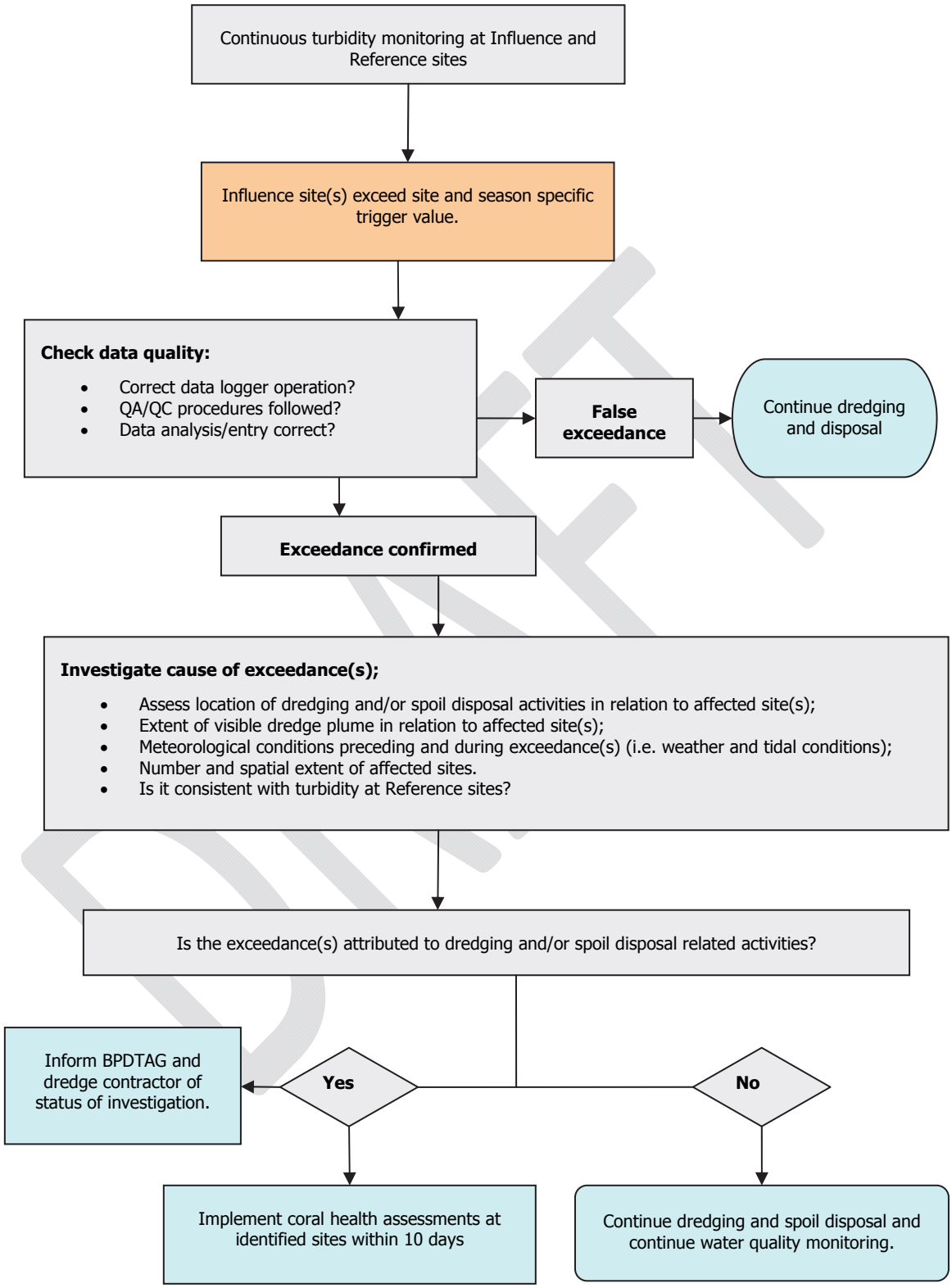


Table 4: Schedule for Implementation of Targeted Coral Health Monitoring

Timing	Activity
0 to 48 hours	Determine whether exceedance of the turbidity trigger was likely to be attributable to dredging and/or spoil disposal activities and whether targeted coral health monitoring should be implemented (as per **Figure 14**)
3 to 10 days	Implement targeted coral health monitoring at identified sites if there are no likely alternative explanations for the exceedance other than dredging and/or spoil disposal activities. If the exceedance is significant and ongoing, targeted coral health monitoring would be implemented more rapidly, where practicable
>10 days	Conduct a further coral health monitoring survey approximately two weeks after the targeted coral health monitoring.

6.3 Coral Health Response Procedure

Adaptive Management

In the event of an exceedance of a Coral Health Management Trigger, Level 1 or Level 2, the coral health management process as presented in **Figure 15** would be implemented. This procedure includes the investigative approach to determine the likely cause of exceedance. As noted for the water quality management process an adaptive management approach would be adopted such that during the course of the dredging and spoil disposal activities, the process for investigation of exceedances may be updated through experience and lessons learned. Adaptive management would be implemented based on the two coral health trigger levels. Where an identified exceedance is attributed to initial capital dredging and/or spoil disposal activities, the following actions would be implemented for each trigger level:

Level 1

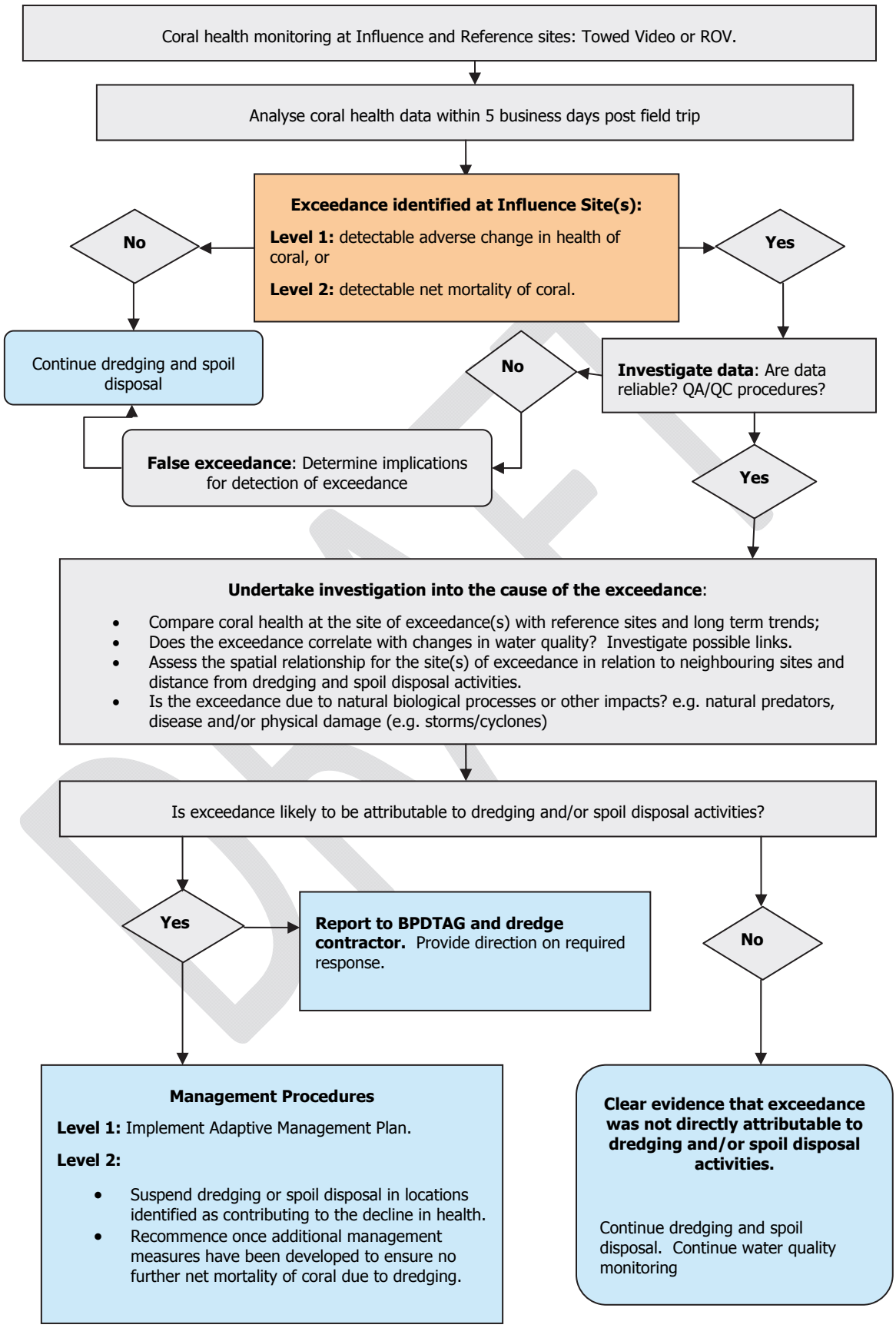
- inform the BPDTAG and dredge contractor of the adverse change in coral health;
- undertake further investigations into the cause of the exceedance; and,
- identify potential management measures to be implemented if further adverse coral health identified.

Level 2

In the event that net mortality of coral is identified at influence sites as a result of initial capital dredging and/or spoil disposal activities the following management procedure would be implemented:

- notify BPDTAG and dredge contractor and suspend dredging and/or spoil disposal activities in locations identified as contributing to the coral mortality within 48 hours;
- implement management measures to ensure no further net mortality of coral due to dredging and/or dredge spoil disposal activities;
- undertake further investigations into the cause of the exceedance, including:
    - Identifying the dredging and/or spoil disposal activities and meteorological and ocean conditions that caused the exceedance.
    - The results of the most recent coral health monitoring for all influence and reference sites.
    - The results of the most recent water quality monitoring at influence and reference sites.
- dredging and/or spoil disposal activities would recommence once management measures have been implemented and turbidity trigger values are met at the impacted sites.

Figure 15: Coral Health Management Process



Management Measures

The management measures that may be implemented should initial capital dredging and/or spoil disposal activities result in coral health triggers being exceeded would depend on the extent and nature of the impact and location of the impacted site(s).

Adaptive management measures would be implemented as required depending on the level of impact and may include:

- moving the dredge operations and vessels to other areas within the development footprint to reduce potential impacts on the affected corals;
- reducing or ceasing overflow during periods when the dredge plume is considered likely to lead to further impacts;
- reducing dredging activities from 24 hours a day to a period timed to reduce impacts (e.g. to 12 hours/day or night); or,
- temporary cessation in dredging activities in areas contributing to decline in coral health.

6.4 Marine Mammals and Turtles

Background

The marine fauna of potential concern during initial capital dredging and spoil disposal activities are marine turtles and migratory species including the Indo-pacific Humpback Dolphin (*Sousa chinensis*), Australian Snub-fin Dolphin (*Orcaella heinsohni*), Bryde's Whale (*Balaenoptera edeni*) and Dugong (*Dugong Dugon*). An assessment of "significance of impact" for threatened and migratory fauna likely or known to occur in the Project area is detailed in Section 6.9.5 of the Commonwealth EIS (RTA 2013).

The objective of the marine mammal and marine turtle management program is to detect and minimise any avoidable impacts to marine mammals and marine turtles resulting from initial capital dredging and spoil disposal activities.

Management Measures

Section 6 of the Queensland EIS (RTA 2011) and Sections 7 and 9 of the Commonwealth EIS (RTA 2013) provides details of potential impacts on threatened and migratory marine species and proposed management measures. The following are the range of management measures for identified potential impacts on marine mammals and marine turtles which would be implemented for initial capital dredging and spoil disposal following the processes shown in **Figure 16** and **Figure 17** respectively:

Disturbance from vessel activities (boat strikes)

- The TSHD would have dragheads with depth control, and where appropriate, fitted with marine wildlife protection or fauna exclusion devices (e.g. turtle deflector, deflector plates, tickler chains on dragheads prior to and during operation). Evidence that this device has been installed and used on the dredger for the entire period of dredging activity would be provided to the administering authority on request.
- Prior to the commencement of initial capital dredging and spoil disposal activities, selected crew from the dredge vessel would be trained as Marine Fauna Observers (MFOs) in marine turtle and marine mammal behaviour and the actions to be taken in the event of marine fauna sightings, injury or mortality.
- During daylight hours, operators of specified vessels would be required to maintain a MFO on watch during dredging operations.

- A log would be maintained on all vessels detailing marine mammal and marine turtle sightings.
- Mobile dredging operations:
    - must not commence if Dugongs, marine turtles, or cetaceans are observed within 300 metres of the dredge; and,
    - where underway, must alter course if Dugongs, marine turtles, or cetaceans are likely to be struck or captured.
- Stationary dredging operations:
    - must not commence if Dugongs, marine turtles, or cetaceans are observed within 300 metres of the dredge; and,
    - must cease if Dugongs, marine turtles or cetaceans are observed within 50 metres of the dredge head.
- Marine turtle monitoring would be carried out as follows:
    - daily monitoring for impacted marine turtles would be undertaken at the dredge and at the shoreline down-current from the dredging operation;
    - if monitoring indicates that more than two marine turtles are killed within a 24 hour period as a result of dredging, the dredge would relocate from the area until an incident investigation has been carried out and relevant preventative actions implemented;
- operating procedures that minimise the risk of marine turtle capture by the dredge head, and the risk from all activities of injury to marine species of conservation significance, would be developed prior to the commencement of dredging activities; and,
- EHP is to be immediately notified of any marine turtle captures by the dredge or injury to any marine species of conservation significance.

The marine turtle and marine mammal management procedures flowcharts for initial capital dredging and spoil disposal are shown in **Figure 16** and **Figure 17**, respectively.

Water Quality

Water quality (and therefore its potential impacts on marine turtles and mammals) would be managed through the water quality management process presented in **Section 6.1**.

Impacts from Artificial Lighting

Light levels from the initial capital dredging works would be minimised to those lights that are necessary for the safe operation of the vessels.

Adaptive Management

Background

This section details the incident response strategy to be implemented during initial capital dredging and spoil disposal activities. Adaptive management responses that relate to marine turtle incidents (injury or mortality) associated with initial capital dredging and spoil disposal activities would follow an incident investigation and action process aligned with a series of tiered response principles.

Figure 16: MarineTurtle and Marine Mammal Management Procedure (Dredging)

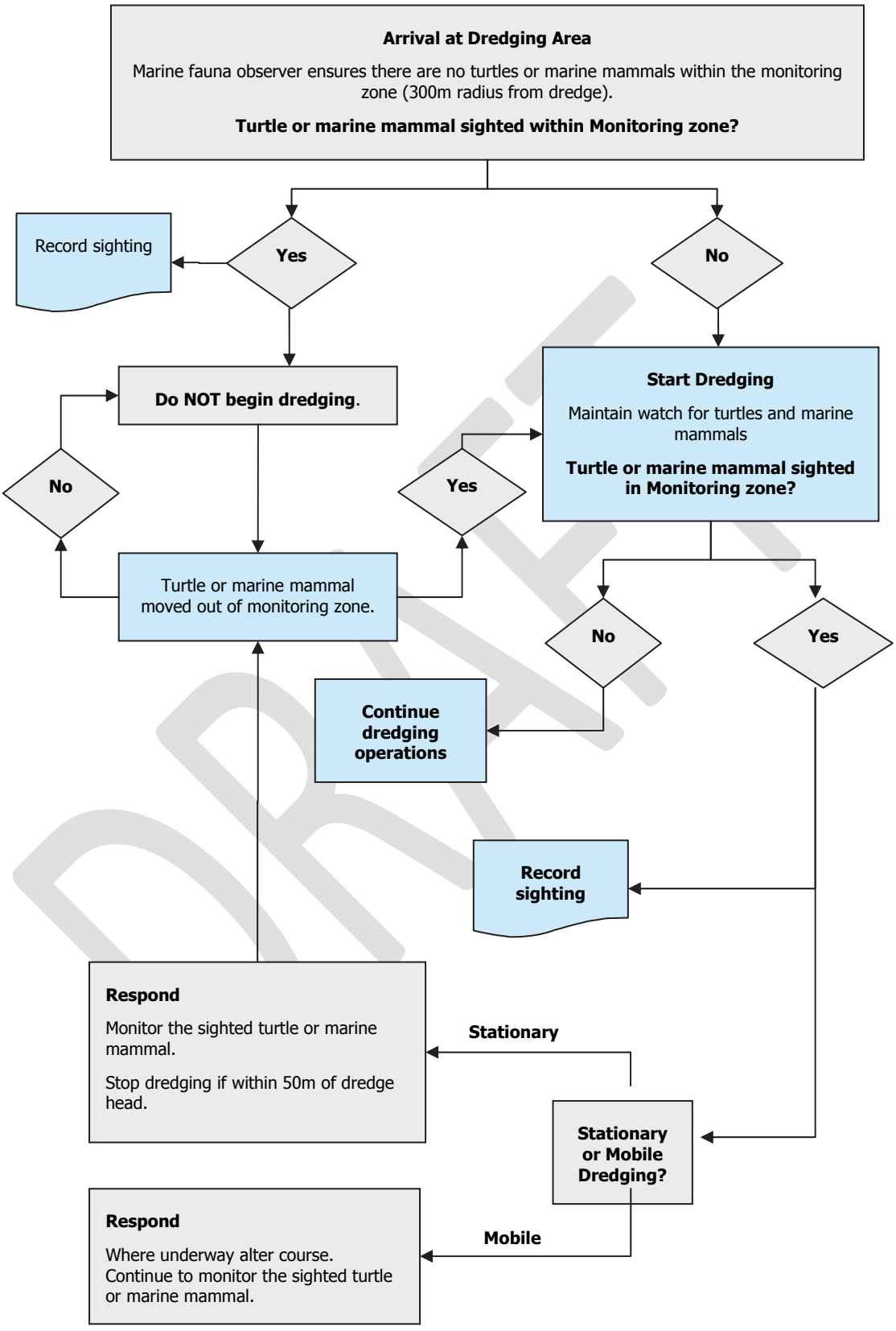
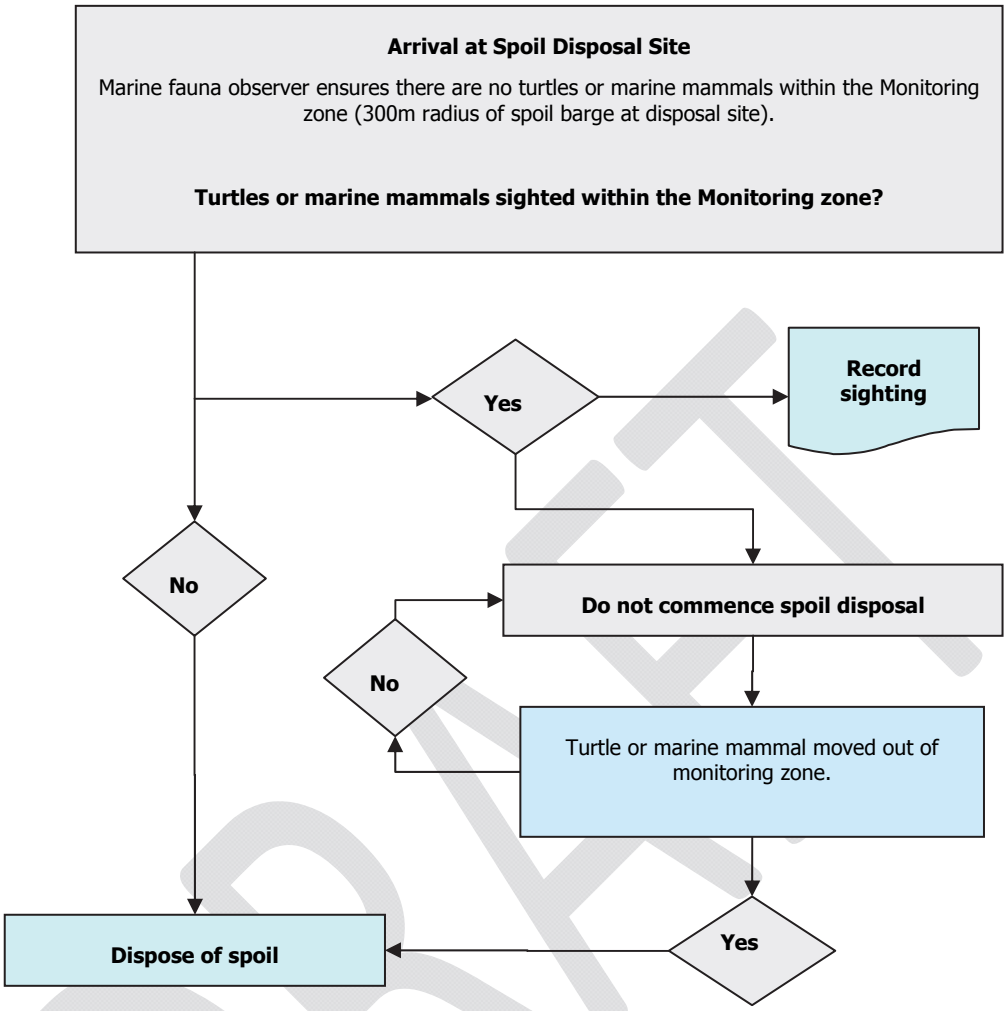


Figure 17: Marine Turtle and Marine Mammal Management Procedure (Spoil Disposal)



In the event of marine turtle injury or mortality, attributed to initial capital dredging and/or spoil disposal activities, RTA would undertake an investigation. The investigation would inform the implementation of three trigger levels to guide the management response.

Management Trigger Levels

Level 1

An injured or dead marine turtle is found and is attributable to initial capital dredging and/or spoil disposal activities:

Should it be determined that current management measures were not being followed, appropriate action would be taken to correct this deficiency. If management measures were being followed, an increased level of "off dredge" observation for further injured or dead marine turtles would be implemented over the following week. For example, additional monitoring of beaches or the reclamation area as appropriate.

Level 2

Three injured or dead marine turtles attributable to initial capital dredging and/or spoil disposal activities are found per seven day period, or six per 28 day period.

RTA would undertake a review of current management measures to identify alternative or additional practicable management measures that could be undertaken. At the same time interim management measures would be implemented to prevent possible sources of harm, where practicable, to reduce the risks of further marine turtle injury or mortality.

Level 3

Four injured or dead marine turtles attributable to initial capital dredging and/or spoil disposal activities are found per seven day period, or nine per 28 day period or more than two marine turtles killed within 24 hours attributable to dredging and/or spoil disposal.

Immediate action would be taken to implement alternative and/or additional management measures to prevent likely sources of harm, including temporary relocation or suspension of activities. A review of management measures would be undertaken by RTA to identify longer-term alternative or additional management measures to reduce the risks of further marine turtle injury or mortality.

Following the implementation of management action or actions associated with an event, the effectiveness of the process and actions taken shall be reviewed periodically. The results of the review would guide adaptive management decisions and further actions as required.

6.5 Marine Pests

Dredgers will be subject to a biofouling risk assessment in accordance with the *National Biofouling Guidance for Non-trading Vessels* (Commonwealth of Australia 2008) prior to deployment to site.

6.6 Underwater Noise

The following mitigation measures will be implemented to reduce the impacts on listed threatened marine fauna and non-avian migratory species related to underwater noise associated with initial capital dredging activities and offshore spoil disposal:

- all vessels would operate in accordance with appropriate industry and equipment noise and vibration standards;
- regular maintenance of vessels would be conducted to the manufacturers' specifications; and,
- where possible, leaving engines, thrusters and auxiliary plants in stand-by or running mode unnecessarily would be avoided.

With the implementation of these mitigation measures, residual impacts to listed threatened estuarine and marine fauna and non-avian migratory species in the vicinity of the Project from underwater noise associated with initial capital dredging activities and offshore spoil disposal would be negligible.

6.7 Monitoring Programs

The receiving habitat monitoring programs incorporate both routine and reactive monitoring components to support the management measures described in **Section 6.1**. The reactive monitoring provides a risk based approach to management of initial capital dredging and spoil disposal activities.

The monitoring programs are designed to provide timely information to minimise potential impacts to receiving habitats. These habitats include near shore reefal habitats between Boyd Point and Thud Point and offshore habitats at Nine Mile Reef.

The monitoring program applies sub lethal indicators which allow management processes to be implemented in order to prevent more substantial impacts occurring. This approach minimises delays in dredging and construction schedules and minimises environmental impact.

The proposed monitoring programs are summarised in **Table 5**. Telemetered turbidty monitoring would commence three months before initial capital dredging operations commence and would continue for at least one month after initial capital dredging operations cease to demonstrate that turbidity has returned to ambient levels.

Table 5: Proposed Monitoring Programs

Monitoring program	**Pre-dredge**	**Dredging**				**Post dredge**	
		P1*	P2	P3	P4	1 month	2 month
Water quality loggers Turbidity	X	X	X	X	X	X	
Coral Health	X	X	X	X	X	X	X

*P = approximately six weekly monitoring period

6.7.1 Water Quality

The objective of the water quality monitoring program is to provide continuous water quality data to assist in the management of initial capital dredging and spoil disposal activities. Water quality data at influence and reference sites would be collected to:

- monitor the spatial extent of turbidity in relation to predicted plumes;
- adaptively manage the risk of impacts to coral in the Zones of Influence from increases in turbidity;
- provide "early warning indicator" of potential impacts on coral health; and,
- validate the appropriateness of coral health Reference Sites, that is, they would not be impacted by increased turbidity or sediment deposition from dredging and spoil disposal activities.

Water Quality Criteria in the Zones of Influence

Water quality within the Zones of Influence is predicted, by 3-D dredge plume modelling, to remain within acceptable limits; consequently, no net loss of coral is anticipated within these Zones. Initial site and season specific turbidity trigger values would be developed for the Zones of Influence based on the background water quality data that has been collected continuously at 10 or 20 minute intervals during the Wet (December 2006 to March 2007; December 2007 to March 2008; February to May 2012) and Dry (April to July 2007; June to August 2010) seasons. The trigger values would be informed by the findings of all relevant published studies, including available water quality guidelines, trigger values from other comparable dredging programs with similar environmental conditions, and site specific baseline data. It is proposed that turbidity trigger values for wet and dry seasons would be based on the 95th percentile of background data at reference and influence sites at Boyd Point and Pera Head (McArthur *et al.* 2002), considering intensity, duration and frequency of the baseline data sets. The rationale for setting the 95th percentiles being that it captures almost the full range of turbidity events that have been observed without detectable impacts on corals, but excludes the few large scale events that could be considered as relatively rare events, albeit cyclonic and/or monsoonal events are not rare during the wet season in the Project area.

Proposed water quality monitoring sites

It is proposed to monitor turbidity at key habitats during initial capital dredging and spoil disposal activities and the monitoring sites have been chosen based on sediment plume modelling and baseline data collected previously. The proposed sites are shown in **Figure 18**.

Influence sites would be established at four sites: Boyd Point (I1), Pera Head (I2), reefal area between Pera Head and Thud Point (I3) and Thud Point (I4). These sites are within the potential Zone of Influence as identified from the plume modelling (**Figure 10** and **Figure 11**). Reference sites would be located outside the Zone of Influence, north of Boyd Point (R1) and at False Pera Head (R2) approximately 11km south of Thud Point. A third reference site would be located immediately north-north-east of Nine Mile Reef (R3).

Water Quality Monitoring Method

Telemetered water quality loggers would be deployed at each of the influence and reference sites. The telemetered loggers would be equipped with turbidity sensors (NTU) and would have remote data transfer capabilities. Turbidity (NTU) readings would be recorded at 15 minute intervals and uploaded at least daily. Data would be digitally logged in the unit and then transmitted using satellite telemetry to base station receivers for storage, display and analysis.

The telemetered loggers would provide as close as reasonably practicable "real-time" water quality data during dredging and spoil disposal activities. The monitoring would capture the spatial extent of the dredge and spoil disposal plumes in relation to coral communities located north and south of initial capital dredging activities and Nine Mile Reef, south-west of the proposed new spoil ground.

Quality Assurance/Quality Control (QA/QC)

Standard Operating Procedures and Quality Assurance/Quality Control (QA/QC) Protocols for monitoring methods, site and field instrument maintenance and data capture, analysis and interpretation would be implemented. These would include:

- training for personnel;
- pre-deployment and deployment checks of loggers;
- regular servicing and calibration checks for loggers;
- protocols for field data checks of loggers;
- protocols for the download of data and raw data filtering and correction; and,
- protocols for data management, data security and data audit.

Due to the potential for biofouling in tropical coastal waters, the telemetered systems would be serviced at approximately four weekly intervals, which would include preventative maintenance and calibration. Turbidity data, and samples for total suspended solids, would be collected during servicing of each telemetered system to validate the state of calibration.

If there is evidence of significant loss of data during initial capital dredging operations the system would be checked within seven days and if necessary replaced.

In the event of the failure of a telemetered logger, boat based *in situ* monitoring will be conducted until the logger is repaired or replaced.

Data Analysis and Interpretation

Water quality (turbidity) data collected from the telemetered loggers would be analysed daily against the turbidity trigger values set for the Zones of Influence to provide early warning of

potential coral impacts associated with initial capital dredging and/or spoil disposal plumes. It is proposed that a five day rolling average of the daily medians at each of the influence and reference sites would be compared to the corresponding site and season specific trigger values. Exceedance(s) of the turbidity trigger values would be reported on a site-by-site basis. If trigger values are exceeded on three consecutive days the Water Quality Management Process is triggered (**Figure 14**).

In the event of an exceedance(s) of the turbidity trigger values, an analysis of the available information would be required to establish the likelihood that the decline in water quality is due to initial capital dredging and spoil disposal activities rather than other causes (refer **Figure 12**).

This would include an assessment of the following factors:

- correct data logger operation;
- data analysis/entry correct;
- QA/QC procedures followed;
- assess location of dredging and/or spoil disposal activities in relation to affected site(s);
- extent of the visible dredge plume in relation to the affected site(s);
- meteorological and ocean conditions preceding and during the exceedance(s) (e.g. wind, tide, wave and swell state);
- effects of extreme weather events in the region (e.g. storms, cyclones);
- number and spatial extent of affected site(s); and,
- whether exceedance(s) was consistent with turbidity at reference sites.

If turbidity trigger values are exceeded at one or more of the telemetered water quality loggers and there are no likely alternative explanations for the exceedance other than initial capital dredging and spoil disposal activities, targeted coral health monitoring would be triggered.

6.7.2 Coral Health Monitoring

The coral health monitoring program has been designed to provide a quantitative measure of coral health (percent bleaching and/or mortality) which can be assessed against management triggers as shown in the Coral Health Management Process (**Figure 13**).

The coral health monitoring program is designed to identify and measure changes in coral health that are attributable to initial capital dredging and spoil disposal activities and that are greater than changes occurring naturally in corals at the reference Sites.

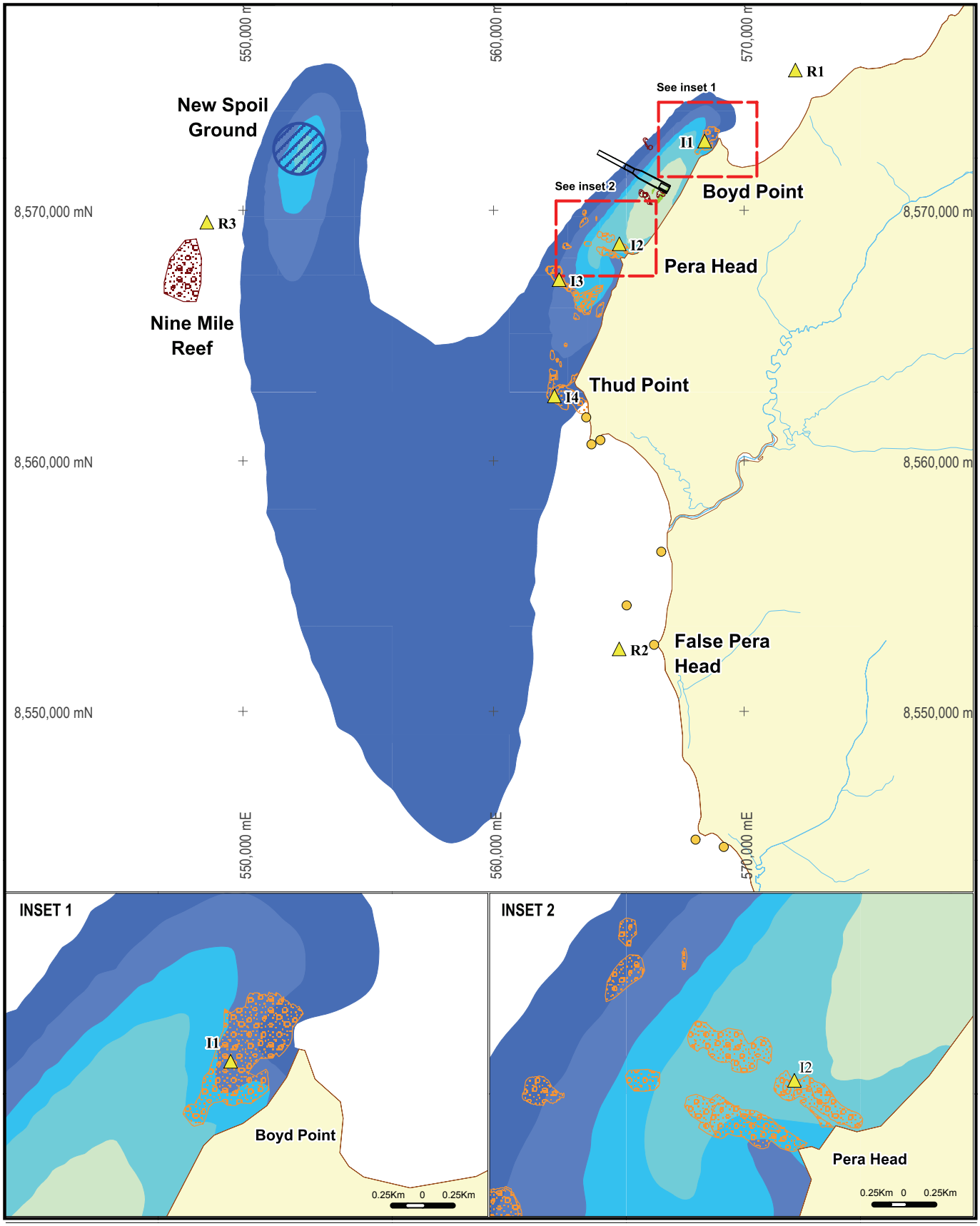
Proposed Monitoring Sites

The locations of the coral health influence and reference sites would be coincident with the telemetered water quality sites (**Figure 18**), or as close as practically possible. The reference sites would be used to assess natural changes in coral health during the initial capital dredging and spoil disposal program.

Monitoring Frequency

Table 5 shows the proposed monitoring frequency. Monitoring would be conducted pre-dredging to establish transects at each site. During initial capital dredging, coral monitoring would be conducted at approximately six weekly intervals.

If the turbidity trigger values are exceeded at telemetered influence water quality sites and the exceedance is attributable to initial capital dredging and/or spoil disposal activities a program of



Proposed dredge area
Proposed logger site
New Spoil ground
Reef substrate available for soft coral/sponges
Reef substrate available for hard coral and/or soft coral/sponges
Unconfirmed reef locations

Note: CSD & TSHD 80th percentile depth averaged TSS shown.
Monitoring locations will be the same for CSD & SHB dredge method.

TSS mg/L

0 - 2	10.0-12.5
2.0-3.0	12.5-15.0
3.0-4.0	15.0-20.0
4.0-5.0	20.0-25.0
5.0-7.5	25.0-30.0
7.5-10.0	30.0 +

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South of Embley Project

Fig 18: Proposed Water Quality Monitoring Sites

N 0 5 10km

Datum/Projection: GDA94/MGA Zone 54 Date: 17/09/2012

targeted coral health monitoring would be triggered (refer **Figure 15**). Sites to be targeted for monitoring would depend on the spatial pattern of any exceedance of the turbidity trigger values, the trajectory of the turbidity plume and the forecast meteorological and ocean conditions.

The targeted monitoring program would include associated reference sites, as well as sites in the area determined to be at risk from the water quality exceedance.

To allow for lag effects on coral health, monitoring is required post dredging to enable assessment against Coral Health Management Triggers after dredging ceases. It is proposed to conduct monitoring one and two months post-dredging in the initial capital program.

Coral Monitoring Procedures

Coral health monitoring would be undertaken using Remote Operated Vehicles (ROV) and/or towed video and/or drop cameras at reference sites and influence sites. Reference sites lie outside the Zone of Influence and influence sites lie entirely within the Zone of Influence as defined by the modelling results. These diver-less methods are required due to a range of OH&S issues identified by RTA, including, presence of Estuarine Crocodiles, low visibility and the remote nature of the site.

Initial baseline surveys would include the establishment of survey transects at influence and reference sites and an assessment of the statistical power of the methodology. Influence and reference sites are shown in **Figure 18**. It is expected that changes of approximately 15% can be detected with high power.

Proposed monitoring sites would be surveyed initially using a ROV or towed video to select locations with higher coral cover to establish transects. Two transects of approximately 30m would be established at each site. The transects would be marked with start and end buoys, however the accuracy of the ROV and towed video (+/- 1-2m) means these are not truly fixed transects.

Quality Assurance/Quality Control (QA/QC)

Standard Operating Procedures and QA/QC protocols for monitoring methods, site maintenance, and data capture, analysis and interpretation would be implemented. This would include:

- training for personnel prior to mobilisation for field surveys to ensure that stringent methods are employed for towed video and/or ROV field work;
- trained scientist on board each survey vessel to oversee data collection and QA/QC collected images;
- regular maintenance of sites, re-establishing transect buoys as necessary;
- procedures to ensure consistency in collection of imagery and quality of imagery; and
- protocols for data management, data security and data audit.

Data Analysis and Interpretation

Coral health would be assessed by analysis of imagery from the ROV and/or towed video. Quantitative processing of imagery would be conducted using coral point count (CPCe) or similar analysis methods, by image analysts with experience in scoring coral health, with frequent cross-referencing and testing to ensure consistent classification.

Interpretation of data would include testing for a change between the "before dredging" and "during dredging" periods at influence sites, and reference sites over the same period.

It is expected that the proposed methodology would allow detection of approximately 15% change with high power. This would be established during the pre-dredging monitoring.

7 REPORTING

RTA would report to the BPDTAG on proposed initial capital dredging activities for Boyd Port and implementation of the DMP for the Port, including monitoring results, management triggers and response actions. A monthly monitoring report would be prepared and submitted to EHP throughout the period that initial capital dredging and spoil disposal works are being undertaken. This report would include:

- a summary of results of all required monitoring with raw data provided in an electronic format appendix (i.e. spreadsheet);
- an evaluation and explanation of the data from the monitoring programs;
- a daily summary of dredge movements (specifying the boundaries of the dredged area by GPS coordinates and disposal activity);
- details of marine turtle and/or marine mammal captures by the dredge and species involved;
- details of any complaints received including investigations undertaken, conclusions formed and action taken;
- a summary of significant equipment failures or events that have potential environmental management consequences;
- an outline of corrective actions that would or have been taken to minimise or reduce environmental harm; and,
- the quantity (volume in cubic metres) and location of dredging material removed and disposed of.

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